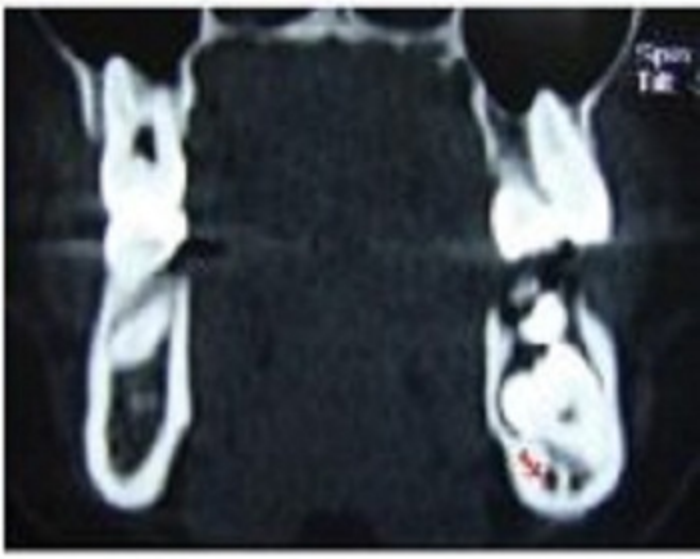

# A Practical Guide to the Management of Impacted Teeth

K George Varghese

*Foreword*
Kishore Nayak



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*This book is dedicated to*
*the loving memory my parents*
*and my esteemed teachers*
*who have made me what I am today,*
*to my students who gave me the impetus for learning*
*and to my colleagues who provided me with support*
*with*
*Love and Respect*

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# Foreword

I am delighted to write the foreword for this wonderful book written by Dr George Varghese. Oral and Maxillofacial Surgery has progressed to a multi-faceted specialty with scope of work ranging from minor oral surgery to major facial ablative and reconstructive procedures. What is frequently overlooked is the fact that dento-alveolar surgery constitutes the bulk of the work for practitioners the world over. In the light of this fact, this book certainly fills a void that many recent publications have failed to do and provides marvelous attention to detail to an area of our profession that many of us take for granted.

The first five chapters of the book devote attention to not just the etiology and indications but provide a wonderful description of the development and applied anatomy of the third molar in truly descriptive yet delightful way! The routine and sometimes seemingly mundane details of instrumentation and surgical procedures have been dealt with "clinical" precision with the added sections on drug therapy and complications make it extremely comprehensive. The concluding chapter in Section 1 on recent advances provides a thought provoking conclusion to the saga of the impacted tooth which will certainly prove stimulating to the reader who will then certainly want to think beyond the book.

The second section of the book delves into the intricacies of the impacted canine in every way possible. It makes a wonderful case and distinction between the modalities of management rather than focus of just description of surgical removals. That is what makes a refreshing change in approach in this textbook. The concluding chapters on autotransplantation, surgical repositioning and supernumerary teeth make the textbook an absolutely all-inclusive one.

Who should be reading this book? Almost certainly all students of dentistry both post and undergraduate, will benefit immensely from the text. It will also serve as a great refresher to all practitioners in the field of dentistry and oral surgery who will want to read this in order to provide a broad update to this important part of their practices.

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# Preface

The steady growth of various dental specialties witnessed in the last century is continuing unabated in this century also. This is evidenced by the development of newer subspecialties in dentistry like cosmetic dentistry and implantology. However, oral surgery and dentoalveolar surgery that is considered as one of the oldest branches of dentistry has not lost its relevance today. Rather it still remains the core of general dental practice.

Impacted teeth and their management is one of the difficulties that general dental practitioners face in the practice of oral surgery. Though one covers the theoretical aspects on the management of impacted teeth during the undergraduate studies, the applied part very often comes only in the actual clinical practice. Naturally doubts may arise regarding the management of different problems. This book is intended as the name suggests to be a practical guide on the management of different problems related to impacted tooth that the practitioner faces in the day today practice.

Our first book titled *A Handbook on the Management of Impacted Teeth* published in 2002 was well received by the dental fraternity so much so that now the book is out of print. Since then there has been numerous requests from our colleagues, students and general dental practitioners for a more detailed one highlighting the practical aspects of the topic. Hope this book will reach up to your expectations.

This book has been divided into two sections. The first section illustrates the management of impacted third molar and the second section deals with the management of impacted canine. In addition section two has chapters on the management of impacted premolars and supernumerary teeth. Special emphasis has been given for the localization of impacted teeth and its relationship to adjoining structures using modern imaging modalities. Similarly instruments required for the surgical removal is also included as a separate chapter.

Though this book is intended for the general dental practitioners and the undergraduate students this will be a handy guide for the postgraduates too.

There may be errors of omission and commission. Any comments and suggestions for improvement are welcome.

Praying for your blessings, wholehearted support and cooperation.

**K George Varghese**

# Acknowledgments

At the outset we thank the God Almighty, Who has made our dream of writing this book a reality. Nothing is possible without His blessings.

I acknowledge with great respect my postgraduate teacher Dr PI John, former Professor and Head of the Department of Oral and Maxillofacial Surgery, Government Dental College, Thiruvananthapuram for teaching the basics of maxillofacial surgery and who inducted me into the specialty.

I am indebted to Dr VK Kuriakose (late) whom I consider as my mentor. Under his guidance I started my career as a maxillofacial surgeon.

My deep appreciation to the contributors viz. Dr LS Sreela, Dr George Philip and Dr Elbe Peter whose untiring efforts have made this possible.

I express my gratitude to Sri Thankappan, Artist, Medical College Kottayam for the neat and timely completion of the drawings for the book.

My special thanks to my wife Alice, my daughter Rose and my son Mathew for their constant support and encouragement to accomplish this endeavor.

I am also grateful to M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, who encouraged me to write this book and for publishing it. I am extremely thankful to Shri Jitendar P Vij (CMD), Mr Tarun Duneja (Director-Publishing) for taking the initiative to publish the book well in time. I owe a great deal to Shri Jose Sebastian, Branch Manager and Shri Jagadeesh S, Marketing Manager, Kochi for the excellent liaison between the publisher and myself as well as for their help and friendship.

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## SECTION 1: Management of Impacted Third Molar



## SECTION 2: Management of Impacted Canine

# Section 1

# Management of Impacted Third Molar

CHAPTER

# 1 Introduction

Although the scope of oral and maxillofacial surgery has expanded in many directions recently, the mainstay of practice remains dentoalveolar surgery. The atraumatic removal of impacted teeth is one of the most commonly performed surgical procedures in the specialty of oral and maxillofacial surgery. A thorough theoretical knowledge and adequate clinical training is essential to perform the surgery successfully. A study by Berge (1995) has shown that there is a four fold increase in the incidence of complications when the surgery was performed by the general practitioner as compared that performed by the oral surgeon. This difference in complication rates may be explained by inadequate surgical training and lack of experience of the former. However, another study by Boer M P et al (1995)[1] has shown no statistically significant difference in the mean complication rate when the surgery was performed by staff members and the rate when surgery was performed by residents.

It was Dr George B Winter who more than anyone else helped to rationalize the technique of removal of impacted mandibular third molar. Winter's treatise was the result of intensive research which extended over the years. The first publication of his findings appeared in 'Dental Items of Interest' under the title of 'Exodontia', a term which he himself has coined. In 1913, he published a large volume on the subject under that name. A revised and much enlarged second edition was printed in 1926 and the title was changed to 'The Impacted Mandibular Third Molar'. It was the most extensive treatise on the subject profusely illustrated.

The term impaction is of Latin origin coming from the term 'impactus'. Its general usage is one which designates an organ or structure which because of an abnormal mechanical condition has been prevented from assuming its normal position.

Webster defines an impaction as the wedging of one part into another. The medical dictionaries applying the word to dentistry mention the lodging of a tooth between the jaw bone and another tooth.

Rounds (1962)[2] gave an explicit definition of impaction as the condition in which a tooth is embedded in the alveolus so that its further eruption is prevented.

Archer (1975)[3] defines impacted tooth as one which is completely or partially unerupted and is positioned against another tooth or bone or soft tissue so that its further eruption is unlikely.

The definition given by Lytle (1979)[4] is closely related to that of Archer. Impacted tooth is one that has failed to erupt into normal functional position beyond the time usually expected for such appearance. Eruption is prevented by adjacent hard or soft tissue including tooth, bone or dense soft tissue.

Andreasen et al (1997)[5] defines impaction as a cessation of the eruption of a tooth caused by a clinically or radiographically detectable physical barrier in the eruption path or by an ectopic position of the tooth.

## TOOTH ERUPTION

Teeth develop with in the alveolar bone. After the crown formation is complete, the root begins to form and active eruption moves the tooth towards its functional position inside the mouth. Tooth eruption is thus defined as the movement of a tooth from its site of development within the alveolar bone to its functional position in the oral cavity. During the eruption process, movement of the tooth occurs in all three dimensions and at the same time there is an increase in its size and that of the alveolar bone. Even though eruption of tooth is a continuous process, it can be arbitrarily divided into the following six stages (Fig. 1.1):

1. Pre-eruptive stage
2. Intra-osseous stage/Alveolar bone stage
3. Mucosal penetration/Mucosal stage
4. Pre-occlusal stage
5. Occlusal stage
6. Maturation stage.

It can be noticed that even after achieving occlusion, a slow but continuous eruption occurs through out the lifetime. The normal eruption of the tooth can be interfered at any of the stages from one to four and an impaction will result.

Although a number of theories had been put forth by various authors to explain the eruption of tooth, none of these theories alone can explain the journey the tooth makes in its lifetime. However, root elongation, alveolar bone remodeling and periodontal ligament formation explain tooth eruption most convincingly. Table 1.1 shows the various eruption stages, the possible related eruption mechanisms/theory explaining eruption and the anatomical structures resisting eruption.

### Terminology

- An **unerupted tooth** is a tooth lying within the jaws, entirely covered by soft tissue and partially or completely covered by bone. It is in the process of eruption and is likely to erupt based on clinical and radiographic findings.
- A **partially erupted tooth** is a tooth that has failed to erupt fully into a normal position. The term implies that the tooth is partly visible or in communication with the oral cavity.
- A **malposed tooth** is a tooth which is in an abnormal position in the maxilla or in the mandible.
- An **impacted tooth** is a tooth which is prevented from completely erupting into a normal functional position. This may be due to lack of space, obstruction by another tooth, or an abnormal eruption path.
- **Primary retention** occurs in syndromes where osteoclastic resorption is deficient such as cleidocranial dysplasia and osteopetrosis.
- **Secondary retention** relates to a cessation of eruption of a tooth after emergence, without a physical barrier in its path or ectopic position of the tooth. Clinically it appears as an in eruption subsequent to emergence.
- **Clinical emergence** is the condition when the tooth has pierced the mucosa.
- **Alveolar emergence** is the piercing of the alveolar bone seen in a radiographic image.

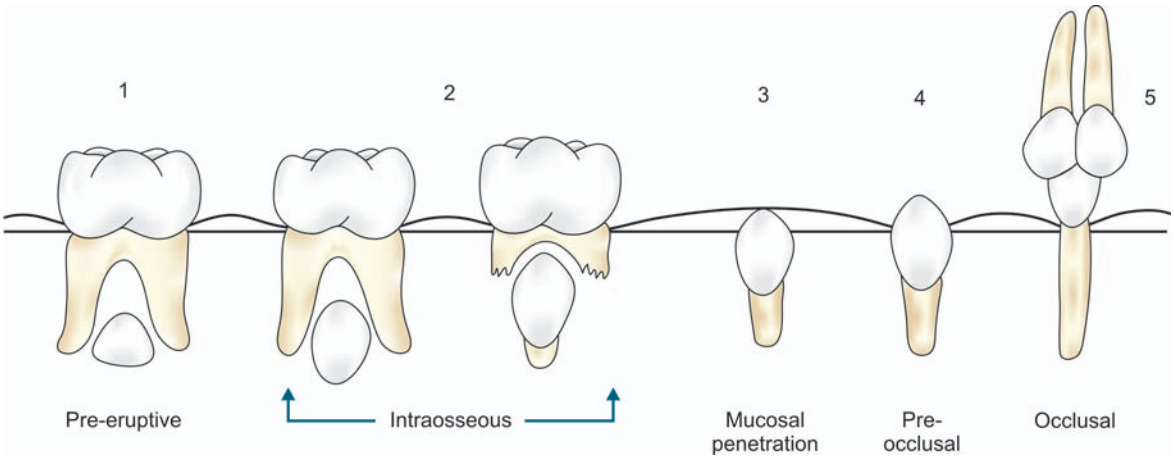



**Fig. 1.1:** Schematic diagram showing different stages of eruption of tooth

**Table 1.1:** Eruption stages, eruption mechanism and structures resisting eruption

| | *Eruption stage* | *Eruption mechanism/ theory* | *Structures resisting eruption* |
|---|---|---|---|
| 1 | Pre-eruptive stage | - | - |
| 2 | Intra-osseous stage | Vascular hydrostatic pressure<br>Root formation<br>Bone formation | Bone<br>Primary predecessors (deciduous tooth) |
| 3 | Mucosal stage | Vascular hydrostatic pressure<br>Root formation<br>Bone formation | Mucosa |
| 4 | Pre-occlusal stage | Vascular hydrostatic pressure<br>Root formation<br>Bone formation | Periodontal ligament<br>Mastication |
| 5 | Occlusal stage | Root elongation<br>Bone formation | Periodontal ligament<br>Mastication<br>Occlusion |
| 6 | Maturation stage | Root elongation<br>Bone formation | Periodontal ligament<br>Mastication<br>Occlusion |

## Obstruction of the Eruption Pathway

This can be considered under the following headings:

1. Lack of eruption space (crowding)
2. Follicular collision
3. Obstruction by physical/mechanical barriers such as scar tissue, fibromatosis, compact bone, unattached mucosa, odontogenic cyst and tumors.

The diagnosis of the nature of obstruction to eruption pathway is by clinical and radiographic examination. Once the etiology is established, the treatment principle is to eliminate the cause and there by permitting the tooth to erupt normally.

1. Lack of eruption space (Crowding): In this situation an orthodontic evaluation is performed to assess whether expansion can be tried to increase the space to accommodate the impacted tooth or whether the extraction of the impacted tooth or adjacent tooth is the treatment of choice.
2. Follicle collision: This is classically seen in the maxillary anterior region when a single supernumerary tooth can prevent the eruption of one or more permanent incisors. Another example is the collision between the second and the third molar tooth germs. The reason why impaction occurs in collision is probably explained by the fact that neither of the follicles can resorb the other, and therefore the eruption of the involved teeth does not occur. The treatment of the condition is the removal of one of the colliding tooth germs. The decision is easy when one of the tooth germ is a supernumerary, where as when both are permanent, the decision is often difficult.
3. Obstruction by physical barriers: The eruption pathway may become obstructed by various obstacles such as odontogenic cysts or tumors, odontomes, eruption sequestra, compact bone, supernumerary tooth, fibrous scar tissue, giant cell fibromatosis, or unattached mucosa. The treatment in general is the surgical removal of the obstructing structure and to permit the eruption of tooth if possible. However, in conditions when the impacted tooth is associated with an odontogenic cyst or tumor it may have to be sacrificed along with the removal of the pathologic lesion.

The modern concept of skillful and effective surgery of impacted tooth has not been one of spontaneous generation. Instead, it is one of gradual evolution extending from the first surgical endeavor of prehistoric

times with its crude elements to the highly refined techniques and precautionary measures that are accepted as ordinary requisites of today. The development of anesthesia, radiography, high speed rotary instruments and antibiotics provided the necessary tools to perform the surgery paying homage to the old saying, "tute cite et jucunde" i.e. safely, quickly, and pleasantly.

While some of the impacted teeth can be extracted easily by the use of an elevator, others require a more difficult surgical exercise. Provided that the tooth is removed skillfully and the end result is acceptable to the patient and the operator, then the method adopted can be considered satisfactory.

The most commonly impacted teeth are the mandibular and maxillary third molars and the maxillary canines. Rarely other teeth also get impacted like the premolars; both maxillary and mandibular premolars and also the second molars (Fig. 1.2).

**Fig.1.2:** Radiograph showing impacted left mandibular second molar (black arrow) and left maxillary second premolar tooth (yellow arrow). All other teeth have erupted and all the four-third molars are developing.

## Incidence of Impaction

Review of literature shows there is considerable variation in prevalence of impacted tooth. This ranged from as low as 6.9% (Shah et al, 1978) to as high as 37.8% (Hugoson and Kugelberg,1998)

Mead (1930)[6] reported from a collection of dental radiographs of 6389 cases of which 1462 were full mouth radiographs of office patients and rest were radiographs of skulls obtained from Smithsonian Institution. Out of the total of 581 impacted teeth, 461 (80%) teeth were third molars - 248 in the mandible and 213 in the maxilla. Among office patients 276 (18.8 %) had at least one impacted tooth.

Archer observed impacted teeth occurring in the following order of frequency: maxillary third molars, mandibular third molars, maxillary cuspids, mandibular bicuspids, mandibular cuspids, maxillary bicuspids, maxillary central incisors, and maxillary lateral incisors.

Bruce et al (1980)[7] after analyzing 990 impacted mandibular third molars found that the incidence of vertical impaction is 29.8%, mesioangular impaction 38%, distoangular impaction 11.8% and horizontal impaction 20.4%. Horizontal and full bony impaction was found to be higher in the older age group than in the younger age group.

In a study of 425 Greek patients by Kamberos S (2002)[8] with impacted teeth (202 male and 223 female) aged between 18 and 75 years old it was found that out of the 940 impacted teeth, 499 (53.08%) were found in females and 441 (46,92%) in males. 406 (43.19%) impacted teeth were found in the maxilla and 534 (56.81%) in the mandible. 51 of the impacted teeth were in the anterior part of the jaws (44 in the maxilla and 7 in the mandible) whereas in the posterior area 889 cases of impacted teeth were found (362 in maxilla, 527 in the mandible). The majority of impacted posterior teeth were third molars. Mandibular third molars were found to be the most frequent impaction (54.04%), followed by the maxillary third molars (37.55%) and canines (4.57%).

In a study of Hong Kong Chinese population by Chu et al (2003)[9] the records of 7486 patients were examined. It was found that a total of 2115 (28.3%) patients presented with at least one impacted tooth. Among the 3853 impacted teeth, mandibular third molars were the most common (82.5%), followed by maxillary third molars (15.6%), and maxillary canines (0.8%). The highest incidence of impaction of 55.1% was found in 20-29 age group.

## Management of Impacted Tooth

Even though surgical removal of impacted tooth is considered as the standard method of management, the following other methods also should be considered depending upon the case:

1. Conservative method: Leaving the tooth alone with frequent follow up clinically and radiographically. For example a deeply situated asymptomatic third molar may be left as such especially in an older age group patient.

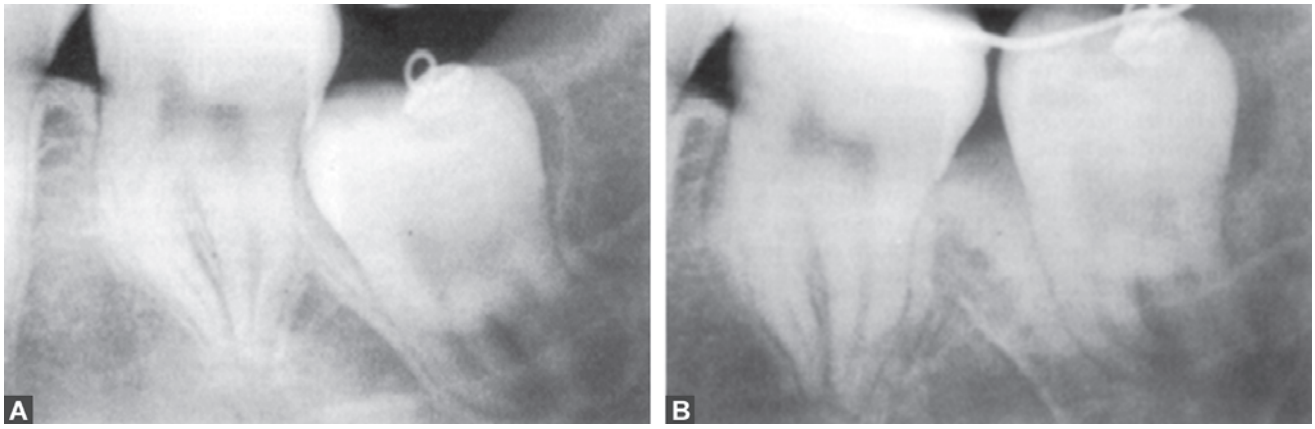
2. Operculectomy: Partially erupted mandibular third molar which has adequate space to erupt and when its further eruption is prevented by thick overlying mucoperiosteum, operculectomy can be performed. If the tooth still fails to erupt fully and remains as such with the crown in communication with oral cavity, it has to be considered for removal.
3. Autogenous transplantation: Occasional use of the third molar tooth when it is sound is used for autogenous transplantation; usually to a first molar socket site. The low incidence of success with the procedure means it is not widely used except in special circumstances.
4. Orthodontic guidance: This is more useful in cases of maxillary canine and to some extent in mandibular canine when the tooth can be guided into functional position in the arch. Orthodontic guidance can also be considered in selected cases of impacted premolars and to a lesser extent to impacted mandibular molars (Figs 1.3A and B)

   Chechi et al (1996)[10] reported a case of combined surgical orthodontic approach for successfully erupting an impacted lower third molar tooth showing close relationship to inferior alveolar canal and its subsequent removal. The authors claimed that the procedure avoided injury to inferior alveolar canal.

   Similar studies were conducted by Hirsch et al (2003).[11] Impacted mandibular third molars in 18 patients were surgically exposed and then orthodontically guided to erupt. After the tooth has erupted, it was removed and periodontal parameters were measured on the second molar. The authors concluded that this non-surgical removal of impacted mandibular third molars avoided damage to the inferior alveolar nerve as well as prevented iatrogenic periodontal sequelae (pocket formation) of the second molars.
5. Eruption activating procedures: These may be tried for developing teeth when indicated. Table 1.2 shows the summary of eruption activating procedures for developing permanent molars.

**Table 1.2:** Eruption activating procedures for developing molars

| | *Eruption stage* | *Intervention* |
|---|---|---|
| 1 | Intraosseous stage | a. Mucosa + bone removal<br>b. Mucosa + bone + follicle removal<br>c. Surgical repositioning<br>d. Space augmentation<br>e. Removal of obstacles preventing eruption |
| 2 | Mucosal stage | a. Mucosa removal<br>b. Space augmentation |
| 3 | Preocclusal stage | a. Orthodontics<br>b. Space augmentation |




**Figs1.3 A and B:** Steps in combined surgical orthodontic eruption of impacted mandibular third molar: (A) Periapical X-ray showing orthodontic bracket attached to impacted molar tooth after surgically exposing the crown, (B) Periapical X-ray showing orthodontically assisted eruption of tooth.

## Burden on Health Care Delivery

The surgical removal of impacted teeth is one of the four surgical operations included in both top 10 day case and inpatient NHS procedures in England. Shepherd et al (1994)[12] quoting the Department of Health, UK reported that in the 1989-90 period more than twice as many people (60,000) were admitted for the surgical removal of teeth as were treated as day cases (28, 000). In addition, 67,000 people had their third molars removed by dental practitioners in the general dental service and 22,000 had their third molars removed in the private sector. Third molar surgery has been estimated to cost the NHS in England up to £30 million per year and approximately £20 million is spent annually in the private sector. In the hospital service, patients waiting for third molar removal account for up to 90% of patients on waiting lists in oral and maxillofacial surgery. Shepherd et al (1994)[12] pointed out that considering the enormity of expenses involved in the surgical removal of impacted tooth, the wholesale removal of unerupted teeth prophylactically seems as inappropriate as the wholesale removal of tonsils and adenoids. Currently in developed countries like UK in terms of health gain, the scales are loaded against intervention even in the presence of mild pericoronitis.

## Controversies on Prophylactic Removal of Third Molars

Longitudinal studies show that the prevalence of disease associated with third molars peaks at ages 18-25 and that impacted third molars that are free of disease in middle-aged people can be safely left *in situ* because disease rarely develops and is usually minor when it does. A substantial number of impacted third molars erupt, given the chance. Malpositioned third molars are often valued by restorative dentists in the construction of bridges, dentures, and over-dentures for older people.

Points in favor of prophylactic removal are that surgery becomes increasingly difficult with advancing age. Before the mid-twenties, an impacted tooth once mobilized during surgery, can be easily dislodged from the socket. After this age a greater effort is required to disrupt the attachment. From middle age onwards the bone of the jaw becomes progressively harder and more brittle so that in elderly people the greater part of the socket may have to be removed before the tooth will move without fracture. More over, significant number of patients present in middle age and beyond with acute problems arising from their third molars; at this time not only their bone but also their cardiovascular system is brittle. Their reduced power of recovery are such that what is an unpleasant experience in the late teens and early twenties can become a major surgical problem with hazards of mandibular fracture, nerve damage, and anesthetic and medical complications.

There is no reliable research evidence to support the prophylactic removal of disease-free impacted third molars. Available evidence suggests that retention may be more effective and cost-effective than prophylactic removal, at least in the short to medium term. However, the concept of prophylactic surgery need not be totally abandoned. Each case necessitates careful thought and discussion with the patient, who should be well informed because our patients will grow older and the full consequences of some of our decisions are still to come.

## Summary

Third molars or wisdom teeth generally erupt between the ages of 18 and 24 years. However, sometimes they fail to erupt because they are either absent or impacted. An impacted third molar tooth that fails to attain a functional position can cause infection, unrestorable caries, periodontal disease, cysts, or tumors. The impacted third molar tooth can be managed conservatively, or alternatively, removed by surgical extraction, a common oral surgical procedure, which can be carried out by general dental practitioners or by oral surgeons. Other procedures include operculectomy, which can be considered in carefully selected cases with the proviso that subsequent removal of the tooth may be required. Surgical exposure or surgical reimplantation/ transplantation may be appropriate treatment in selected cases.

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CHAPTER

# 2 Why Teeth Get Impacted?

The third molars or the wisdom teeth normally erupt last, between 18 and 25 years of age. Since they erupt at about the time when the youth goes off into the world to become 'wise' the name 'wisdom teeth' was used to describe them.

A number of theories has been put forth to explain the phenomenon of impaction. The most commonly accepted ones are the following:

1. Discrepancy between the arch length and the tooth size.
2. Differential growth of the mesial and distal roots.
3. Retarded maturation of the third molar—dental development of the tooth lags behind the skeletal growth and maturation.
4. Incidence of extraction of permanent molars is reduced in the mixed dentition period, thus providing less room for eruption of third molars. This is very relevant in the present day due to increased awareness of the population and dental treatment started early in childhood.
5. Evolution theory.
6. Lack of development of jaw bones due to consumption of more refined food which causes lack of functional stimulation to the growth of jaw bone.

This theory is strengthened by the facts brought out by Nodine (1943)[1]. He noticed that Eskimos of the north, Australian Aborigines of the south and Indians of Mexico did not have impacted teeth. Their food was found to be primitive which requires lot of mastication. Nodine suggests that the major cause of aberrant or impacted teeth in the adults of Western Europe, United Kingdom, United States and Canada are artificial feeding of babies, intake of soft diet like biscuits, toffees and intermarriage between different races.

Berger (1930)[2] lists the following local causes of impaction:

1. Irregularity in the position and pressure of an adjacent tooth.
2. The density of the overlying or surrounding bone.
3. Long continued chronic inflammation with resultant increase in density of the overlying mucous membrane.
4. Lack of space due to under developed jaws.
5. Unduly long retention of the primary tooth.
6. Premature loss of primary tooth.
7. Acquired diseases such as necrosis due to infection or abscess

Impaction may also be found where no local predisposing conditions are present.

According to Berger the following are the systemic causes of impaction:

A Prenatal causes: Hereditary and miscegenation

B Post natal causes: Rickets, anemia, congenital syphilis, tuberculosis, endocrine dysfunction, malnutrition.

C Rare conditions: Cleidocranial dysostosis, oxycephaly, progeria, achondroplasia, and cleft palate.

## EVOLUTION THEORY

Evolutionists have taught that humans evolved from ape-like ancestors that possessed larger jaws and teeth than us. The evolution has produced 'an increase in brain size at the expense of jaw size (MacGregor,1985).[3] In the process of evolution the jaw has become smaller, allowing less room for the third molars to erupt and causing numerous dental problems. Our better understanding of the complex teeth-jaw relationship has revealed this explanation is far too simplistic. Research now indicates that the reasons for most third molar problems today are not due to evolutionary changes but other reasons. These reasons include a change from a coarse abrasive diet to a soft western diet, lack of proper dental care, and genetic factors possibly including mutations. It was a common practice in the past to routinely remove wisdom teeth. Recent research has concluded that this practice is unwise.

The third molars are often labelled vestigial (of use in the past but not today) and used as evidence to support human evolution from a hypothetical less evolved primate ancestor. The vestigial organ view was expressed by Durbeck (1943).[4] "*It is a well-known fact that nature tries to eliminate that which is not used … Likewise, civilization, which has eliminated the human need for large, powerful jaws, has decreased the size of our maxillae and mandibles. As a direct result, in a surprisingly large number of adults, the lower third molar occupies an abnormal position and may be considered a vestigial organ without purpose and function. This has been termed the phylogenic theory. It implies that, because throughout the history of man the jaws decreased in size from a lack of function, some present-day adults do not have room for a full complement of teeth, and the third molar, being the last to erupt, is denied room to accommodate itself.*"

The loss of an organ in evolution purely as a result of disuse, also called Lamarckian Evolution, has now been thoroughly disproved. The belief that wisdom teeth are vestigial organs that lack a function in the body is less common today.

The putative problem is that humans today have smaller jaws but just as many teeth as their evolutionary antecedents (Sakai, 1981).[5] The result is the common assumption that most humans do not have enough room in their mouth for wisdom teeth which lack a function and only cause us much health trouble (Schissel, 1970).[6] This view was evidently first widely propounded by Darwin (1896),[7] who concluded: '... the posterior molar or wisdom-teeth were tending to become rudimentary in the more civilized races of man. … They do not cut through the gums till about the seventeenth year, and I have been assured that they are much more liable to decay, and are earlier lost than the other teeth; but this is denied by some eminent dentists. They are also much more liable to vary, both in structure and in the period of their development, than the other teeth. In the Melanin races, on the other hand, the wisdom-teeth are usually furnished with three separate fangs, and are generally sound; they also differ from the other molars in size, less than in the Caucasian races. Professor Schaaffhausen accounts for this difference between the races by "the posterior dental portion of the jaw being always shortened"... I am informed by Mr Brace that it is becoming quite a common practice in the United States to remove some of the molar teeth of children, as the jaw does not grow large enough for the perfect development of the normal number.'

### Antagonistic View to Evolution Theory

The conclusion that a smaller jaw cannot contain the large teeth we inherited from our ancestors, and consequently wisdom teeth are not needed, has recently been challenged on several fronts. Macho and Moggi-Cecchi (1992)[8] concluded that compared to other primates the third molars are the smallest in Homo sapiens. Further, if the third molars are forced to develop in a more restricted space they tend to be smaller than anterior teeth and in humans this reduction often leads to agenesis of the third molars.[9] Corruccini (1991)[10] observed that dental crowding in whites seems to be more related to smaller alveolar space than to smaller jaws overall or to larger teeth. Furthermore, in an extensive study of aberrant maxillary third molars, Taylor (1982)[11] found a lack of evidence for a genetic trend towards elimination of the third molar from human dentition as assumed by many evolutionists. It is now widely acknowledged today that these teeth are not rudimentary or vestigial: they aid in chewing our food as do all of our other 28 teeth. The outdated vestigial organ conclusion, though, has influenced the extraction of billions of teeth, the removal of many which may have been unnecessary according to current research (Leonard, 1992).[12]

Wisdom teeth extraction was for many years one of the more common surgical interventions in the Western world (Ganss, 1993).[13] Leff (1993)[14] and others claim that a significant percent of third molars that are extracted could be saved. This observation is supported by the fact

that extraction rates are influenced by local beliefs and for this reason vary considerably (Singh, 1996).[15] In America some estimate 20% of all young people with otherwise healthy teeth develop impacted wisdom teeth requiring medical attention, yet in the past some estimate nine out of ten American teenagers who have dental insurance lost their wisdom teeth.[16] One report concluded the cost of this operation may exceed that of most routine medical or dental procedures. (Tulloch et al, 1987)[17]

Many dentists once routinely advised extraction of all wisdom teeth, regardless of whether they were causing problems-some even routinely removed wisdom teeth during adolescence if it only appeared that they might later become impacted[18,19]

The research now argues that since the appearance of wisdom teeth is part of normal development, third molars that cause problems should be dealt with in the same way as any other problem teeth (Tulloch et al, 1990).[20] Leff[21] concludes that, if other viable options exist aside from extraction there is 'an excellent chance they'll never be a problem.' This conclusion is a major reversal of the previous perception held by many dentists for decades, namely that wisdom teeth are essentially useless trouble-makers-'little time bombs'.

## ROLE OF GENETICS

Jaw and maxillary shelf size are individual genetic traits that vary according to a normal curve as do all human dimensions. Some individuals inherit very small maxillary sinus, and those toward the smaller end of the normal curve may sometimes experience wisdom teeth problems. An example is when a petite woman marries a large man and the children inherit a jaw structure that cannot completely accommodate their teeth.[22, 23] These cases, though, are relatively few and are not the norm(Barrett, 1957).[24] Wisdom teeth problems are more common among European whites compared to Orientals and blacks. This conclusion is supported by research on dental problems and race that concluded that racial differences exist'. It is tempting to suppose that interbreeding would exacerbate malocclusion and increase the number of impactions.[25] This may be true partly because certain jaw shapes and sizes are associated with third molar impaction and jaw shapes are an inherited trait. However, this is only one factor. The major factors, the size of the jaw, maxillary sinus and teeth, all vary widely in all races. Studies by Chung( 1970)[26] and Neiswander (1975)[27] found significant differences in mandibles existed in the population they studied which was evidently due to a dominant gene which produced different risks of malocclusion. In another study of race, Barrett ( 1957)[28] did not find a single case of an impacted third molar in his sample of 69 adult Yeundumu Aborigines. Yeundumu generally have large maxillary sinus but they also usually have large teeth. A problem may result when either intergroup or intragroup marriage produces a child with large teeth and a small maxillary sinus which causes crowding, or a large maxillary sinus and small teeth which results in excessive tooth spacing. Barrett notes the diet of the Yeundumu is now less abrasive and softer, consequently wisdom teeth and other tooth problem may be more likely in the newer generations. Curtis (1935)[29] found that both predynastic Egyptians and Nubians rarely had wisdom teeth problems, but they often existed in persons living in later periods of history. He concluded that the maxillary sinus of the populations he compared were similar and attributed the impactions he found to diet and also to disuse causing atrophy of the jaws which resulted in a low level of teeth attrition. Dahlberg (1963)[30] in a study of American Indians found that mongoloid peoples have a higher percentage of agenesis of third molars than other groups and few persons in primitive societies had wisdom teeth problems. As Dahlberg notes, third molars were 'very useful in primitive societies' to chew their coarse diet.[31]

### Role of Diet

The two most commonly cited explanations for third molar problems, i.e. natural selection and mutation effect; both have been challenged by many researchers including Calcagno and Gibson (1988).[32] The fact that impacted teeth are rarely seen in animals and nontechnologic human societies indicates that some change in humans that occurred in their recent past is responsible.[33, 34] Many researchers have concluded that the dietary shift to soft, processed foods has caused a decrease in masticatory demands (the disuse theory) resulting changes in the teeth-jaw relationship which could lead to malocclusion and wisdom teeth.[35] According to Singh et al (1996)[36] the earlier human diet tended to be highly abrasive 'which caused attrition of teeth,' resulting in the total arch length

(the widths of all the teeth added together) to become less. Especially 'the processed foods has caused consequential reduction in masticatory functional demand' producing a higher rate of impacted wisdom teeth.

Begg (1954),[37] in a study of 'stone age men' concluded that human teeth continually migrate in two directions throughout life, horizontally and vertically. Begg sampled skulls of Australian Aborigines who had died before the westernization of Australia by the British and who had consumed a diet he judged 'late paleolithic,' (for this reason he used the term stone age to describe their diet). He concluded that the coarse, hard gritty, fibrous and unprocessed diet causes inter proximal and occlusal attrition which 'permits all the lower teeth to move gradually forward relative to the upper. The result of teeth wear produces mesial drift because the space required to accommodate the teeth in each jaw gradually becomes less, allowing a proper fit of the third molar teeth. This wear does not occur with the modern diet, and consequently Begg argues many westerners often don't have enough room in their mouth for wisdom teeth, and therefore crowding of permanent canines and incisors is more likely to occur today.

Several other research studies on primitive skulls have concluded a clear association between civilization and dental attrition, and lack of dental attrition was strongly related to teeth crowding and wisdom teeth impaction.[38] In a summary of the research on diet and dental crowding, Lombardi (1992)[39] concluded, "Dental crowding is endemic among technologically advanced populations and uncommon in primitive groups. The significant elements in the development of most dental crowding are mesial migration and the lack of inter proximal attrition. Mesial migration of the posterior teeth provides the functional replacement for the tooth surface lost to attrition because of the rigors of a primitive diet. In modern man there is little attrition of the teeth because of a soft, processed diet; this can result in dental crowding and impaction of the third molars."

In short, this theory concludes that the inter proximal wear is highly correlated with the chewing force required by the diet. A diet consisting largely of tough foods, such as nuts, seeds, fibrous vegetables, and partially cooked meat, requires high chewing forces that cause lateral movement of the teeth relative to each other. This rubbing of adjacent teeth is the cause of inter proximal wear. The amount of particulate matter or grit in the diet is a secondary factor in inter proximal wear, although it accounts for most of the occlusal wear. Advanced population that consume a diet composed largely of cooked meat and vegetables, as well as processed foods, do not require the large chewing forces that lead to lateral movement of the teeth and inter proximal wear. The low incidence of crowding in primitive population seemingly results from the high degree of inter proximal attrition and not from a more harmonious concordance of tooth and jaw size.[39]

Goose (1963)[40] found from measurements of jaw sizes and teeth, that a decrease occurred in the palate coronal dimensions between the middle ages and the seventeenth century. He concluded that this change was unlikely to be due to racial changes or hybridization since no evidence exists of racial mixing during recent British history. Conversely, profound changes in diet have occurred since medieval times which can account for the differences found. Studies in numerous other populations also indicate that diet and other environmental factors are of major importance in tooth variation problems (Mac Gregor,1985),[3] ( Kallay,1963).[41]

In short, when the chewing workload is reduced, the mandible and jaw muscles atrophy, and when chewing workload is increased, the muscles strengthen and the jaw develops. Other dental problems such as malocclusion are also 'widely believed to be a disease of civilization' (Mills, 1963).[42]

## SUMMARY

Several factors have been found to be important in causing third molar problems and malocclusion. The most important factor is probably diet. But the influence of other factors including mutations needs to be examined more fully to understand why wisdom teeth are more often a problem today. The once common belief that wisdom teeth problems are related to putative evolutionary modifications has now been discredited. Mac Gregor concluded following an extensive study that the 'increase of brain size at the expense of jaw size' evolutionary view is invalid. The evidence derived from paleontology, anthropology, and other studies indicates very convincingly that a reduction in jaw size has occurred due to civilization. The main associated factor appears to be the virtual absence of inter proximal

attrition, but initial tooth size may have some effect. Jaw size and dental attrition are related and they have both decreased with modern diet. Jaws were thought to be reduced in size in the course of evolution but close examination reveals that within the species Homo sapiens, this may not have occurred. What was thought to be a good example of evolution in progress has been shown to be better explained otherwise.

Hence, it can be concluded that the problems associated with wisdom teeth in modern society are not due to evolution or mutation effect but largely to changes in diet, namely to softer, less abrasive processed foods which do not give the teeth the workout which they require to ensure proper relationship in the jaw.

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CHAPTER

3

# Why Do We Remove Impacted Teeth?

It is likely that prehistoric people did not have the infections which we have associated today with impacted and partially impacted third molars. Although caries and periodontal disease were prevalent, evidence suggests that dental pathology was relatively low. Towards the end of the 17th century, people experienced an increase in the prevalence of dental disease, most likely as a result of shift in lifestyle and diet.

From that time until the advent of modern dentistry at the beginning of the 20th century, there was a dramatic acceleration in the rate of dental disease associated not only with third molars but also with every other tooth. Today, despite advances in preventive dentistry, the location of third molars in the dental arches often make them difficult to care for, and their frequent impaction exposes patients to degenerative conditions infrequently associated with any other tooth.

As a general principle, teeth should not be removed without due cause. This applies to unerupted/ impacted third molars as much as it does to any other teeth. All forms of surgery, whether under local anesthesia or general anesthesia, carry some risk of complications and there is an inevitable morbidity associated with surgical removal of teeth even in the best of hands. Apart from this, there is a question of cost involved. Therefore, there has to be a distinct reason for the removal of third molar tooth.

Even though not all unerupted/impacted teeth cause problems, all have that potential. Based on extensive clinical studies the following indications for removal have been identified.

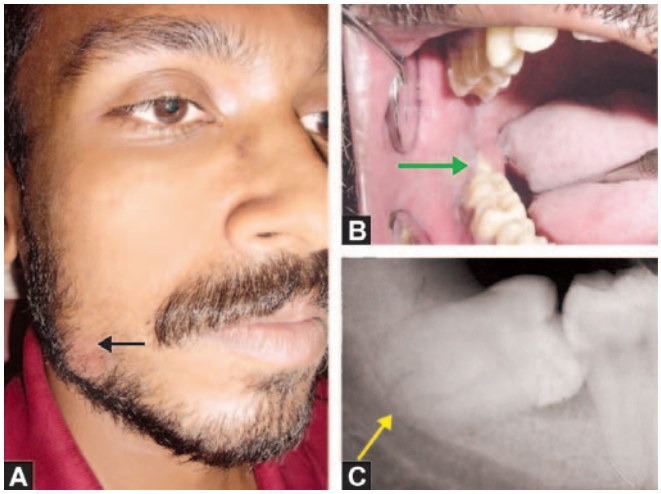
**1. Pericoronitis and Pericoronal abscess:** This is the most common cause for extraction of mandibular third molars (25 to 30%). Pericoronitis is commonly found to be associated with distoangular and vertical impaction. If improperly treated, infection may extent posteriorly resulting in sub masseteric abscess.

In certain cases chronic pericoronal abscess may point extra orally leading to difficulty in diagnosis regarding the focus of origin of infection (Figs 3.1 A to C)

The aim of a study conducted by Halverson et al (1992)[1] was to obtain a predictive clinical profile of the impacted mandibular third molar at greatest risk for pericoronitis. It was noted that 81% involved vertically oriented while mesioangularly impacted accounted for only 11.2% of pericoronitis cases. The remaining cases comprised distoangular and horizontally impacted mandibular third molar (3.4% and 3.8% respectively). It was concluded that the risk for pericoronitis appears to increase with greater vertical orientation and higher the eruption.

**2. Dental Caries:** Incidence of caries of the 2nd molar or 3rd molar is about 15%. This high incidence is attributed to difficulty to perform oral hygiene measures in the third molar area (Figs 3.2 and 3.3).

Shugars and co-investigators (2004) noted a definite association between dental caries incidence in asymptomatic third molars and caries in restorations in




**Figs 3.1 A to C:** (A) Chronic pericoronal abscess in relation to impacted third molar pointing extra orally (black arrow), (B) Intraoral view showing impacted 48 (green arrow), (C) Periapical X-ray showing horizontally impacted tooth with the root closely related to mandibular canal

**Fig.3.2:** Horizontally impacted 38 with dental caries

**Fig.3.3:** Secondary caries beneath the restorations in 37 and 38 (yellow arrows)

second and first molars. One third of the study population had caries in the third molar. Almost all the patients who had caries in the third molar also had caries in the first or second molar. The absence of caries in the first or second molar was associated with caries-free third molar. Hence, removal of third molars may be a prudent option to avoid caries of other molar teeth

Partially erupted impacted tooth with extensive caries can cause traumatic ulcer of buccal mucosa (Fig.3.4) or tongue.

**3. Periodontal diseases:** Blakey et al (2002) reported that the prevalence of increased periodontal probing depths (PD) in the third molar region is higher than that is expected in asymptomatic third molars. They noted that in a sample of 329 patients 25% cases had at least one PD –> 5 mm in the third molar region. Increased periodontal probing depths and attachment loss leads to increased periodontal pathogen colonization and increased levels of inflammatory mediators. Various other studies have shown that chronic oral inflammation associated with periodontal disease has been implicated in increasing the risk of cardiovascular disease and renal insufficiency, restricted fetal growth and preterm births. Endothelial cell activation is the common cause for these clinical conditions.

Recurrent food impaction between the partially erupted third molar results in periodontal inflammation and subsequent bone loss. This weakens the support of

**Fig. 3.4:** Ulceration of buccal mucosa due to sharp margins of carious 38.

the second molar and later on leads to pulpo periodontal involvement. Where there is periodontal disease and pocketing between the third molar and the second molar, there is some evidence to suggest that if removal of the third molar is delayed beyond the age of 30 years then the condition may become irreversible. Removal of the third molar will result in repair of the injured periodontium and therefore early removal of the impacted third molar is beneficial. Untreated horizontal and mesio-angular impactions are particularly prone to cause bone loss distal to the second molar (Fig.3. 5)

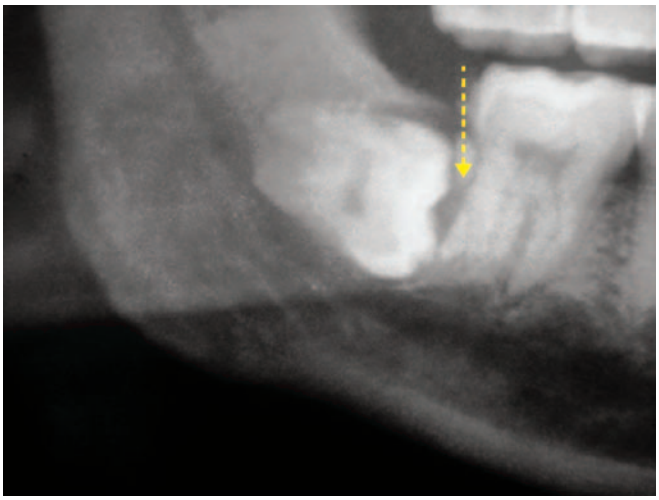


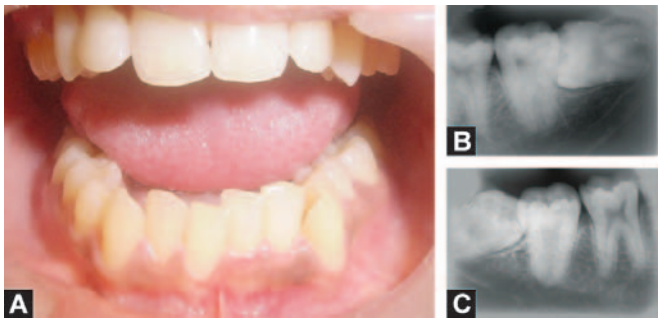
**Fig.3.5:** Horizontal impaction of 48 causing bone loss (yellow arrow) distal to 47

Late removal of such impacted teeth has not been shown to improve the periodontal status of the adjacent second molar, but early extraction of the impacted wisdom tooth reduces periodontal damage.

**4. Orthodontic reasons:**

*a. Crowding of incisors:* Third molars can produce an anterior component of force leading to crowding of mandibular incisors. Hence removal of third molars have been recommended during or after orthodontic treatment (Figs 3.6 A to C ).

However, there has been much contention regarding the role of wisdom teeth in post-treatment change (commonly called relapse) after orthodontic treatment. Many still believe that they create pressure on the front teeth as they develop and erupt causing crowding of the lower anteriors. Much of the reasoning for this is that during the late teens to mid to late twenties, lower incisor crowding can be seen to develop in many cases and this also happens to be the most common age group for developing wisdom teeth to erupt or become impacted; hence the association.




**Figs 3.6 A to C:** (A) Crowding of mandibular incisors which is suspected to have originated secondary to impaction of 38 and 48 (B and C)

The hypothesis that the mesial pressure from the third molars is transferred through the contact points resulting in the narrow contacts of the lower incisors is slipping. Recent studies have examined the strength of this hypothesis and the following statements can be made:

- The presence or absence of third molars, whether impacted or erupted, does not influence the amount of post-retention relapse following orthodontic treatment (Kaplan, 1974).
- There is no difference in mandibular incisor crowding between people who have third molars impacted, erupted normally, congenitally absent or extracted early (Ades et al, 1990).
- Direct measurement of proximal contact pressure before and after third molar extraction reveals no mesial pressure from impacted third molars (Southard at al, 1991).
- A critical review of the literature reveals a weak association between third molars and incisor crowding. Therefore, it is impossible to exclude third molars as a minor factor in the development of late incisor crowding (Vasir and Robinson, 1991).

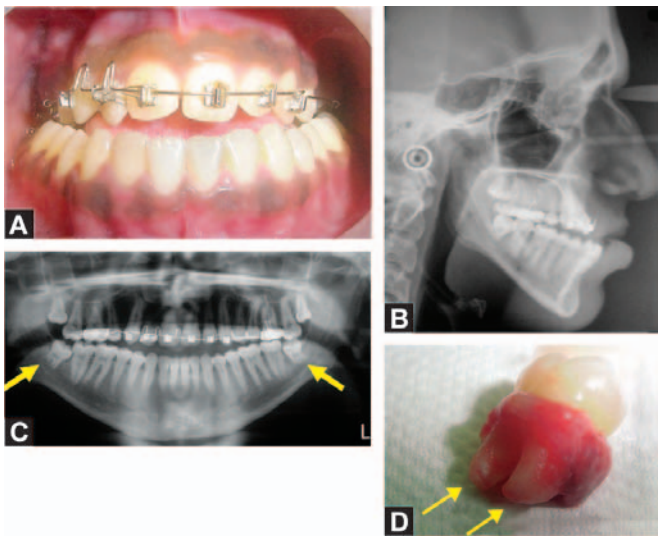
On this basis, it can be concluded that although there are many valid reasons for third molar extraction, there is no reason to believe that extraction of third molars will alleviate or prevent crowding of incisors. Therefore, routine prophylactic removal cannot be justified solely for reasons of orthodontic stability.

*b. To facilitate orthodontic treatment:* Since current trends in orthodontics have shifted towards non-extraction

therapy, molar distalization mechanics and treatment modalities have become increasingly popular especially in the management of Class II malocclusion. The use of headgear for molar distalization was followed by easier to use non-compliance intraoral appliances. In those cases where distalization of second molars is considered, extraction of impacted / erupted maxillary third molar tooth is indicated to facilitate the distal movement of maxillary molars.

5. **To facilitate orthognathic surgery:** In the presurgical preparation for orthognathic surgery, removal of third molars at the planned osteotomy sites should be considered. Bilateral sagittal split osteotomies (BSSO) can be better performed when third molars are not present at the site of osteotomy. Third molars (both erupted and unerupted should be removed preferably one year before the planned osteotomy to ensure the formation of adequate bone (Figs 3.7 A to D).

Rigid fixation of the osteotomized segments is facilitated when there is adequate sound bone to secure plates and screws. Erupted maxillary third molars that are out of occlusion after a mandibular advancement should be considered before orthognathic surgery. However, maxillary third molars that are developing or are superiorly positioned are more easily removed at the time of Le Fort I osteotomy.




**Figs 3.7 A to D:** (A) Intra-oral photo of an 18-year-old young man with class III incisor relationship and mandibular excess who is being prepared to undergo surgical mandibular setback by bilateral sagittal split osteotomy (BSSO), (B) Cephalogram of the patient showing all features of mandibular excess. (C) OPG of the same patient showing impacted 38 and 48 with the apex incompletely developed (yellow arrows) which makes its surgical removal easy, (D) Extracted 48 showing the incompletely developed roots (yellow arrows)

6. **Odontogenic cysts and tumors:** Follicular sac of the impacted tooth can give rise to tumors and cysts (Figs 3.8 to 3.14). This is one of the most important reasons for the removal of asymptomatic third molars.

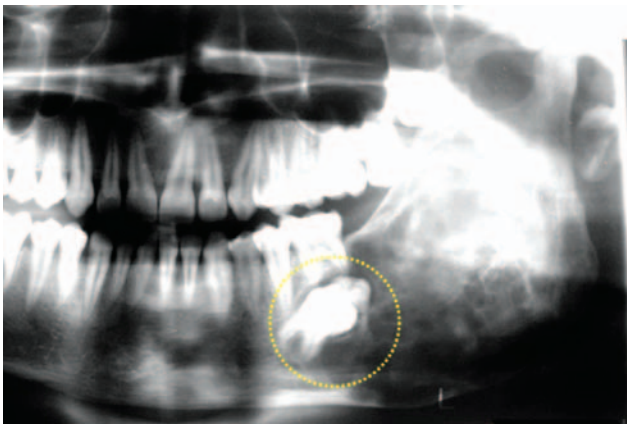


**Fig. 3.8:** OPG showing impacted 37 and 38 (yellow circle) associated with odontogenic tumor involving left ramus and angle of mandible

**Fig. 3.9:** OPG showing impacted 37 associated with extensive dentigerous cyst of mandible involving the left ramus, angle and body crossing the symphysis

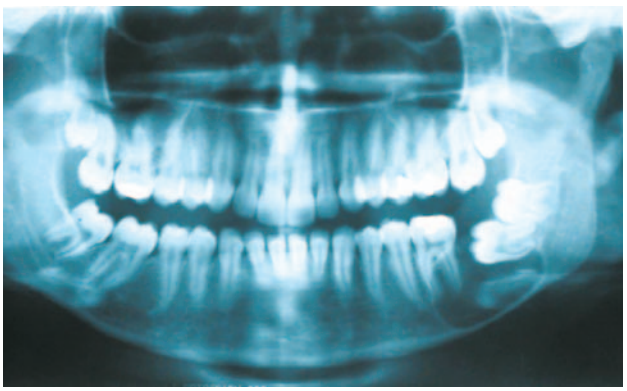


**Fig. 3.10:** OPG showing impacted 37 and 38 associated with dentigerous cyst involving the mandible

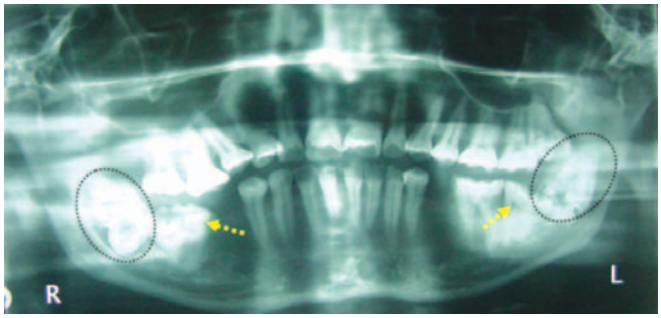



**Fig. 3.11:** OPG showing odontomes associated with bilaterally impacted mandibular third molars (black oval). Note the bulbous crown of second molars (yellow arrows)

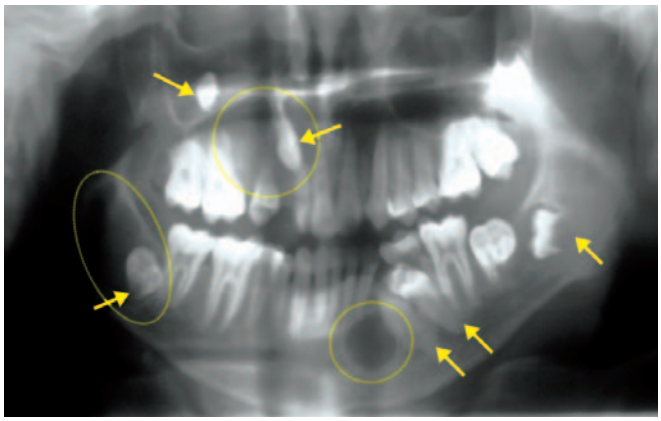


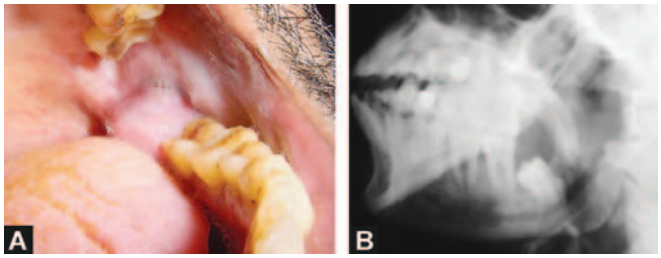
**Fig. 3.12:** OPG showing multiple impacted teeth (yellow arrows) and multiple jaw cysts in a 17-year-old patient

Olson et al (2000)[2] reported an unusual odontogenic carcinoma, which occurred in a dentigerous cyst associated with an impacted third molar in a 66-year-old male patient. The impacted tooth and the lesion were excised based on evidence of radiographic change and clinical findings.

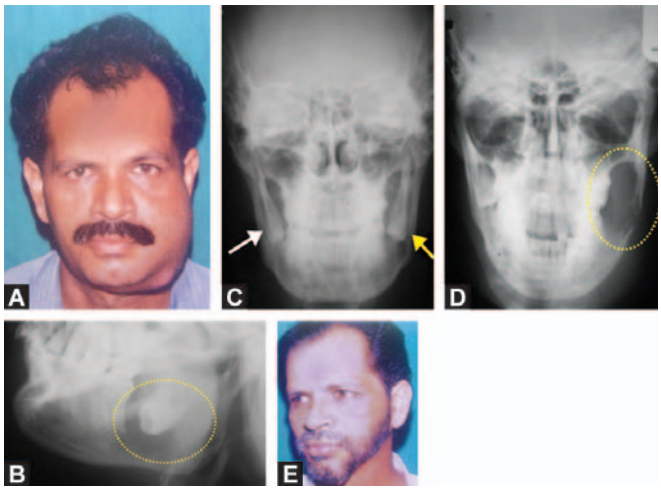
Rarely epidermoid carcinoma has been reported associated with impacted mandibular third molar tooth (Figs 3.13 A and B and 3.14 A to E).

**7. Management of unexplained pain:** Removal of impacted teeth very often relieves the patient of unexplained pain. It is still obscure how this pain relief occurs. However, the patient should be informed of the pros and cons.

The situation with regard to facial pain of an atypical nature is a difficult one and removal of a completely buried tooth should only be considered as a last resort and only when the patient points to that area as the source of pain. In some cases, this relieves the pain but there is no guarantee. It is not known why a completely buried third molar should cause pain. Much more commonly, atypical facial pain is associated with temporomandibular joint dysfunction and this possibility must be eliminated. Signs of muscle spasm are normally present in dysfunctional situations. Confusion can arise when there is concomitant muscle pain associated with a clenching habit and local third molar pain.




**Figs 3.13 A and B:** Carcinoma associated with impacted 38. (A) Intraoral photograph of a 76-year-old man with recurrent pain and swelling in the left retromolar region, (B) Lateral oblique view of mandible showing impacted 38 in the ramus with surrounding radiolucent area. Incision biopsy was taken from soft tissues in the retromolar region. The biopsy report came as poorly differentiated epidermoid carcinoma. The case was surgically treated with hemimandibulectomy and block dissection. In spite of this, the patient succumbed to the disease later




**Figs 3.14 A to E:** (A) A 46-year-old man with recurrent swelling left side of face, (B) Lateral oblique view of mandible showing impacted 38 in the ramus with surrounding radiolucent area, (C) PA view of mandible showing bilaterally impacted mandibular third molars (white and yellow arrows). A provisional diagnosis of dentigerous cyst of mandible was made. Surgical removal of impacted 38 along with surrounding soft tissue was done under general anesthesia. Specimen was sent for histopathological examination. (D) Postoperative radiograph showing irregular bony margin. The biopsy report came as poorly differentiated epidermoid carcinoma. (E) Postoperative photo after wide excision and hemimandibulectomy. However, the patient succumbed to the disease later

Sometimes it may be during a routine radiographic examination to identify any focus of facial pain that the presence of an impacted tooth is identified (Fig.3.15)

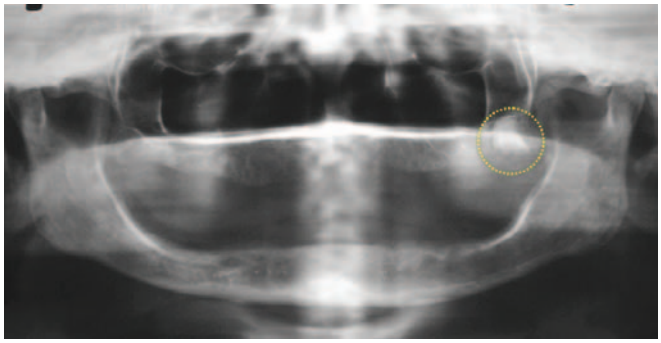


**Fig. 3.15:** OPG of a 67-year-old lady who was wearing denture for 9 years complained of headache and facial pain. Since no oral focus could be identified, an OPG was taken to rule out any bony pathology. OPG revealed an impacted 28 (yellow dotted line) which was not clinically visible in oral cavity.

**8. Resorption of root of adjacent tooth:** Once the root resorption of second molar is identified, removal of third molar should not be delayed to avoid further damage to the former.

**9. Teeth under dental prosthesis:** Risk versus benefit ratio is assessed in each case before planning surgical procedure. Teeth that are more superficial should be considered for removal before fabricating prosthesis. Rarely, an unerupted third molar may lie in an atrophic mandible and a careful choice needs to be made whether it is better to remove the tooth or leave it *in situ*. There is no clear evidence as to what is best to do and a degree of common sense must therefore prevail. This situation needs to be carefully evaluated. In very elderly patients the third molar might be left but in a middle-aged patient where there is a risk of spontaneous fracture or where minor trauma might cause a fracture then prophylactic removal is appropriate.

**10. Prevention of jaw fracture:** Prophylactic removal of impacted third molars should be considered for those engaged in contact games. An impacted third molar presents an area of lowered resistance to fracture (Fig. 3.16).

Moreover presence of impacted tooth in the line of fracture may cause increased complications in the treatment of fracture (Figs 3.17 A and B).

Recent studies by Zhu et al (2005) have shown a definite relationship between the presence of unerupted mandibular third molar and fractures of mandibular condyle.

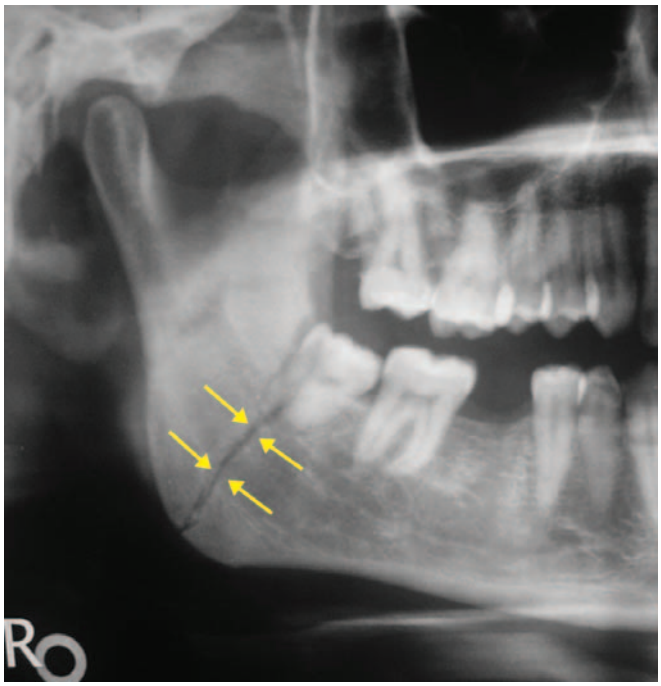
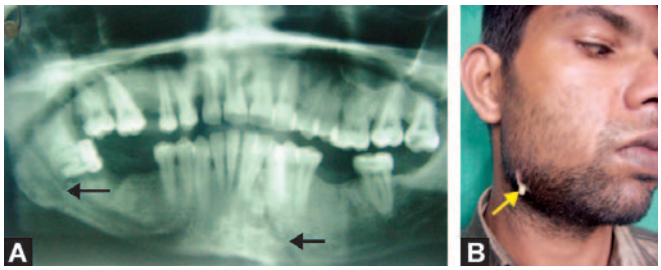
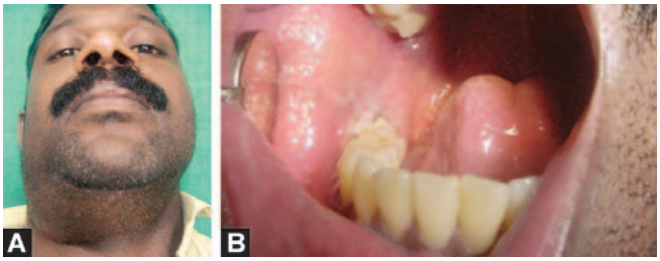



**Fig. 3.16:** Radiograph showing fracture of mandible in the right angle (yellow arrows). The presence of impacted 48 has caused an area of weakness which predisposed the area to fracture.




**Figs 3.17 A and B:** (A) Infection in relation to fracture of the right angle of the mandible (black long arrow). Note the presence of impacted 48. Even though there is another fracture in the left parasymphysis region (black short arrow), it has not lead to infection. (B) Extra oral pus discharge (yellow arrow) from the infected fracture in the right angle

**11. Deep fascial space infection:** Pericoronitis associated with impacted tooth has the potential for developing into deep fascial space infection (Figs 3.18 A and B). Litonjua (1996)[3] found that among the patients who reported for management of impacted mandibular third molars, 11% presented with deep fascial space infection of which 72% were secondary to pericoronitis. Vertical impaction (68%) was associated with highest incidence of pericoronitis.



**Figs 3.18 A and B:** Deep fascial space infection associated with impacted 48 in a 28-year-old man. (A) Note the swelling in the submandibular region spreading to neck. (B) Intraoral view showing impacted 48. Surprisingly the associated trismus was minimal

Osaki et al (1995)[4] conducted a study on the clinical characteristics of infections caused by impacted third molars in elderly persons over 60 years of age. Pericoronitis was the most frequent infectious condition associated with impacted third molars in this elderly population. A significant percentage of the infectious conditions that arose in these patients may be due to the combination of physiologic alveolar bone resorption and denture irritation. This combination of factors may expose teeth that were not previously accessible to the oral environment, thus increasing their risk of infection.

**12. Impacted teeth as potential source of infection (e.g. prior to administration of radiotherapy):** Teeth at risk of infection which could result in osteoradionecrosis or endocarditis should be removed. Cardiac patients with valvular disease or those who have undergone valve replacement have evidence of molar periodontal defects and inflammatory mediators in their crevicular fluid; should have asymptomatic third molars removed. Although the risks of these conditions developing endocarditis may be small, their serious nature precludes the retention of a potentially infected third molar. A partially erupted third molar tooth would come into this category, whereas a completely unerupted tooth which is never likely to erupt would not. In borderline situations, removal should be undertaken if symptoms are likely in the future. Other medical procedures such as organ transplantation, chemotherapy, or the insertion of alloplastic implants should be considered in a similar way.

**13. For autogenous transplantation to a first molar socket:** Although this was very popular in the past, the procedure has fell into disrepute due to unpredictable results. However, it is worth trying when indicated.

Since pericoronitis is the commonest indication for surgical removal of impacted third molar it is appropriate to discuss the condition in a more detailed manner.

## Pericoronitis

Pericoronitis is the inflammation of the soft tissues associated with the crown of a partially erupted tooth and is seen most commonly in relation to the mandibular third molar. The common symptoms and signs are pain, bad taste, inflammation, and pus expressible from beneath the pericoronal tissue. The condition is aggravated by trauma from an opposing tooth. Pericoronitis is the commonest cited reason for removal of wisdom teeth; though its presence does not necessarily mean that the associated tooth requires removal.

Unless the cause is removed pericoronitis may present as a recurrent condition requiring multiple episodes of treatment. In severe episodes, an acute pericoronal abscess may develop which may remain localized or spread to involve one or more of the adjacent deep fascial spaces and may be associated with systemic as well as local signs and symptoms.

## Identification of Risk Factors

1. Presence of unerupted/partially erupted tooth/teeth in communication with the oral cavity. Vertical and distoangular mandibular third molars are most commonly affected.
2. Pathological periodontal pocketing adjacent to unerupted/partially erupted teeth.
3. Opposing tooth/teeth in relation to pericoronal tissues surrounding unerupted/partially erupted tooth/teeth.
4. Previous history of pericoronitis.
5. Poor oral hygiene.
6. Respiratory tract infections.

## Diagnostic Criteria

- Presence of unerupted/partially erupted tooth/teeth in communication with the oral cavity.
- Cardinal signs/symptoms of inflammation associated with the pericoronal tissues.
- Local pain/discomfort.
- Swelling.

- Erythema.
- Associated signs/symptoms (variable expression):
  - — Pus expressible from beneath the pericoronal tissues.
  - — Restricted mouth opening.
  - — Abnormal taste.
  - — Halitosis.
  - — Cervical lymphadenopathy.
  - — Presence of associated disease - pericoronal/cervical abscess.
  - — Systemic signs and symptoms.
  - — Evidence of trauma by opposing tooth/teeth.

## Treatment

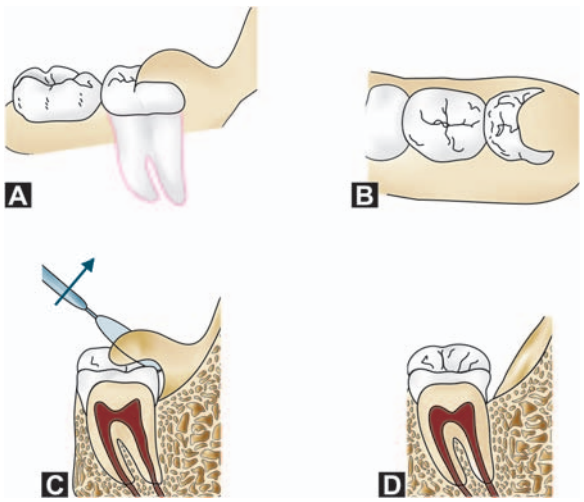
The following should be considered in the acute phase:

1. Irrigation of pericoronal space: Irrigation of the pericoronal space mechanically removes any debris that may have collected within the space. The irrigant should be sterile. Irrigants that may be used include; water for injection, normal saline, chlorhexidine and local anesthetic solutions.
2. Use of local agents to cauterize the soft tissues: Caustic agents to cauterize the local tissues, if used, should be applied with caution and appropriate care taken to avoid injury to adjacent tissues.
3. Removal of opposing tooth/teeth: This is done if traumatic occlusion with pericoronal tissues is present.
4. Use of appropriate analgesia: Pericoronitis is an inflammatory condition and NSAIDs should be considered the analgesic of choice unless contra-indicated.
5. Use of appropriate antibiotics in the presence of severe local disease or if systemic symptoms are identified: The use and choice of antibiotics is controversial. The bacterial flora is a complex mixture of gram-positive and gram-negative organisms and consideration should therefore be given to the use of broad spectrum or combinations of antibiotics depending upon the clinical situation.
6. Advice regarding oral hygiene: Meticulous oral hygiene is to be maintained. Frequent use of warm saline gargle will hasten the resolution of the condition.
7. Use of 0.12% chlorhexidine mouthwash is advisable.

The following should be considered after resolution of the acute phase

A *Local soft tissue surgery:* Operculectomy. This involves the surgical removal of the overlying soft tissue using surgical blade or using electrocautery under local anesthesia. Most authors favor the latter, since it will also aid in hemostasis. Before operculectomy is planned it is mandatory to have a good periapical radiograph of the area to note the angulation of the tooth and to verify that there is adequate space for the tooth to erupt (Pell and Gregory Class I) once the overlying soft tissue is removed surgically. If on the other hand the space is inadequate between the second molar and the anterior border of ramus of mandible (Pell and Gregory Class II and III), it is futile to attempt operculectomy, since there is the possibility of regrowth of the soft tissue during the healing phase causing recurrence of pericoronitis. More over, a vertically impacted tooth in Postion A has a better chance to erupt normally than a distoangular one. Additionally age of the patient also should be considered when operculectomy is contemplated.

The schematic diagram showing the various steps of operculectomy is shown in Figs 3.19 A to D. It may be noted that, in most cases operculectomy may have to be combined with a sulcus deepening procedure in the area because of the inadequate height of the attached gingiva and the shallow sulcus. Because of the necessity of all these procedures, operculectomy




**Figs 3.19A to D:** Schematic diagram of operculectomy using electrocautery - (A) Note the operculum covering erupting 38, (B) Occlusal view, (C) Use of electrocautery tip to excise the operculum, (D) Postoperative appearance.

has fell into disrepute recently and most authors favor surgical removal of impacted lower third molar following a second instance of pericoronitis.

B. *Removal of involved tooth:* As stated above most authors favor this to operculectomy especially when factors contributing to normal eruption mentioned above are not there.

## Contraindications for Removal of Impacted Tooth

1. Poor systemic condition of the patient: Patients with uncontrolled or poorly controlled systemic disease are unsuitable candidates for surgical removal of impacted third molars. This is because complications can occur either intra operatively or post operatively in such patients. Hence, a proper history, physical examination and laboratory investigations are mandatory in all the cases to rule out systemic diseases.
2. Advanced age: As age advances the bone becomes sclerosed, there is decreased healing response, greater bony defect following surgery, the surgical procedure is more difficult, more likely hood of fracture to occur, the surgical insult is less tolerated and the recuperation period is prolonged.
3. Damage to adjacent structures: Removal of deeply impacted third molars is likely to damage the inferior alveolar neurovascular structure resulting in permanent anesthesia.
4. Questionable nature regarding the future status of second molar: Extraction of a badly decayed and unrestorable second molar will permit the third molar to assume a more functional position or at least serve as a bridge abutment. Such cases have to be meticulously evaluated and final decision taken after consultation with the prosthodontist and endodontist.
5. Deeply impacted third molars in patients with no history or evidence of pertinent local or systemic pathology should not be removed.

## Removal of Asymptomatic Impacted Third Molars

Besides the obvious indications for removal of impacted teeth such as overt pathology, removal is also the preferred option for teeth if there is insufficient anatomic space to accommodate normal eruption. It is clear that timely removal of such impacted third molar teeth at an early age is a valid and scientifically sound treatment rationale based on medical necessity. Current textbooks on oral and maxillofacial surgery also document the scientific basis for the treatment of asymptomatic impacted teeth. For example, Peterson's Contemporary Oral and Maxillofacial Surgery states, "if impacted teeth are left in the alveolar process, it is highly probable that one or more of a number of problems will result." Clinical decision-making in the management of pathology associated with impacted teeth depends on the anticipated natural course. The parameters state that in order to limit known risks and complications associated with the removal of impacted teeth, it is medically appropriate and surgically prudent to remove such teeth prior to complete root development. This is supported by the National Institutes of Health Consensus Development Conference: Removal of Third Molars, which found that "third molars should be removed in the younger age patient because there is less transitory or permanent morbidity," and less anesthetic risk.

Treatment at an older age carries with it an increase in the incidence and severity of perioperative and postoperative problems, a longer and more severe period of postoperative recovery, greater anesthetic risk and greater and more costly interference in daily activities and responsibilities.

While making a treatment decision, the risks and benefits of removal of impacted teeth must be weighed against the risks of retention and the cost and availability of professional clinical monitoring for an individual patient. The final decision should be based on valid scientific and clinical information.

## SUMMARY

The removal of third molars is not indicated if they are asymptomatic and free of any pathology as long as good oral hygiene is maintained. The possible outcomes of surgery may be worse than that of non-treatment; the risk of an impacted third molar developing pathology being small compared to the risks of surgical intervention. Conservative treatment has also been found to be more cost-effective. Late anterior crowding related to impacted third molars cannot be accurately predicted and hence

the removal of third molars to prevent crowding may be unjustified. Conservative treatment is also advised for medically compromised patients when the risk to the patient's overall health outweighs the benefits of surgery.

## Indications for Surgical Management

The surgical removal of impacted third molars is indicated in some situations. The decision to remove the impacted third molar must be made with due consideration to the patient's overall health status and the potential risk of complications. Preoperative assessment should be carried out and informed consent obtained prior to surgery. The following are the indications for removal:

- *Infection:* removal of any symptomatic wisdom tooth should be considered, especially where there have been one or more episodes of infection such as pericoronitis, cellulitis, abscess formation; or untreatable pulpal/periapical pathology
- *Caries:* removal should be considered when there is caries in the third molar and the tooth is unlikely to be usefully restored, or when there is caries in the adjacent second molar tooth which cannot be satisfactorily treated without the removal of the third molar
- *Orthodontic consideration:* may be indicated prior to orthognathic surgery
- *Prosthetic consideration:* removal of partially erupted or unerupted third molar close to the alveolar surface should be considered prior to denture construction or implant placement
- *Other pathology:* third molars in relation to other pathology e.g. cysts, fractures, tumors may require removal.

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CHAPTER

# 4

# Development of Mandibular Third Molar

A biological review of the events that result in the development of third molars sheds light on why these teeth may develop frequently with morphological malformation, malposition and possibly even agenesis. Third molars are the only teeth that develop entirely after birth. All other teeth begin development in utero or, as in the case of permanent second molars, are entering into the tooth bud stage of development near birth. The initiation of the development of third molars does not begin until ectodermal dental lamina, migrating distally in the growing child's mouth, spatially relates to and interacts with jaw mesenchyme, which is derived from the embryonic cranial neural crest. In the case of third molars, the interaction of these two tissues is initiated following birth after significant jaw growth at around 5 years of age. If these two tissues never interact, no tooth will form. Since no subsequent similar interaction occurs between these two distinct tissue types after third molar tooth bud initiation, no other teeth develop at a later age. Development for all mammalian teeth is very similar after tooth bud initiation.

Initiation of third molars occurs macroscopically at or near the surface of the developing jaw bone. During the five years from birth to the initiation of third molars, genetic factors and environmental factors influence jaw growth and dental lamina migration, which ultimately may affect the timing of the interaction and final positioning of the two tissues necessary for the initiation of tooth bud development. For normal tooth pattern to occur with regard to size, shape and position, the two tissues must be in the right place at the right time. Alterations in the pattern of jaw growth, as well as changes in the migration of dental lamina, occur due to evolutionary forces and environmental factors such as trauma and disease. Environmental factors and teratogens have been shown to affect tooth development with devastating effects on tooth size, shape and position. It is not surprising, therefore, that aberrations in normal third molar pattern frequently occur.

The following is the milestone with regard to development and eruption of mandibular third molar:

| | |
|---|---|
| Tooth germ visible | 9 yrs |
| Cusp mineralization | 11 yrs |
| Crown formation | 14 yrs |
| Roots formed (apex open) | 18 yrs |
| Eruption | 18-24 yrs |

A number of longitudinal studies have been performed that have clearly defined the development and eruption pattern of the mandibular third molar.

Bjork (1956)[1] found that there are three factors which are significant in the development of mandible and which are related to the amount of space for the third molar:

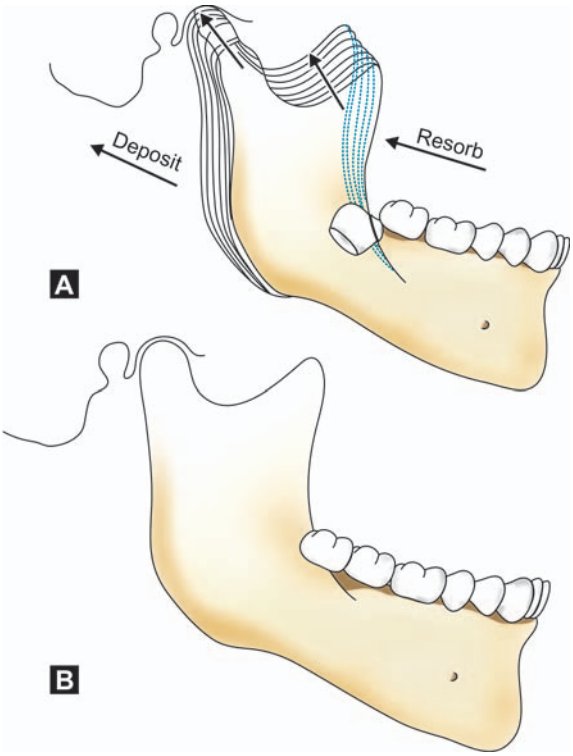
1. A predominantly vertical direction of condylar growth, resulting in little resorption of the anterior border of the ramus.
2. Insufficient mandibular growth in length in proportion to the amount of tooth structure.
3. A backwardly directed trend of eruption of dentition will diminish the length of the arch.

At the time of development the tooth germ it is located at the anterior border of the ramus with the

occlusal surface facing anteriorly. As the body of the mandible grows in length at the expense of the resorption of the anterior border, the developing third molar occupies a position at the root level of the second molar by 16 to 18 years (Figs 4.1 A and B). At this time it undergoes a rotational movement. The angulation of the crown slowly changes from horizontal to mesioangular and later to vertical. This rotational movement is of great importance because those third molars that do not follow this sequence get impacted even when sufficient retromolar space existed.

Hattab(1997)[2] noted that a significant proportion of mesially impacted mandibular third molar had changed their angulation and became fully erupted by the time the individual reached 24 years of age. Positional changes and eruption of impacted mandibular third molar are unpredictable phenomena.

Studies by Venta I et al (1991)[3] showed that the lower third molars that did erupt after the age of 20 years were initially: (1) root formation complete; (2) impacted in soft tissue; (3) vertical; (4) placed at the same occlusal level as the neighbouring second molar; (5) showed sufficient space between the ramus and the second molar. In contrast, the teeth that remained impacted at the age of 26 years showed such initial features as: (1) incomplete root formation; (2) embedding in bone; (3) mesio-angularity; (4) situated at the cervical level of the neighbouring second molar. It was concluded that a panoramic tomogram taken at age 20 years revealed radiographic features on which an estimation of future eruption of mandibular third molars could be based.




**Figs 4.1 A and B:** Showing the progressive remodeling of ramus for creating space for the eruption of molars. However in certain instances, this growth ceases before sufficient space has been created for eruption of third molar, which becomes impacted.

In the mandible, the mean change in inclination was 19 degrees and the percentage of teeth with changed angulation was 76%. In the maxilla, only 23% of the teeth changed their inclination. The state of impaction (soft tissue, partially in bone, completely in bone) had changed for 44% of the teeth (Venta I et al, 2001)[4]

Nance et al (2006)[5] following a study in 237 patients concluded that if impacted third molars are angled mesial/ horizontal, it is unlikely that these teeth will erupt. Mesial/ horizontal impacted third molars often have PD _> 4 mm and infrabony defects between the second and third molar. Retaining these teeth after 30 years of age greatly reduced the chance of the periodontal status improving with third molar removal. The prudent decision for treatment of mesial/ horizontal impacted third molars seems to be removal. Conversely, if third molars are impacted vertical/distal, a period of follow - up might be prudent to see if the third molars will erupt to the occlusal plane. It was noted that one-third of vertical/distal impacted third molars erupted to the occlusal plane. However, removal of these teeth should be considered if PD _> 4 mm in the third molar region exists or develop during follow up.

## Predicting the Eruption/Impaction of Mandibular Third Molars

Predictions of future eruption or impaction of lower third molars could be made using a transparent device developed by Venta I et al (1997).[6] Termed as 'Third Molar Eruption Predictor' (US patent 5,816,814; not commercially available) could be superimposed on a panoramic tomogram taken of a patient at age 20 years. The device was developed from data on 40 lower third molars initially retained at age 20 years; one half of these remained impacted, and the other half of them erupted by age 26 years. Tracings were made from panoramic tomograms taken at age 20 years. The critical point for

prediction in the overlay was the intersection of a horizontal reference line and the anterior border of the ascending ramus. To estimate this critical separation line, Bayes' Decision Theory was used. The sum of false negatives and false positives was least at a distance of 14.5 mm from the distal surface of the second molar. Mesial from this point, the probability of impaction was 76%; distal from this point, the probability of eruption was 72%. Tested against 35 initially unerupted lower third molars, the predictions made by the device and the actual clinical findings were in conformity in relation to 97% of the test teeth. It could thus be concluded that the method was simple to use and may prove a good addition for predicting lower third molar development.

The 'Third Molar Eruption Predictor' though initially developed for use on panoramic tomogram can also be used on periapical radiographs after calibration of the device. The device could be calibrated using the method of simple proportions and Bayes' Decision Theory. It was noted that the predictions made with the calibrated device were in conformity with the final clinical outcome in 84% of the cases.

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CHAPTER

# 5 Surgical Anatomy

## MANDIBULAR THIRD MOLAR

Modern day surgery is based on anatomy. Unless the operator builds on that soild foundation, he is no way better then 'a hewer of flesh and a drawer of blood'. Hence a discussion of those anatomic structures with which the surgeon is concerned in the surgical removal of mandibular third molar is pertinent.

The mandible consists of a horseshoe shaped body and two flat, broad rami. Each ramus is surmounted by two processes, viz. coronoid process and condylar process.

The lower third molar tooth is situated at the distal end of the body of the mandible where it meets a relatively thin ramus (Fig. 5.1).

This meeting point constitutes a line of weakness and a fracture may occur if undue force is exerted during elevation of impacted third molar. The tooth is embedded between the thick buccal alveolar bone and a thin lingual cortical plate (Fig.5.2).

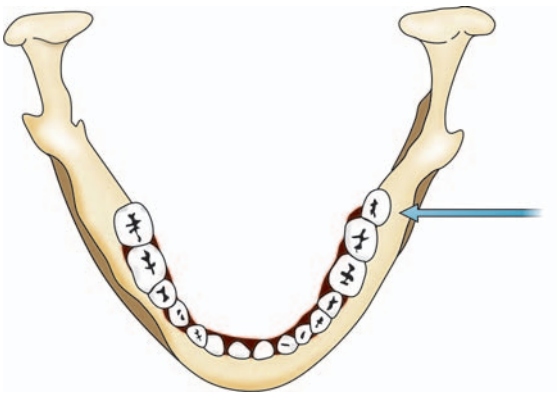


**Fig. 5.1:** Occlusal view of mandible showing the location of wisdom tooth on left side (blue arrow)

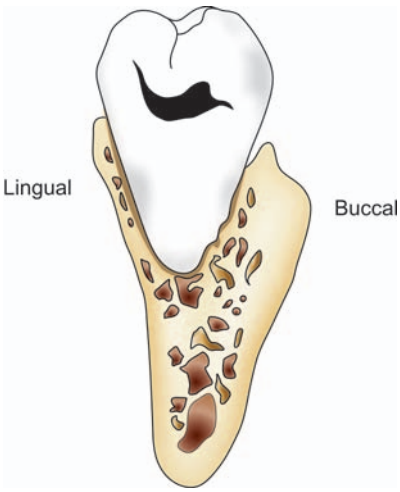



**Fig. 5.2:** Coronal section of mandible in the region of third molar showing a thick buccal alveolar bone and a thin lingual plate

When the mandible is viewed from below, it will be seen that the wisdom tooth socket lies on a prominent ledge or shelf of lingual bone. In many instances the lingual bone consists of a thin cortical plate less than 1 mm in thickness. Extraction can be facilitated by removal of this thin lingual cortical plate (Fig 5.3). This principle is employed in the lingual split bone technique. In cases where the lingual plate is very thin, attempts to remove fractured apices of tooth may inadvertently lead

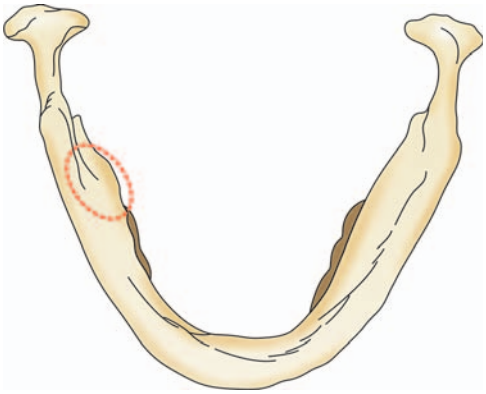


**Fig.5.3:** View from the inferior surface of mandible to show the lingual shelf of bone (red dotted line) which encloses the mandibular third molar

to their displacement through the lingual plate into the lingual pouch.

The buccal bone is predominantly formed by the buccal cortical plate of mandible and the external oblique ridge, the latter being the site of insertion of buccinator muscle. Reduction of the buccal plate will not permit the same ease of surgical access and its loss tends to weaken the mandible. The external oblique ridge is a bulky prominence in some patients and it impedes the buccal surgical approach to the wisdom tooth.

The interdental bone between the second and third molar may be minimal or even missing. In such case while using elevators extreme care should be used not to damage the bony and periodontal support of second molar, lest it may lead to periodontal pocket formation in the post operative period.

## Neurovascular Bundle

Below or alongside the roots of the third molar is the mandibular canal. The canal is usually positioned apically and slightly buccal to the third molar roots. However a variation from the usual position is not infrequent. The canal encloses the neurovascular bundle. The neurovascular bundle contains the inferior alveolar artery, vein and nerve enclosed in a fascial sheath. Since the calcification of the mandibular canal is completed before formation of the roots of third molar, the growing roots may impinge on the canal causing its deflection. Occasionally roots are indented by the mandibular canal, and rarely penetration of the roots of the wisdom tooth by this structure may occur. In the latter case, the neurovascular bundle will be torn during extraction of the tooth. Sometimes the apices may reach the superior wall of the canal and protrude into it (Fig.5.4). In such cases attempted elevation of a small fractured root tip may displace it into the mandibular canal. Furthermore, penetration of mandibular canal by instruments or forceful intrusion of third molar roots may injure the artery or the vein resulting in profuse bleeding.

From its start at the mandibular foramen, the canal and its contents are surrounded by a thin layer of bone with a configuration similar to lamina dura and this is radiographically detectable. In cases where the roots of the third molar are in direct contact with the neurovascular bundle, the lamina dura may be partially or totally absent. Hence, the radiographic evaluation of the relationship of the mandibular canal and roots of the third molar forms an important part of the preoperative assessment.

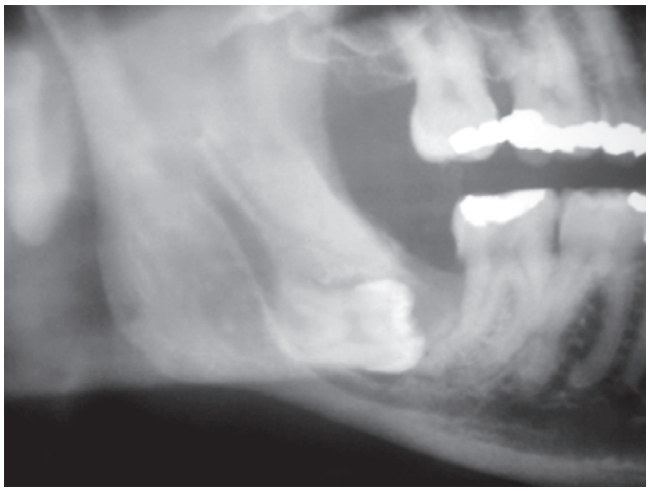


**Fig. 5.4:** Radiograph showing close relationship of impacted third molar roots to the mandibular canal

## Retromolar Triangle

Behind the third molar is a depressed roughened area which is bounded by the lingual and buccal crests of alveolar ridge; the retromolar triangle. Lying lateral to the retromolar triangle is a shallow depression, the retromolar fossa. Either in the retromolar triangle or in the fossa an opening may be present through which emerge branches of the mandibular vessel (Fig.5.5). This branch supplies the temporalis tendon, buccinator muscle and adjacent alveolus. Although these are small vessels, a brisk hemorrhage can occur during the surgical exposure of the third molar region if the distal incision is carried up the ramus and not taken laterally towards the cheek.

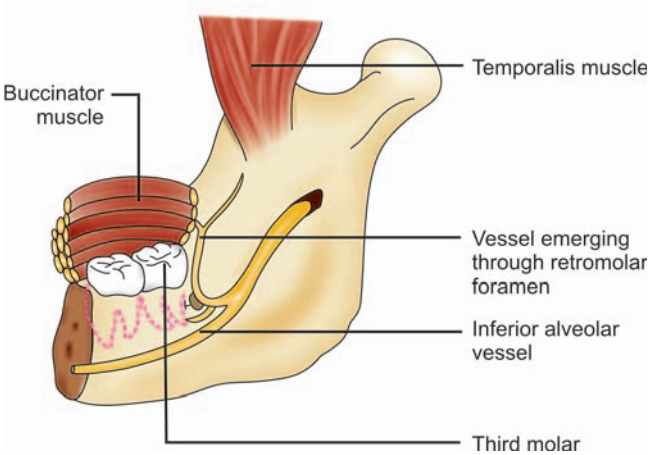



**Fig. 5.5:** Schematic diagram showing the retromolar vessel emerging through retromolar foramen

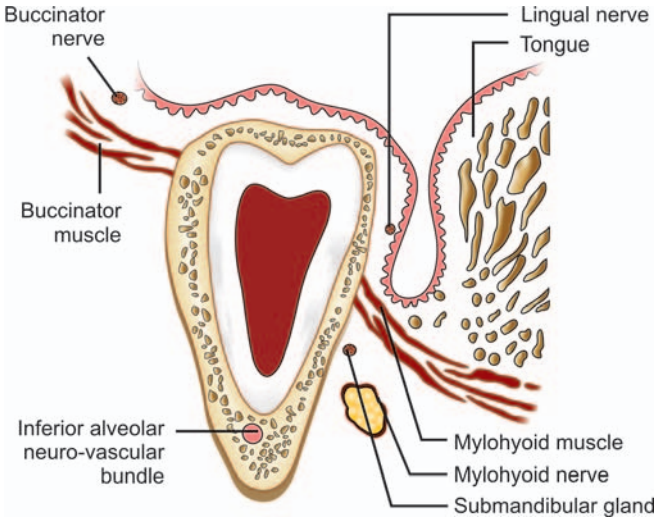



**Fig. 5.6:** Schematic diagram showing coronal section through the third molar region and the relationship of important anatomical structures to impacted mandibular third molar

The retromolar pad, which is the soft tissue covering the retromolar area is predominantly made up of loose connective tissue. When a gum flap is present over the occlusal surface of third molar, it will resist the upward movement of the tooth during elevation. Therefore a relieving incision through the overlying mucoperiosteum must be made before elevating the tooth.

The tendinous insertion of temporalis muscle terminates as two limiting prongs on the borders of the retromolar triangle. Stripping of these fibers during the removal of third molar can result in postoperative pain.

## Facial Artery and Vein

The facial artery and anterior facial vein cross the inferior border of the mandible just anterior to the masseter muscle and have a close relationship to the second and third molar. It is possible to cut these vessels if the BP blade slips when making a buccal cut in that region. Hence, it is always sensible to begin the incision in the depth of the sulcus and direct the blade upwards towards the tooth.

## Lingual Nerve

The lingual nerve lies on the medial aspect of the third molar (Fig.5.6)

Frequently lingual nerve courses submucosally in contact with the periosteum covering the lingual wall of the third molar socket or it may run below and behind the tooth. The proximity of this important nerve to the third molar places it in danger during the surgical removal of wisdom tooth. Hence great care must be taken to protect it. Injury to lingual nerve will lead to prolonged anesthesia of the anterior two-thirds of the tongue.

Based on studies by Pogrel(1995)[1], Holzle(2001)[2], Behnia(2000)[3] and Keisselbach(1984)[4] on cadavers it can be concluded that: (1) the lingual nerve was observed at or above the crest of the lingual plate in 4.6 to 17.6% of the cases; (2) the direct contact of the lingual nerve with the lingual plate in the retromolar region was observed in 22.3 to 62% of the cases; (3) the horizontal distance from the lingual nerve to the lingual plate in these studies ranged from 0 to 7 mm; and (4) vertical distance from the lingual nerve to the crest of the lingual plate ranged from 2 mm above the crest to 14 mm below it.

On an average the lingual nerve is found about 0.6 mm medial to the mandible and about 2.3 mm below the alveolar crest in the frontal plane.

From the above findings it can be concluded that during surgery for the removal of impacted third molar lingual nerve injury is most likely to occur when it traverses along or near the crest of the lingual ridge or in the retromolar pad.

Len Tolstunov (2007)[5] cited four anatomical risk factors contributing to lingual nerve injury described below:

**1. Lingual version of distoangular impacted lower third molars:** This is the first anatomical risk factor to be considered. Distoangular impactions are the most difficult mandibular impacted teeth to extract. The long axis of these

third molars is directed away from the operator toward the ramus of the mandible. Radiographically, some of the distoangular impactions show superimposition of roots of the third molar on to the roots of the second molar. Roots of these distoangular impacted mandibular third molars may be directed lingually. This three-dimensional position of the third molar is often called the lingual version. Thus in distoangular impaction there is vulnerability of the lingual nerve in the retromolar pad area.

**2. Lingual plate deficiency:** Lingual plate deficiency can present itself as a dehiscence (vertical collapse or cleft) or fenestration below the lingual crest (Fig.5.7). In such cases the apices of third molar penetrates the lingual plate. This indicates the additional risk of deflecting the fractured roots into the lingual pouch during its attempted removal. Its occurrence is likely to be developmental and appears at a time when the third molar forms in the limited space between the vertical ramus of the mandible and the erupted second molar. A pathological lesion in this area (e.g., cyst or tumor) can also erode the lingual plate and further compromise its integrity.

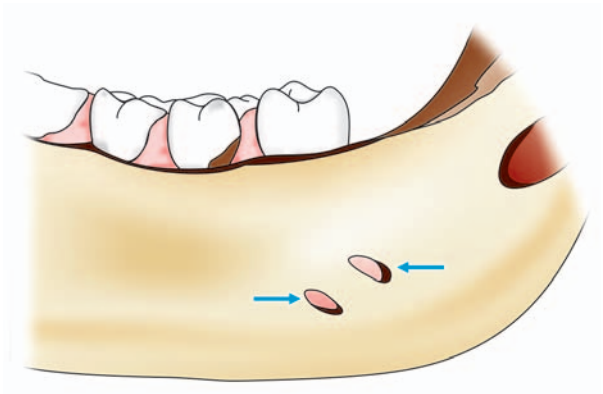


**Fig.5.7:** Penetration of the apices of roots (blue arrows) of lower third molar through lingual plate

**3. High-lateral position of the lingual nerve:** High position of the lingual nerve at or above the lingual crest in the retromolar region can place it near or on the lingual plate. Based on studies by various authors quoted above, the lingual nerve can potentially be in full contact with the lingual plate and at or above the crest of the lingual plate up to 2 mm. This again contributes to the vulnerability of the lingual nerve in the retromolar pad area.

**4. Local chronic inflammatory condition:** Chronic pericoronitis of the lower wisdom teeth is one of the most common reasons for their removal. Occasionally, the presence of a long-standing pericoronal or periodontal infection in the retromolar region can lead to scarring and adherence of the lingual soft tissue with the lingual nerve to the lingual plate. If the lingual plate is deficient, the lingual soft tissue can adhere directly to the exposed roots of the third molar. This again adds to the vulnerability of the lingual nerve in the third molar region.

## Implication of Lingual Nerve Anatomy in the Surgical Technique

Currently the buccal approach has become the favored one for removal of impacted lower third molars. Here the external oblique ridge is used as a marker for the incision going distally and buccally, and begins at the distobuccal angle of the second molar, bearing in mind that the ramus of the mandible flares laterally and posteriorly. This portion of the incision is continuous with the vertical buccal release incision alongside the first or second molar. This usually allows the surgeon to gain adequate access to the lower wisdom teeth, impacted or not and carefully manage the lingual flap which might include the retromolar pad without endangering the lingual nerve. If a straight line is drawn through the central fossae of the premolars and the molars, and it is extended through the retromolar pad, this line would end on the lingual or medial surface of the ramus, almost exactly where the lingual nerve usually comes down between the medial surface of the mandible and the hyoglossus muscle on its way anteriorly and inferiorly through the lingual mucosa to the lateral border of the sub-mandibular gland and the floor of the mouth. An incision directed in any of these areas could very likely cause a severance of the lingual nerve.

From the above discussion regarding the anatomical variation of the position of the lingual nerve and anatomical factors contributing to lingual nerve injury, it is logical to assume that proper clinical assessment of the case and knowledge of anatomy plays a vital role in avoiding lingual nerve damage. More over there is no clinical methods to assess the exact course of the lingual nerve in the third molar area. Miloro et al (1997)[6] reported that using high-resolution magnetic resonance imaging (MRI) the precise in situ position of the lingual nerve in the third molar region can be located. In the third molar region, there were only 2 of 20 cases (10%) in which the nerve was above the lingual crest, and there were 5 of 20 instances (25%) in which the nerve was in direct contact with the lingual plate. Their

study reconfirms the relative vulnerable position of this structure during third molar surgery.

## Mylohyoid Nerve

This nerve leaves the inferior alveolar nerve just before the latter enters the mandibular foramen. It then penetrates the spheno-mandibular ligament and proceeds close to the mandible in the mylohyoid groove. In 16% of the cases the nerve may be enclosed in a canal.

The nerve may be damaged during lingual approach for the removal of impacted mandibular third molar.

## Long Buccal Nerve

This nerve emerges through the buccinator muscle and then passes anteriorly on its outer surface. When the mouth is wide open, the level at which the nerve passes through the muscle corresponds to the upper part of the retromolar fossa.

Rarely injury to the nerve can occur when the posterior part of the incision is placed too laterally. This results in anesthesia of the lower part of the buccal mucosa in the molar region. No specific treatment is required for this as this will heal spontaneously and the patient will regain sensation with in a short period.

## Bone Trajectories of Mandible

The bone trajectories ('grain') of the mandible run longitudinally. This has an important bearing while using chisel for bone removal. A buccal chisel cut made parallel to the superior border in the third molar region can produce an extensive horizontal split in the buccal cortical plate. This split in the buccal cortical plate may extend up to the first molar denuding the roots of the teeth. This mishap can be avoided by making a 'vertical stop cut' (Fig.5.8) with the chisel distal to second molar and the bevel facing posteriorly, before removing the buccal plate around the third molar. Then for removing the buccal plate, a horizontal cut is subsequently made backward from a point just above the lower end of stop cut with bevel of the chisel facing downward.

Extreme care should be taken while using the chisel. Incorrect angulation of the chisel and the use of too great a force can result in fracture of mandible distal to the third molar.

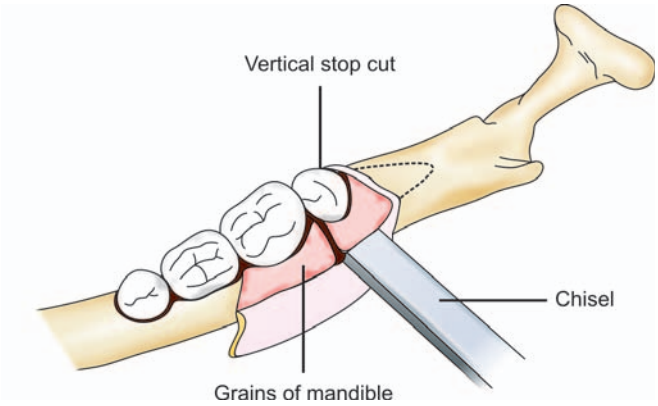



**Fig. 5.8:** While using chisel for bone removal in the third molar region, initially a 'vertical stop cut' is made distal to second molar to avoid splintering of buccal plate of bone. This is followed by making horizontal bone cut backward

## Lingual Plate

Because of the extreme thinness of the lingual plate the apices of lower third molar frequently perforates it. Attempted elevation of fractued roots may lead to their displacement through the thin lingual cortex into the 'lingual pouch'. Difficulty will be experienced in retrieving such dislodged root fragments. Rarely the whole tooth may be pushed into the lingual pouch (Fig.5.9).

When the lingual plate is correctly removed with a chisel it is not necessary to make a vertical stop cut distal to the second molar on the lingual side as it is done on the buccal side. In this area, the thin cortex surrounding third molar lingually joins the thick body of mandible and the

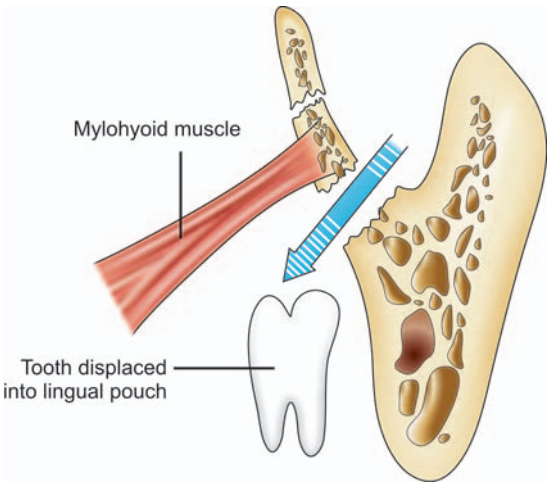



**Fig. 5.9:** Whole tooth displaced into lingual pouch beneath the mylohyoid muscle

inner plate breaks off at that junction and never extends forwards. This is the underlying principle in the 'Lingual split bone technique' popularized by Sir William Kelsy Fry.

However, a careless blow with the chisel lingually may lead to detachment of the entire lingual plate including the lingula. It may be noted that the lingula is only about 25 mm from the distal aspect of third molar.

## Musculature

The various muscles surrounding the third molar region are:

- Buccinator - anteriorly
- Temporalis - distally
- Masseter - laterally
- Medial pterygoid and mylohyoid - medially

**Buccinator muscle:** This horseshoe-shaped muscle forms the musculature of the cheek. It is inserted along the external oblique ridge and continues along the pterygomandibular raphe. It is attached to the maxilla at the level of the apices of molar roots.

During the surgical removal of deeply impacted third molar, the insertion of attachment of buccinator on the external oblique ridge may have to be severed. This predisposes to marked postoperative swelling, trismus and pain.

**Temporalis muscle:** This fan-shaped muscle is inserted on the coronoid process and anterior border of mandible. Two tendons can be noticed where the muscle attaches to the anterior border of mandible. The outer tendon is inserted to the anterior border of coronoid process. The inner tendon is attached to the temporal crest of mandible. The retromolar fossa is found in between these tendons.

During buccal approach for the removal of third molars, the outer tendon has to be sectioned to enable reflection of the flap. This in turn will facilitate adequate bone removal from the buccal and distal side.

**Masseter:** This muscle is inserted into the lateral side of the ramus from the coronoid process up to the angle.

The muscle is rarely involved in third molar surgery. Postoperative edema may extend posteriorly to involve the muscle leading to trismus and pain. Additionally, preoperative or postoperative infection may lead to submasseteric abscess formation.

**Medial pterygoid muscle:** This is inserted on the medial aspect of mandible in the angle region.

Even though not directly involved in third molar surgery, while using a lingual approach postoperative edema may result in trismus due to secondary involvement of the muscle.

**Mylohyoid muscle:** This muscle is inserted on the mylohyoid line from canine to the third molar region.

In the lingual approach, the insertion of the muscle is partly severed. This leads to transient swallowing difficulty. Moreover, postoperative infection can spread to sublingual or submandibular space.

## Maxillary Third Molar

The maxillary third molar is situated in the tuberosity region of the maxilla distal to the second molar. The root of upper third molar is very often in close proximity to the floor of the maxillary sinus (Fig.5.10).

In cases where the sinus is large, the roots of these teeth may protrude into the sinus resulting in the development of an oro antral fistula following its removal. Similarly attempts to remove a fractured root can result in pushing the root fragment into the sinus. Cases in which the third molar root is conical, use of a dental forceps for extraction may 'squeeze' the tooth dislodging it into the maxillary sinus.

The impacted upper third molar is often covered by a thin layer of buccal cortical plate. Surgical removal is facilitated by removing this plate. Since the presence of an unerupted third molar constitutes an area of weakness in the tuberosity, the latter may fracture during the removal of the tooth. Rarely the thin buccal plate enveloping the third molar may fracture during extraction and the tooth may be displaced into the infratemporal space. Recovery of such a tooth will prove difficult because of the presence of fatty tissue and other

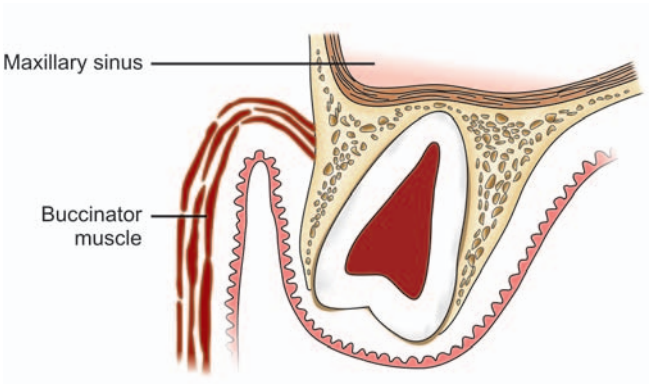



**Fig. 5.10:** Schematic diagram of coronal section through maxillary third molar region showing relationship of impacted third molar to the maxillary sinus and buccinator muscle

important anatomical structures like pterygoid venous plexus, maxillary artery and mandibular nerve.

Cases in which the maxillary wisdom tooth is erupting buccally, it may impinge on the coronoid process interfering with mandibular movements. This will cause pain on closing the mouth and also on lateral excursion of the mandible to the opposite side. In addition, it causes ulceration of the buccal mucosa opposing the crown.

## Classification of Impacted Mandibular Third Molar

A number of classifications have been developed to aid in the determination of surgical difficulty. A classification system is useful to categorize the degree of impaction and plan a surgical approach that facilitates removal and minimizes morbidity. It is a tool for predicting the difficulty of removal. Most classification is based on the analysis of the periapical x-ray or the orthopantomogram (OPG).

The most widely used are

**1. Angulation (Winter, 1926) of the impacted tooth (Fig.5.11):** Vertical, Mesioangular, Horizontal, Distoangular, Buccoangular (Figs 5.12 A and B), Linguoangular, Inverted, Unusual.

**2. Relationship of the impacted tooth to the anterior border of the ramus (Pell and Gregory, 1942):** This is an indication of the amount of space available between the ramus and the distal side of the second molar which is the effective space available for tooth eruption (Fig.5.13).

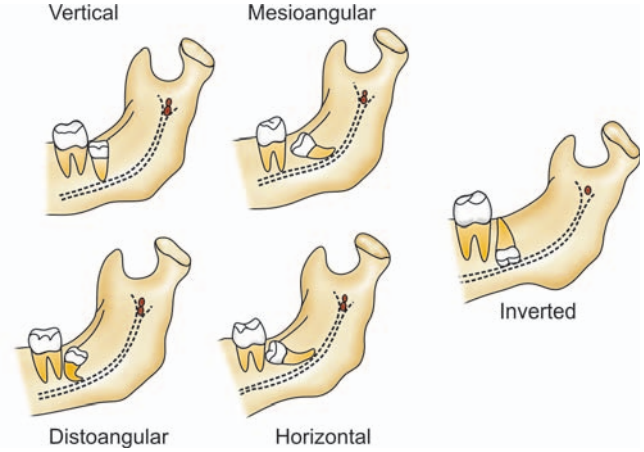



**Fig. 5.11:** Classification based on angulation of tooth (Winter's classification)

*Class I:* Sufficient space available anterior to the anterior border of ramus for the third molar to erupt.

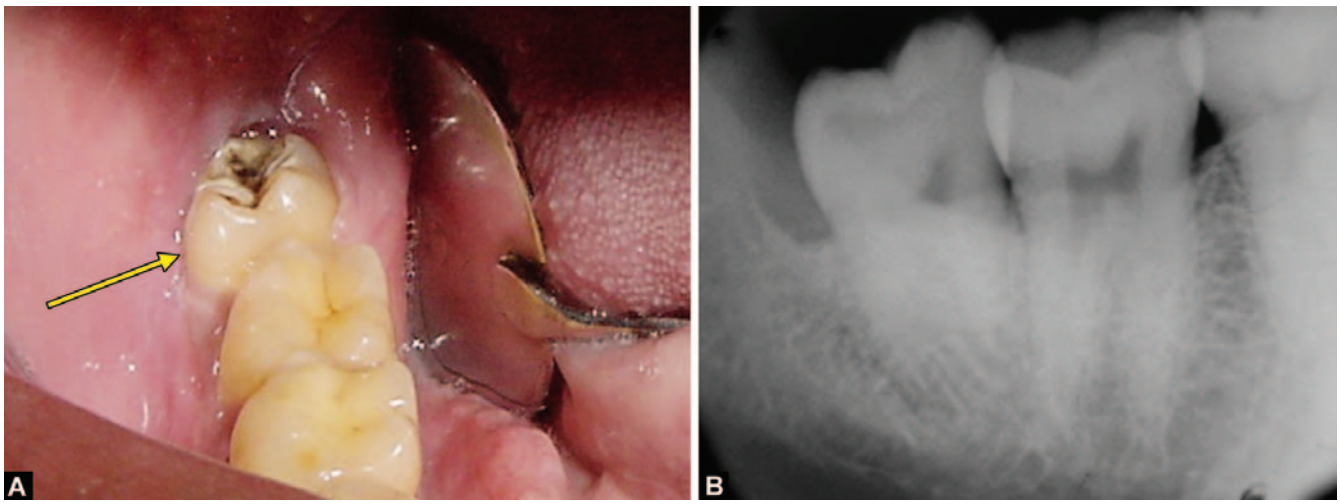
*Class II:* Space available is less than the mesio distal width of the crown of the third molar

*Class III:* All or most of the third molar is located within the ramus.

Teeth that are buried in the ramus are more difficult to remove.

**3. Depth of impaction and the type of tissue overlying the tooth (Pell and Gregory Classification based on relationship to occlusal plane):** i.e. soft tissue, partial bony, or complete bony impaction (Fig.5.14).

*Position A*: The highest portion of the tooth (occlusal plane) is on a level with or above the occlusal line.




**Figs 5.12 A and B:** (A) Partially impacted 48 in buccal version (yellow arrow), (B) Periapical X-ray shows that the tooth is also in distoangular position. Such tooth when deeply impacted will be very difficult to remove surgically

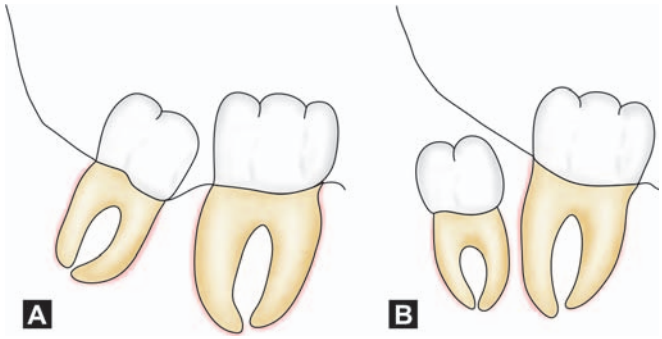

**Fig. 5.13:** Pell and Gregory Classification based on relationship to the anterior border of ramus


**Fig. 5.14:** Pell and Gregory Classification based on relationship to the occlusal plane of the impacted tooth to that of the second molar

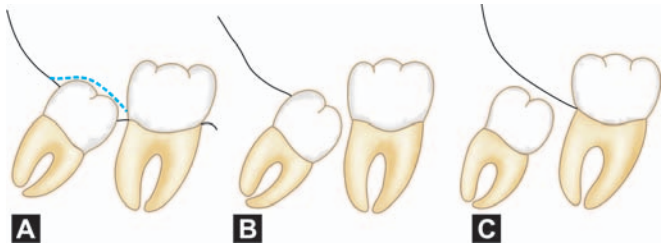
*Position B:* The highest portion of the tooth is below the occlusal line but above the cervical line of second molar.

*Position C:* The highest portion of the tooth is below the cervical line of second molar.

A mesioangular impaction with a class I ramus relationship and position A depth would be the easiest type of impaction to remove. A distoangular impaction with a class III ramus relationship and position C depth would involve a difficult surgical procedure. Figure 5.15




**Figs 5.15 A and B:** Examples of impaction showing combination of angulation of tooth, relationship to anterior border of ramus and depth of impaction. (A) Mesioangular impaction in Class I ramus relation and Position A depth—an impacted tooth easy for removal. (B) Distoangular impaction in Class III ramus relation and Position B depth—an impacted tooth difficult for removal

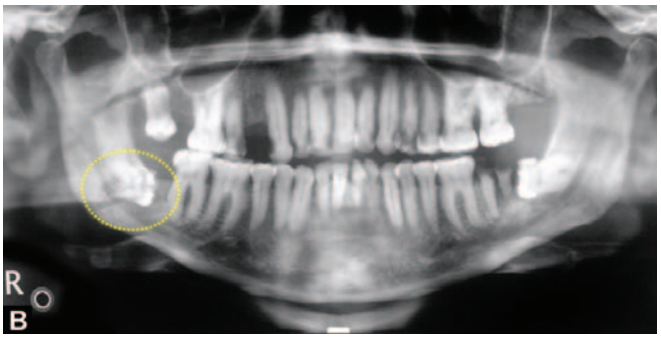


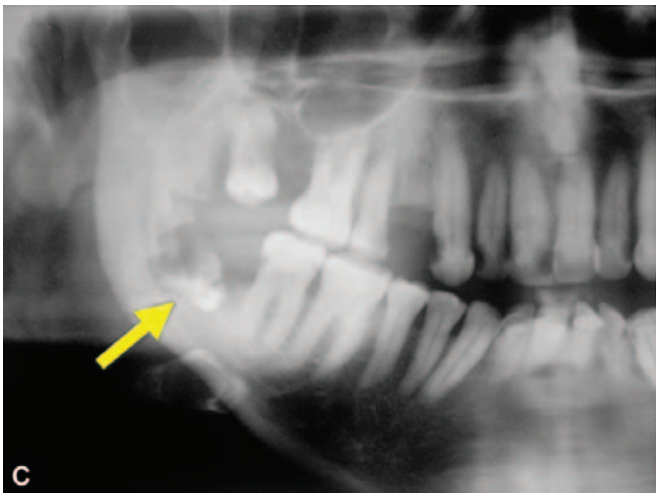

**Figs 5.16A to C:** Classification based on dental procedural codes. (A) Soft tissue impaction (D7220), (B) Partial bony impaction (D7230), (C) Full bony impaction (D7240)

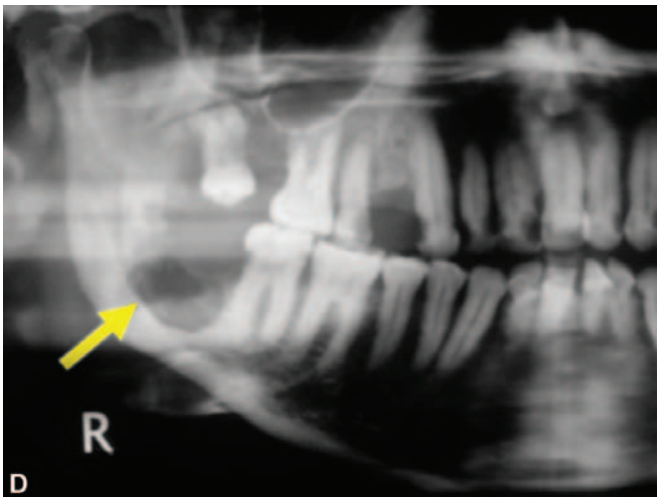
and 5.16 shows examples of impaction in which there is combination of classification based on angulation of tooth (Winter's classification), relation to anterior border of ramus and depth of impaction (Pell and Gregory classification).

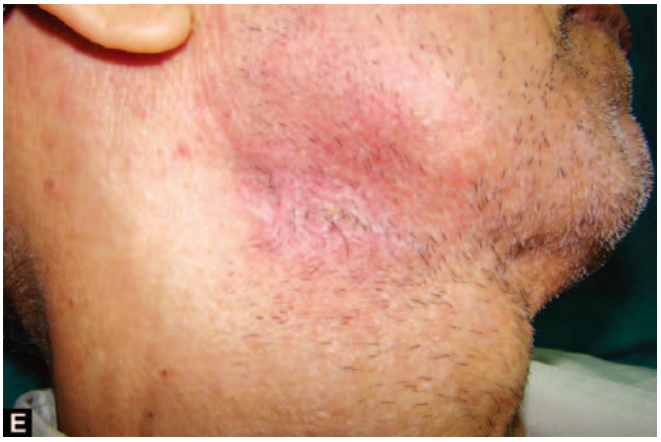
Considering the Pell and Gregory classification in a study conducted by Obiechina et al (2001)[7] in Nigerian population with 473 impacted mandibular third molars; showed that 22.62% of the teeth were in Class I,60.89% were in Class II, while 16.49% were in Class III relationship. The study also showed that 54.55% impaction were in Position A, 31.92% were in Position B while 13.53% were in Position C. The study concluded that the level of impaction suggests that a remarkable number of impacted mandibular third molars should be removed under general anesthesia.

4. **Type of tissue overlying the tooth:** i.e. soft tissue, partial bony, or complete bony impaction.
5. **State of Eruption**
    1. Erupted
    2. Partially erupted
    3. Unerupted
6. **Number of roots**
    1. Fused roots (Single)
    2. Two roots
    3. Multiple roots
7. **Classification system based on dental procedure codes (Table 5.1 and Fig. 5.16 and Figs 5.17A and B):** This classification that is used by insurance companies is also relevant (2005).[8] These codes are based on clinical and radiographic interpretation of the tissue overlying the impacted maxillary or mandibular third molar. A D7220 is the removal of an impaction whose height of contour is above the alveolar bone and is covered by soft


**Figs 5.17A to E:** Horizontally impacted 47 and 48 in a 72-year-old man who reported with discharging sinus from the right side of face of 4 months duration (A). The patient was found to have chronic anemia (Hb. 6.4 gm/dl), but no other systemic disease. OPG of the patient revealed a deeply impacted 48 (B-yellow circle) in the angle of mandible as the possible focus for extra oral sinus. After getting clearance from the physician and following transfusion of 3 units of packed red cells (RBC concentrate) the Hb level increased to 9.7 gm/dl. Since the patient was not willing for surgery under general anesthesia, after proper informed consent the removal of 48 was attempted under local anesthesia. The bone was found to be sclerosed and it was difficult to differentiate between the tooth and bone by noting the color or texture of the two. There was total absence of periodontal ligament for the tooth and the tooth was very brittle. The tooth was 'anchored' to the bone comparable to the classical description of 'glass in concrete'; the 'glass' being the tooth and the 'concrete' the bone. Only part of the impacted tooth alone could be removed (C-yellow arrow) after 'struggling' for an hour. The procedure was abandoned. The case was later posted under general anesthesia and the lower border of mandible exposed by submandibular approach. After removal of adequate amount of bone, taking care to avoid fracture of mandible, the tooth was successfully removed. D shows the postoperative OPG with the impacted tooth completely removed (yellow arrow). E shows the healed extra oral sinus after one month.

**Table 5.1:** Summary of classification system based on the dental procedure codes

| *Dental procedural code* | *Nature of impaction* | *Degree of difficulty of removal* | *Steps in surgical procedure* |
|---|---|---|---|
| D 7220 | Height of contour of impacted tooth is above the alveolar bone and is covered by soft tissue only—a soft tissue impaction. | The whole procedure is considered simple. | Removal of the tooth is accomplished by incision, reflection of a mucoperiosteal flap and elevation of the tooth. |
| D 7230 | Superficial contour is covered by soft tissue and whose height of contour lies beneath the surrounding alveolar bone—a partial bony impaction. | Intermediate in difficulty | Incision, reflection of a soft tissue flap, removal of some amount of bone and sometimes tooth sectioning |
| D 7240 | Tooth is covered with soft tissue and bone—full bony impaction. | Most difficult to remove | Incision, soft tissue flap elevation, removal of overlying bone and frequently sectioning of tooth |
| D 7241 | Complete bony impactions with unusual surgical complications (root aberrations, proximity to anatomic structures, internal or external resorption) | More complicated and difficult to remove than D 7240. (see Figs 5.17 A to E) | Incision, soft tissue flap elevation, removal of overlying bone and frequently sectioning of tooth |

tissue only—a soft tissue impaction. Removal of such a tooth is accomplished by incision, reflection of a mucoperiosteal flap and elevation of the tooth. The whole procedure is considered simple. A D7230 is the removal of an impaction whose superficial contour is covered by soft tissue and whose height of contour lies beneath the surrounding alveolar bone—a partial bony impaction. Such teeth are removed after reflection of a soft tissue flap, removal of some amount of bone and sometimes tooth sectioning. Such surgeries are considered intermediate in difficulty of removal. A code D7240 connotes an impacted tooth that is covered with soft tissue and bone—full bony impaction. Such teeth require soft tissue flap elevation, removal of overlying bone and frequently sectioning of tooth for removal. These impactions are considered the most difficult to remove. An additional code, D7241, can be used for complete bony impactions with unusual features like root aberrations, proximity to anatomic structures, or resorption leading to possible surgical complications. Removal of such teeth is more difficult than regular full bony impactions.

Disadvantage of the present classification: Even though there are a number of classifications available to classify impacted mandibular tooth in the dentulous jaws, no accepted classification is available to classify impacted tooth in edentulous mandible or maxilla or impacted tooth associated with infection (bony/soft tissue), osteomyelitis (Fig. 5.18) or pathological lesions like cyst or tumor. Moreover local complicating factors or systemic condition of the patient is not taken into consideration while classifying impacted mandibular third molars.

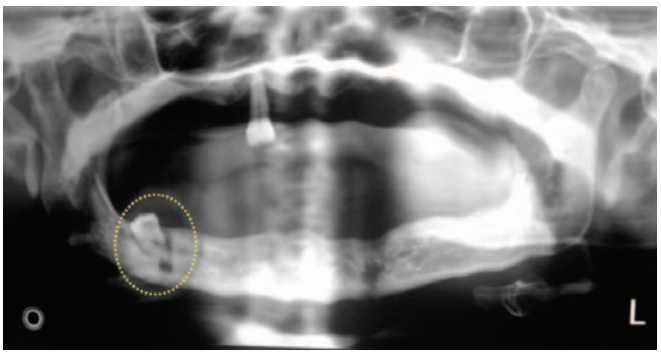



**Fig.5.18:** OPG showing impacted 48 with associated osteomyelitis in a 78-year-old lady who reported with recurrent pain and swelling of the right side of face of 2 years duration

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CHAPTER

# 6 Preoperative Planning

Diagnosis of impacted third molar should be based on patient complaint, history, physical evaluation and diagnostic test evaluation.

Preoperative evaluation of the third molar, both clinically and radiographically is an important step for the successful and speedy removal. Time spent at this stage is time gained. A good periapical radiograph is a must. If required the periapical radiograph should be supplemented with an occlusal X-ray. An OPG or a lateral oblique radiograph should be taken whenever intra oral radiographs are inadequate to provide the necessary information regarding the tooth or adjacent structures. However, the former lack the details seen in a periapical film.

## PREOPERATIVE PLANNING HELP IN THE FOLLOWING WAYS

1. It provides a rough estimate of time required for the procedure. (Put in extra 15 minutes for any eventuality.)
2. Helps to exclude those cases which are beyond one's competence.
3. Expect the complications that are likely to occur and get informed consent from the patient
4. Helps in selection of instruments.
5. Selection of the type of anesthesia to be employed-whether local anesthesia or general anesthesia is required. Most patients can tolerate surgery under local anesthesia lasting from 45 minutes to 1 hour.

A complete assessment of the possible problems which could be encountered in the surgical removal of an impacted third molar and a treatment plan can be formulated only after a careful clinical and radiographic examination of the area.

## Clinical Examination

This include (1) History taking (2) Extra oral examination, and (3) Intraoral examination

### *1. History Taking*

*Complaints of the patient:* Impacted teeth very often cause no symptoms and patients are unaware of its presence until told by the dental practitioner. Symptoms when present are usually related to pericoronitis, which may be either acute or chronic in nature or complaints related to acute pulpitis associated with dental caries. Symptoms associated with other conditions listed in Chapter 3 under indications for surgical removal may also be present.

*Medical and dental history:* An important part of the interrogation is the medical and dental history of the patient. Advances in modern medicine have resulted in the improved survival of people with significant medical conditions. As a result people are living longer and receiving treatment for disorders that were fatal a few years ago. These patients have a relatively high risk of developing complications from surgical procedures. Hence, it is imperative that the dental surgeon be competent to recognize and manage such cases in the

safest possible manner. Apart from the fate of the patient, neglect of the medical history can result in unpleasant medico-legal problems.

There are three basic aspects regarding the dental management of medically compromised patient. The first is to detect such patients. This is a difficult task, especially when there are no significant symptoms or if the patient is uneducated and has no idea about the disease and the drug therapy. However, this does not preclude the responsibility of the dental surgeon in the event any complications occur. Secondly, if the patient is found to have a systemic disease it is essential to determine the implications of the disease or its treatment on the dental management. Finally, once it has been decided, it then remains necessary to discover how best to deal with the problem.

In an ordinary dental surgery setting, it is unlikely that the dental surgeon will undertake a full medical examination of the patient prior to any surgical procedures. Instead the operator must rely on a proper medical history that will help to identify those patients with medical conditions that will require precautionary measures. A written questionnaire will help as a screening measure to recognize such patients. Alternatively, if the patient is not literate the dental surgeon or the assistant can do a thorough interrogation and the matter entered in the case record. The basic example is as follows:

## Medical Evaluation Form

A detailed medical history will help to identify medical conditions which contraindicate surgical removal or

**Medical Evaluation**

Date

Please note to answer the questions correctly. For any clarification contact the dental staff. Your health and fitness is of utmost importance to make sure that the dental treatment you receive will not affect adversely your general health.

Name, address and Tel. no. of your Physician

Are you suffering from/ suffered any of the following conditions/ disease?

| | | | |
|---|---|---|---|
| Diabetes | Yes/No | Liver or Kidney Disease | Yes/No |
| High Blood Pressure | Yes/No | Thyroid Disease | Yes/No |
| Heart Attack | Yes/No | Asthma | Yes/No |
| Angina | Yes/No | Fits or Epilepsy | Yes/No |
| Bleeding Problem | Yes/No | Stroke | Yes/No |
| Rheumatic Fever | Yes/No | Any other illness | Yes/No |

Do you consider yourself to be in the high-risk group for HIV/ AIDS/ Hepatitis B

Are you currently on any medication? Yes/No
If yes, What are they and Dose? 1.
2.
3.

Are you allergic to any drugs or substances Yes/No
If yes, What are they? 1.
2.
3.

Have you ever had adverse reaction to local or general anesthetic? Yes/No

Have you ever had any dental treatment, operation or surgery? Yes/No
If yes, list the operation, year and any complications 1.
2.
3.

Ladies- Are you pregnant? Yes/No

Are you a smoker/ chewer/ consume alcohol? Yes/No
If yes, frequency, intensity, duration?

To the best of my knowledge, all the preceding answers are true and correct. If I ever have any change in my health, abnormal laboratory test, or if my medication change, I will inform the dentist at the next appointment without fail.

Signature & Name Patient Bystander Doctor

modify the management of the patient with impacted tooth. A detailed discussion of the medical conditions to be considered is beyond the scope of this chapter.

However, the following are the common medical conditions to be considered which have significant impact in the management of patients with impacted third molar:

1. Cardiovascular diseases
   (a) Hypertension
   (b) Infective endocarditis
   (c) Ischemic heart disease
   (d) Thromboembolic disorders (patients on anticoagulants)
2. Endocrine diseases
   (a) Diabetes mellitus
   (b) Hyperthyroidism
   (c) Adrenal insufficiency
3. Bleeding disorders
4. Respiratory diseases
   (a) Bronchial asthma
   (b) Chronic obstructive pulmonary disease (COPD)
5. Liver disease
   (a) Chronic alcoholism and Liver cirrhosis
   (b) Viral hepatitis
6. Pregnancy
7. AIDS and HIV infection
8. Prosthetic joint replacements
9. Neurological Disorders
   (a) Epilepsy
   (b) Stroke
   (c) Parkinson's disease
10. Patients with organ transplantation
11. Chronic renal failure
12. Allergy to drugs/ food items

## Significance of Medical Evaluation

A proper medical history enables the operator to take the necessary precautions that will ensure patient's safety during the dental surgical procedure. These may be either one or a combination of the following precautions:

1. Additional investigations: For example clotting screen for those with history of bleeding.
2. Alteration of patient's current medication to facilitate surgery. For example stopping warfarin preoperatively. Such measures must only be taken in consultation with the patient's physician.
3. Administration of preoperative medication: (a) antibiotic cover, (b) steroid cover, (c) oral sedation
4. Selection of anesthetic that is safe for the patient
5. Undertaking surgery in a hospital set up where appropriate medical back up is available.
6. Selection of medication (e.g. antibiotics and analgesics) that is safe for the patient. For example avoid penicillin in those with reported history of allergy.
7. Anticipate and adequately prepare for a potential medical emergency. For example, acute asthmatic attack.

### *2. Extraoral Examination*

The face and neck is examined for signs of swelling or redness of the cheek suggestive of infection. The lower lip is tested for anesthesia or paresthesia. The regional lymph nodes are palpated for enlargement and tenderness.

### *3. Intraoral Examination*

The following points are noted:

1. Mouth opening: Normal mouth opening/microsomia/macrosomia/trismus/hypermobility of TM joint/habitual dislocation/fibrosis of mucosa e.g. submucous fibrosis. In retrognathic mandible accessibility to third molar area is restricted, while in prognathic mandible accessibility is better.
2. General examination of oral cavity: Oral mucosa, teeth, oral hygiene.
3. Third molar area: State of eruption of tooth, tissue overlying the tooth (bone/soft tissue only), signs of pericoronitis.
4. Condition of impacted tooth: Carious or with fillings, internal resorption (not to be mistaken for caries), angulation of tooth, locking of crown of third molar beneath second molar. This is later confirmed with appropriate radiographs.
5. Condition of second molar and first molar: Caries, crown/filling, distal periodontal pocket/resorption of root of second molar, missing second molar. Carious second molar or large filling/crown of second molar is likely to fracture while using leverage in attempting to elevate third molar. The patient has to be warned of this to avoid unpleasantness later on in the event of a mishap.

6. Amount of space available between the distal surface of second molar and the ascending ramus: If the distance is small, the tooth is less accessible; if large it is accessible. In the maxilla the accessibility depends on the relationship of the tooth to the tuberosity. Distal tilting of second molar also decreases accessibility.
7. Adjacent bone: May be infected along the mesial surface of the tooth and may involve the second molar necessitating its extraction. Infection / osteomyelitis may involve the ramus posterior to the crown especially in cases of recurrent sub-masseteric abscess arising in relation to distoangularly impacted third molar.
8. Fracture may complicate the removal of an impacted third molar. When the jaw contains an impacted tooth, it is more vulnerable to a blow and frequently fractures through an unerupted third molar crypt. After the tooth is removed, the fracture is immobilized in the usual manner. Fracture caused by an attempted surgical removal of third molar should be recognized and a careful record should be made of it.
9. Pathological complications due to skeletal diseases should be noted. They may increase the danger of fracture as in osteogenesis imperfecta and osteosclerosis. In acromegaly the removal of tooth is difficult because the mandible consists of massive bone. In Paget's disease the tooth may be affected by resorption and repair by bone make its removal difficult.
10. Presence of cysts and tumors: Small eruption cysts and large cysts may occur in relation to impacted tooth. Generally they cause displacement of the tooth. Tumors, benign and malignant may be found involving the tooth, especially ameloblastoma. Odontomes also may be found around third molar tooth.

## Radiography of Impacted Mandibular Third Molar

The purpose of a careful radiological evaluation is to complement the clinical examination by providing additional information about the third molar, the related teeth and anatomical features, and the surrounding bone. This is necessary in order to make a sound decision about the proposed surgical procedure, the most appropriate location for this to take place, and to highlight aspects of management which may require specific mention to the patient.

Moreover, diseases of adjacent soft and hard tissues may proceed to advanced stages without symptoms (e.g. associated cyst/ tumor), it is important that radiographic evaluation be performed. The most commonly accepted imaging modality is the intra oral periapical X-ray and panoramic radiograph. Other imaging techniques may be appropriate if they provide appropriate visualization of the entire tooth and associated structures. However, it must be kept in mind that radiographs may not provide complete or accurate information as to tooth position.

Most of the local factors causing difficulty in removal of third molar can be diagnosed by careful interpretation of preoperative radiograph.

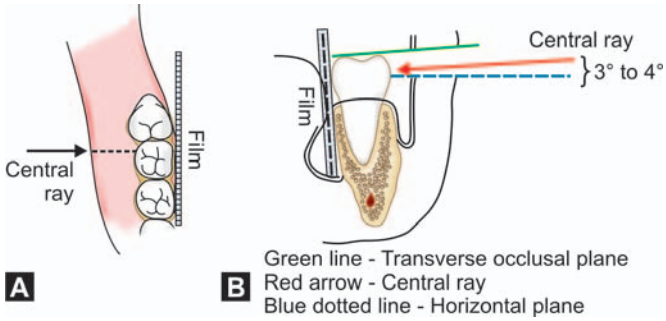
The following intra oral and extra oral radiographs are required:

1. Periapical radiograph
2. Occlusal X- ray of mandible
3. Lateral oblique view of mandible
4. Orthopantomogram

An important criteria for a good film is that there should be a clear superimposition of the buccal and lingual cusps of the second molar upon one another in the same vertical and horizontal plane which is visualized as a typical 'enamel cap' appearance of the second molar.

**1. Periapical radiograph:** An ideal periapical X-ray should include the whole third molar, its investing bone, the anterior border of ramus, the inferior alveolar canal and the adjacent second molar tooth. An important criteria for a good film is that there should be a clear superimposition of the buccal and lingual cusps of the second molar upon one another in the same vertical and horizontal plane which is visualized as a typical 'enamel cap' appearance of the second molar. This can be achieved by positioning the X-ray tube in such a way that the central ray will be parallel to the occlusal surface of the second molar and pass through the distal cusps of the second molar at right angles to the film packet. In a good film the lateral image of the second molar will be sharp without vertical shortening. In a poor film with incorrect angulation, the 'enamel cap' will be absent and there will be overlapping of contact points of molars.

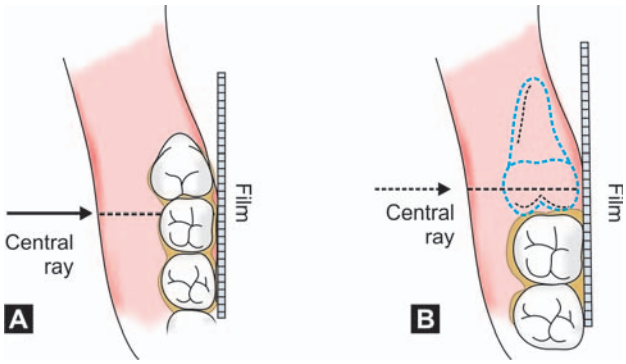
For taking a good periapical radiograph, the patient is seated with the mouth open, occlusal plane of mandibular teeth horizontal and parallel to the floor. The film is then inserted on the lingual side of the corresponding third molar with the anterior edge of the film reaching up to the mesial surface of first molar. In suspected cases of horizontal impaction, the film should be inserted more posteriorly so that the root apices also will be visualized in the radiograph. A film holder or a straight 'mosquito' hemostat will help to grip the film and position it correctly. The X- ray tube is positioned so that the central ray will be parallel to the occlusal surface of the second molar and pass through the distal cusps of the second molar at right angles to the film packet. Moreover, when viewed from the front the angulation of the central ray should be parallel with the transverse occlusal plane which is usually at an angle of 3° to 4° above the horizontal plane (Figs 6.1 A and B).



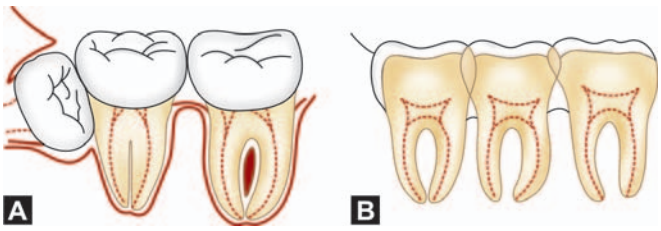

**Figs 6.1A and B:** (A) Positioning of periapical film packet and angulation of central ray in an average case (viewed from above), (B) Angulation of the central ray when viewed from the front—the central ray (red arrow) is parallel with the transverse occlusal plane (green line) which is usually at an angle of 3° to 4° above the horizontal plane (blue dotted line)

In cases of horizontal impactions, the central ray is directed through the middle of the crown of the impacted tooth (Figs 6.2 A and B) and at right angles to the film packet. Lingual tilt or rotation of the second molar if present should be considered while positioning the tube and interpretation of such radiographs.

As stated above in a good film the lateral image of the second molar will be sharp without vertical shortening. But in a poor film with incorrect angulation, the 'enamel cap' will be absent and there will be overlapping of contact points of molars (Figs 6.3 A and B). This occurs when the central ray is not parallel to the transverse occlusal plane and if the central ray does not pass at right angles to the film in the horizontal plane.




**Figs 6.2A and B:** Location of the film and direction of central ray seen from above. (A) Average case. Note that central ray is directed along the crown of the second molar. (B) In case of a horizontal impaction. Note that the central ray is directed through the middle of the crown of the impacted tooth




**Figs 6.3 A and B:** (A) Schematic diagram showing that when the central ray is not parallel to the transverse occlusal plane the enamel cap of the second molar is absent, (B) If the central ray does not pass at right angles to the film in the horizontal plane, overlapping of contact points occur

Very often the correct positioning of periapical film in the third molar region can be difficult due to gagging reflex or pain in the floor of the mouth due to sharp edge of the film or difficulty in positioning the X-ray film sufficiently posteriorly. Should these difficulties occur, the resulting film will be far from adequate to yield sufficient information about the impacted tooth and surrounding area. Also the narrow viewing field obtained in periapical film has limited diagnostic value. However, periapical radiographs are more discriminating than OPG and may be more helpful in detecting caries, bone height at the level of second molar and root contour.

**2. Occlusal X-ray:** This will help to confirm the presence of a bucco-lingual relationship indicated by a periapical X-ray, and will demonstrate the exact position of the crown of the tooth and the shape of laterally deviated roots.

**3. Lateral oblique view of mandible:** There is inevitable distortion associated with this radiograph due

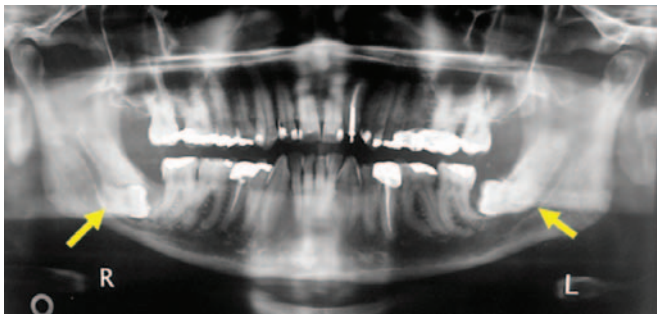



**Fig. 6.4:** OPG of a 61-year-old man showing bilaterally impacted third molar with their roots in close relationship to inferior alveolar neurovascular bundle

to the need to rotate the opposite side of the mandible out of the path of the central ray during exposure of the film. Hence, this is not as useful as a good periapical X-ray to assess the local factors causing difficulty in removal. However, this X-ray has a definite role in the following situations:

- When periapical film could not be taken due to retching, trismus or some other cause.
- To provide additional information like vertical height of mandible in the area, amount of bone beneath deeply buried impacted tooth in a thin mandible, existence of pathology in the vicinity like cyst / tumor or double impactions.

Since the introduction of OPG, the indication for the use of extra oral X-ray's is limited. However, its use may be considered in the absence of OPG.

**4. Orthopantomogram (OPG):** Recently due to easy availability OPG has replaced the lateral oblique view of mandible. All the information available from a lateral oblique view can be had from OPG with less distortion (Fig. 6.4). Routine use of OPG is an important advance in the accurate localization of impacted teeth

OPG is considered the gold standard for surveying the maxilla and mandible for diseases and other pathological conditions in the lateral plane.

Different radiographic views helps to identify other conditions affecting the area (Figs 6.5 A and B)

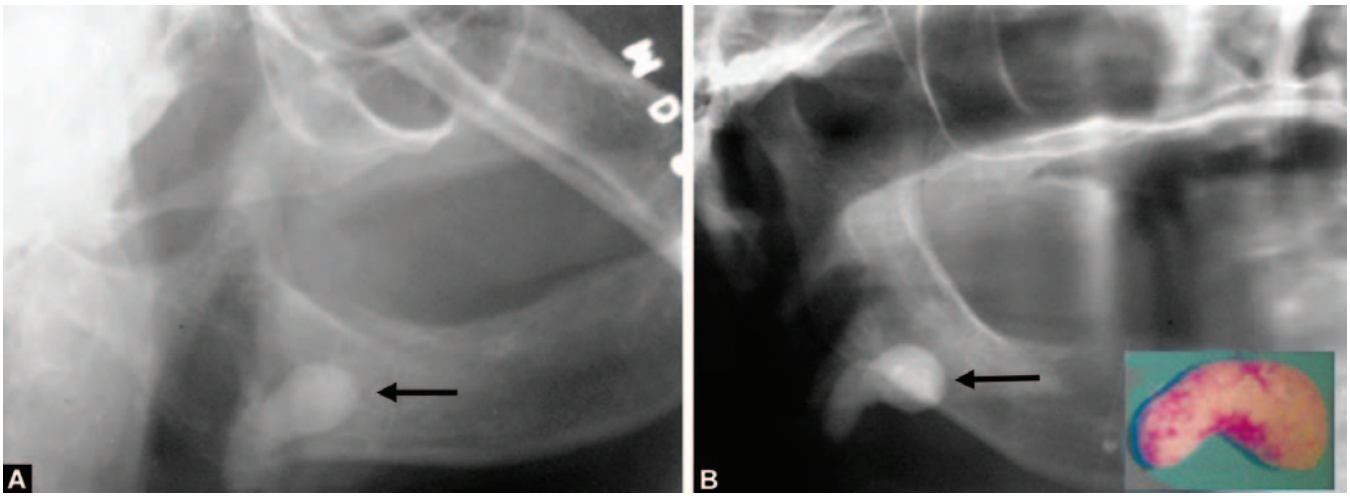
## Interpretation of Periapical X-ray

The radiograph should be carefully examined in a well lit X-ray lobby. The use of a good hand lens will greatly assist the detection of small ancillary roots and the relationship of roots to the inferior alveolar canal.

The following factors are considered while interpreting the radiograph:

a. Access
b. Position and depth of impacted tooth
c. Root pattern of impacted tooth
d. Shape of crown
e. Texture of investing bone
f. Relation to inferior alveolar canal
g. Position and root pattern of second molar.

***a. Access:*** By noting the inclination of the radio-opaque line cast by the external oblique ridge the ease of




**Figs 6.5A and B:** A 63-year-old lady was referred to the author with a provisional diagnosis of impacted 48 who complained of recurrent pain and swelling of the right side of face with a lateral oblique X-ray of mandible (A) taken by the general dental practitioner (note the dark arrow). Detailed history and findings of clinical examination was suggestive of submandibular calculus. Subsequently an OPG (B) was taken which showed a change in position of the opaque mass which confirmed the final diagnosis of salivary calculus. The calculus was removed (see the inset picture in figure 'B') under general anesthesia by a submandibular approach

access can be determined. If this line is vertical the access is poor and if horizontal, access is good.

***b. Position and depth of impacted tooth:*** This is determined by a method described by George Winter. In this technique three imaginary lines are drawn on the radiograph. These lines are described as 'white', 'amber' and 'red' lines (Figs 6.6 to 6.10).

The first line or 'white' line is drawn along the occlusal surface of the erupted mandibular molars and extended posteriorly over the third molar region. From this the axial inclination or position of impacted tooth can be assessed. For example, the 'white' line will be parallel to the occlusal surface of a vertically impacted tooth. While in case of a disto-angular impaction, the occlusal surface of the tooth and 'white' line are seen to converge as if to meet in front of the third molar.

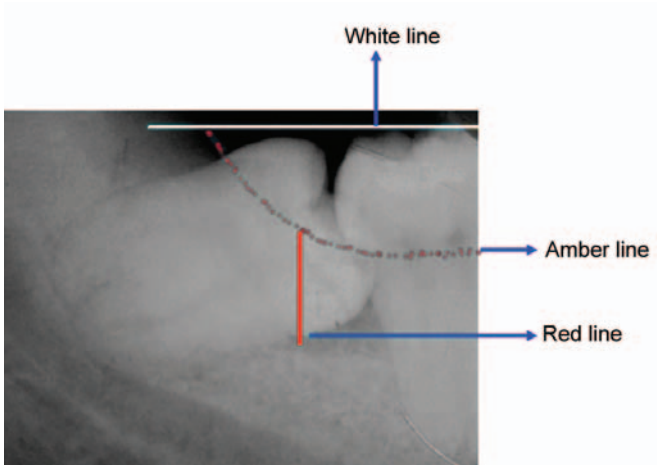



**Fig. 6.6:** White, amber and red lines (Winter's WAR lines) marked in the periapical X-ray

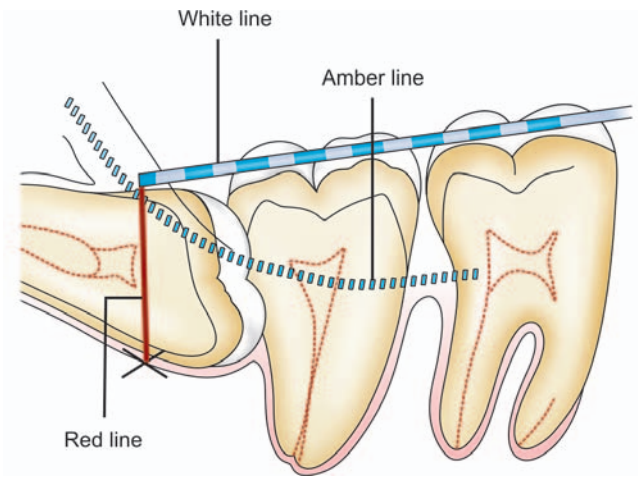



**Fig. 6.7:** Tracing of 'WAR' lines on a horizontally impacted mandibular third molar. 'White' line is drawn along the occlusal surface of the erupted mandibular molars and extended posteriorly over the third molar region. 'Amber' line is drawn from the surface of the bone lying distal to the third molar to the crest of the interdental septum between the first and second molar. 'Red'line is a perpendicular dropped from the 'amber' line to an imaginary 'point of application' of an elevator

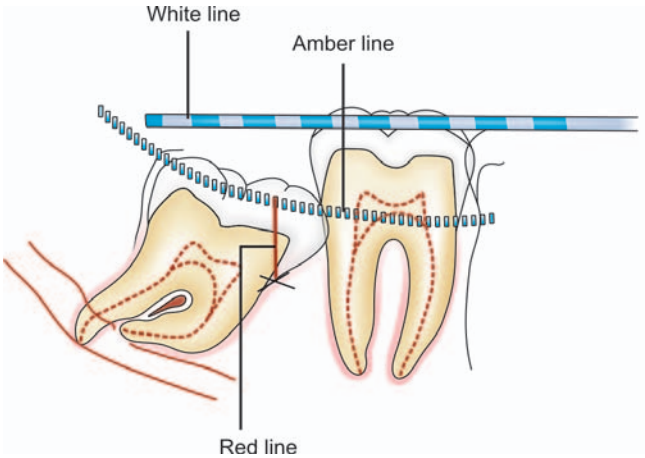



**Fig. 6.8:** 'WAR' lines drawn on a mesioangularly impacted mandibular third molar

The second imaginary line or 'amber' line is drawn from the surface of the bone lying distal to the third molar to the crest of the interdental septum between the first and second molar. When drawing this line it is important

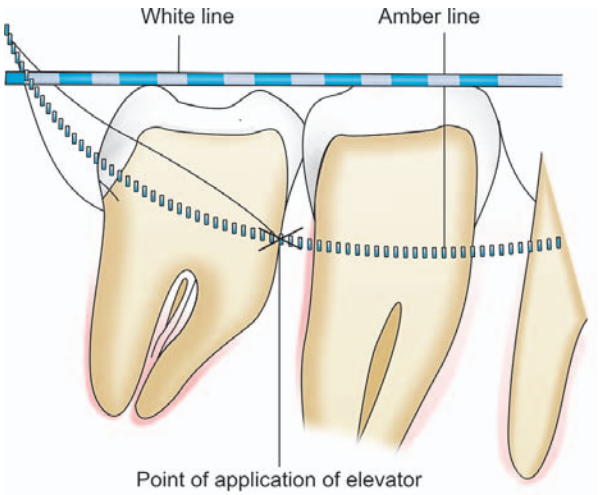



**Fig. 6.9:** 'WAR' lines drawn on a vertically impacted mandibular third molar. Note that there is no 'red' line drawn. The point of application of elevator (marked X in red colour) is at the same level of 'amber' line at the mesial aspect of the third molar

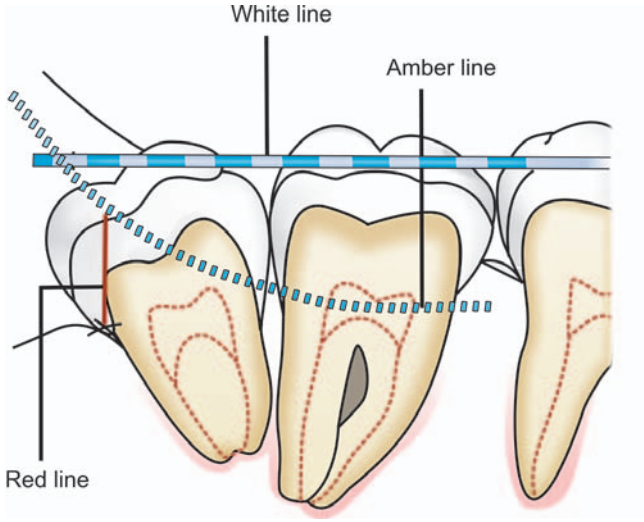



**Fig. 6.10:** 'WAR' lines drawn on a distoangularly impacted mandibular third molar. Note that in distoangular impactions the perpendicular 'red' line should be dropped to the cemento-enamel junction on the distal side of the impacted tooth and not on the mesial side as in other angulations

to differentiate between the shadow cast by the external oblique ridge and that cast by the bone lying distal to the tooth. It is important to note that the posterior end of the 'amber' line is drawn on the shadow cast by the bone in the retromolar fossa and not that cast by the external oblique ridge which lies above and in front of it. The 'amber' line indicates the margin of the alveolar bone enclosing the tooth. Hence, when soft tissues are reflected, only that portion of the tooth shown on the film to be lying above and in front of the 'amber' line will be visible; while the reminder of the tooth will be encased within the alveolar bone.

The third line or 'red' line is used to measure the depth at which the impacted tooth lies within the mandible. It is a perpendicular dropped from the 'amber' line to an imaginary 'point of application' of an elevator. With the exception of disto-angular impaction, the cemento-enamel junction on the mesial surface of the impacted tooth is used for this purpose. In a deeply impacted tooth, the 'red' line will be longer and more difficult will be the surgical procedure. It has been noted that for every 1 mm increase in the length of 'red' line, extraction becomes about three times more difficult. As a general rule, any tooth with a 'red' line 5 mm or more is better removed under general anesthesia. If the 'red' line is 9 mm or more, the inferior surface of the crown of the impacted third molar will be either at the level or below the apex of the second molar. In such cases bone removal has to be done with great caution to avoid accidental fracture of mandible.

When assessing the depth of disto-angular impactions, the perpendicular 'red' line should be dropped to the cemento-enamel junction on the distal side of the impacted tooth (Fig. 6.10) and not on the mesial side as in other angulations. Use of cemento-enamel junction on the mesial side of the impacted tooth for this purpose will give a misleading estimation of depth.

**Significance of disto-angular impaction:** One of the serious mistakes made by dental surgeons embarking on surgical removal is to misdiagnose a disto-angular impaction as a vertical impaction. This is because clinically many disto-angular impactions give a false picture of vertical impaction to a casual observer. While many vertical impactions can be removed using a straight elevator applied to the mesial surface of the tooth, application of such a force to a disto -angular impaction, the bone lying distal to the tooth will prevent its removal. Further application of excessive force will cause fracture of mandible. Hence for the removal of such tooth it is essential that adequate space is created distal to the tooth into which the tooth is displaced before elevation is attempted. This serious error can be avoided by noting the following points during the interpretation of periapical X-ray:

- In a vertical impaction, the anteroposterior width of the interdental septum between the second and third molar is same as that of the width of the septum between the first and second molar. While in case of a disto-angular impaction (Fig. 6.11) the interdental septum between the second and third molar is much narrower (yellow arrow) than that between the first and second molar (blue arrow)

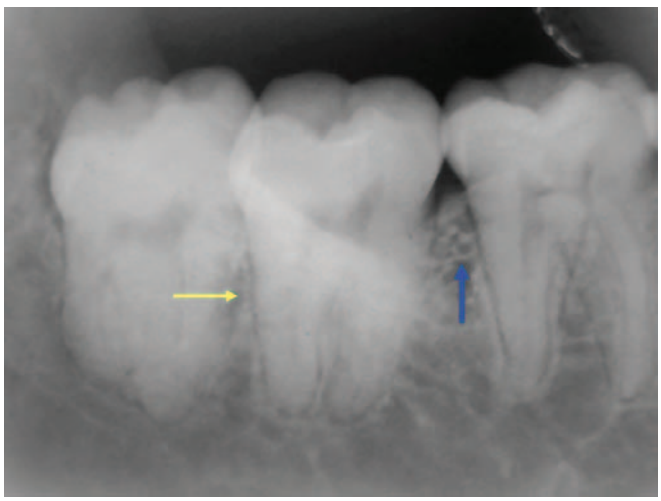


**Fig. 6.11:** Periapical radiograph showing distoangularly impacted 48. See text for explanation

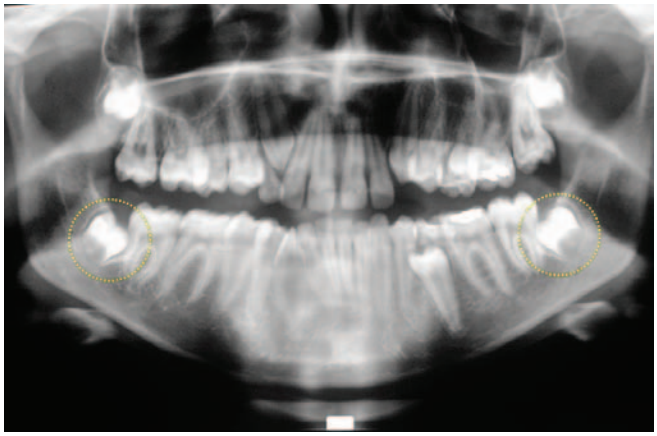


**Fig. 6.12:** OPG 38 and 48 with limited root development (yellow circle). See text for explanation.

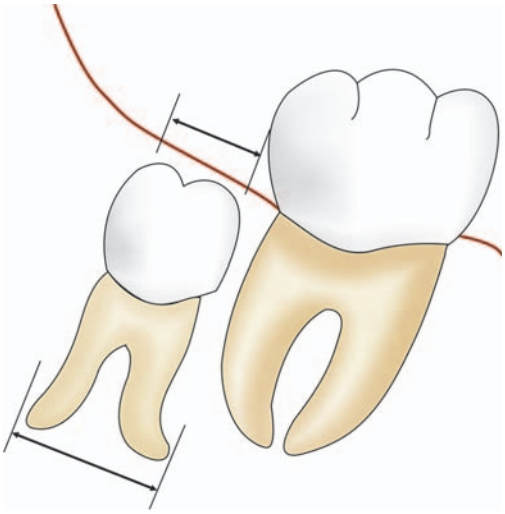


**Fig. 6.13:** If the mesiodistal diameter of the roots is greater than the mesiodistal diameter of the crown; the roots must be sectioned before removal

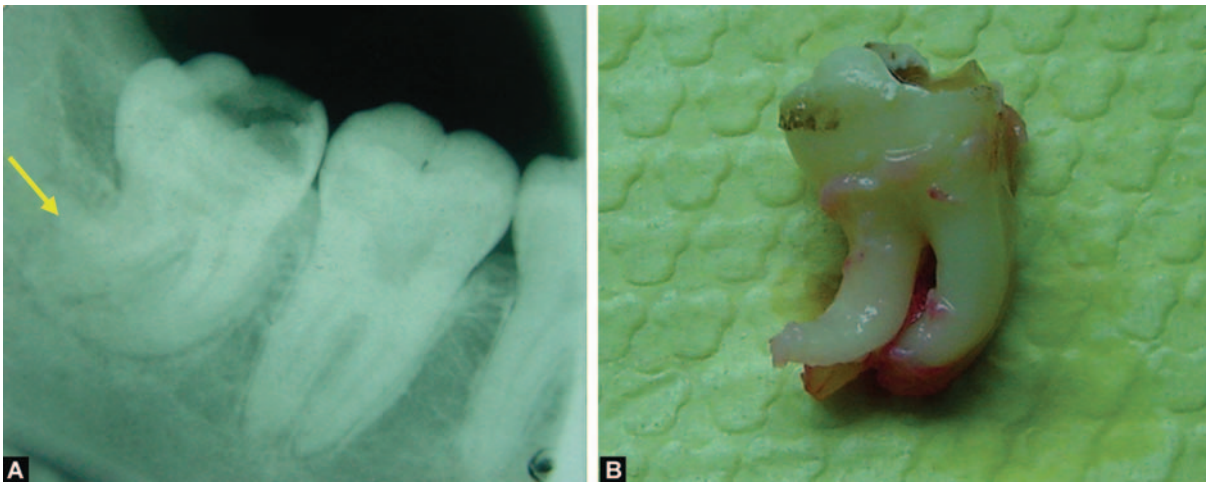
- Moreover as stated above, in case of a disto-angular impaction, the occlusal surface of the tooth and 'white' line are seen to converge as if to meet in front of the third molar.

***c. Root pattern of impacted tooth:*** The number, shape and curvature of roots are noted. The presence of hypercementosis if any is determined. Root often appears blunt and short when the apical portion of root takes a sharp bend in the direction of X-ray beam. Such finding calls for more meticulous examination of the film.

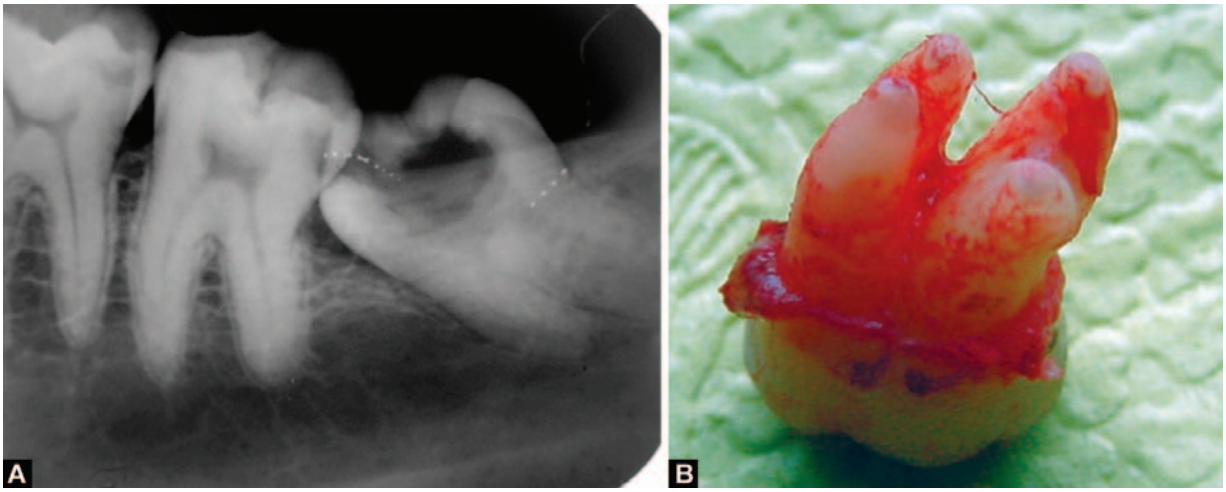
Root morphology influences the degree of difficulty for removal of an impacted third molar. Limited root development leads to a "rolling" tooth, which can be difficult to remove (Fig. 6.12).

Such teeth are sectioned in multiple planes before attempting removal. A tooth with one-third to two-thirds root development is easier to remove than a tooth with full root development. Such teeth typically have a wide periodontal ligament, and ample space exists between the roots and the inferior alveolar nerve (IAN). Similarly, third molars with conical and fused roots are easier to remove than third molars with widely separated and distinct roots. Roots with severe curvature, however, are more difficult to remove than less curved or straight roots. Roots that curve in the same direction as the pathway of removal break less often than roots that curve in a direction opposite to the pathway of removal. Roots with a mesiodistal diameter that is greater than the tooth diameter at the cervical line must be sectioned longitudinally before removal (Fig. 6.13).

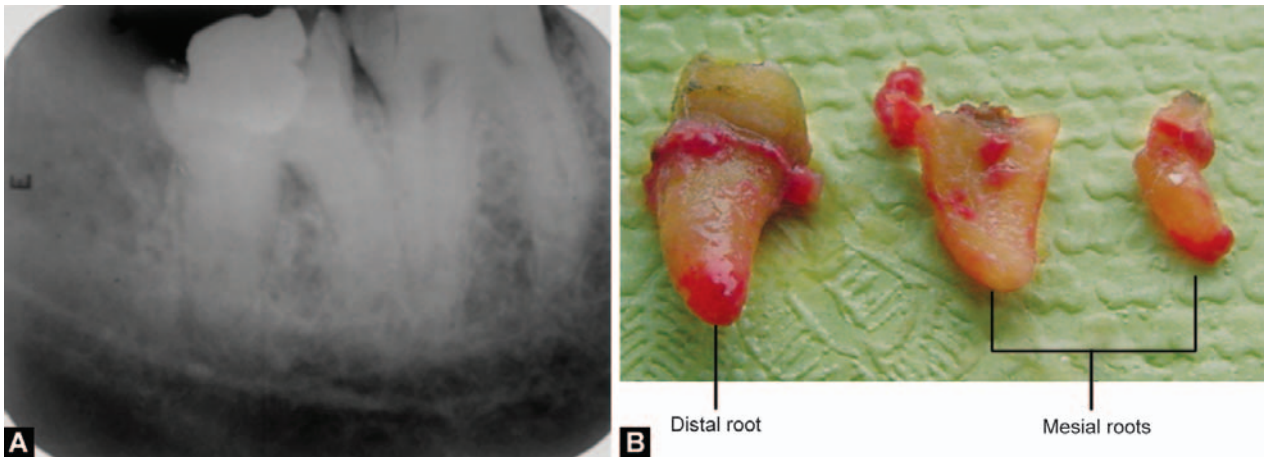
The presence of multiple roots may not be visible in radiographs as the lingual roots will be overlapped by the buccal roots (Figs 6.14 A and B to 6.17 A and B)



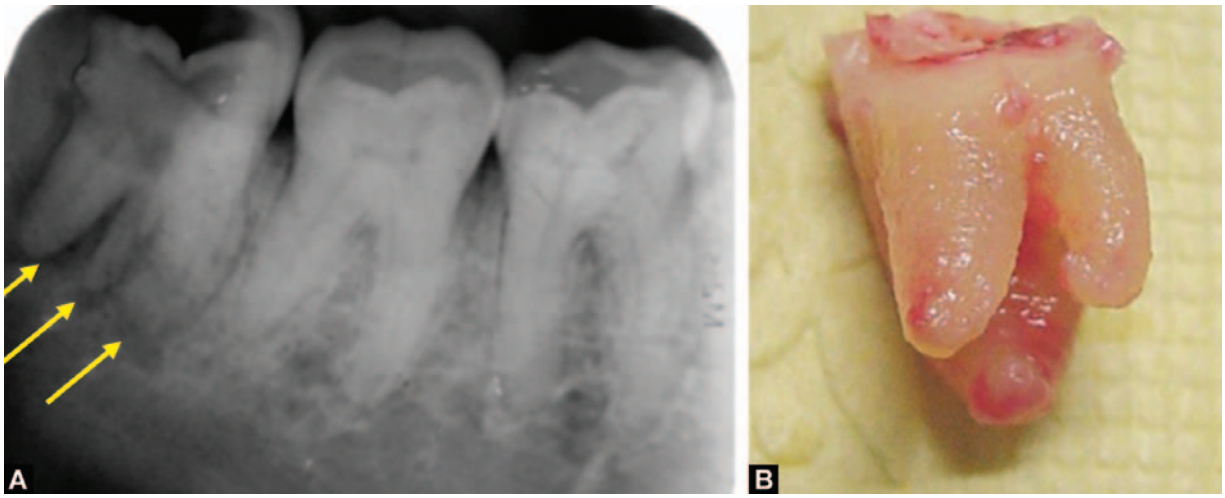

**Figs 6.14 A and B:** (A) Periapical X-ray showing curved distal roots of 48, (B) Specimen showing two distal roots



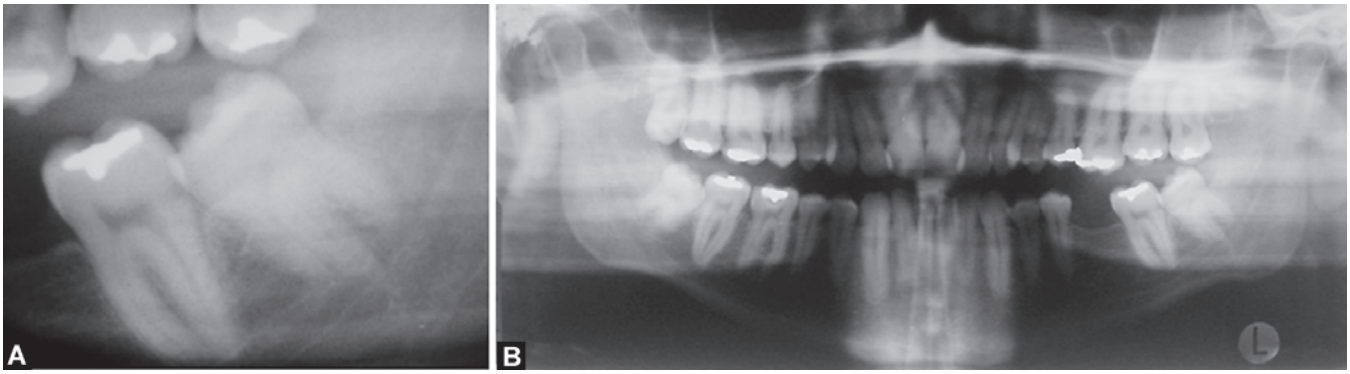

**Figs 6.15 A and B:** (A) Periapical X-ray of an 18-year-old man showing impacted 38. Even though the X-ray is of good quality, only one mesial and one distal root is visible, (B) Surgical removal of tooth was difficult and the extracted tooth showed four roots




**Figs 6.16 A and B:** (A) Periapical X-ray of 42-year-old man showing impacted 48. Even though the X-ray is of good quality, only one mesial and one distal root is visible, (B) Surgical removal of tooth was difficult and the roots were removed separately




**Figs 6.17 A and B:** Periapical X-ray clearly showing 3 roots for 48, (B) Extracted specimen showing 3 roots




**Figs 6.18A and B:** (A) Periapical X-ray showing 3 roots for 38, (B) OPG shows 3 roots for 48 also

However, depending on the location of multiple roots and the change in angulation of central ray, presence of multiple roots can be identified (Figs 6.18 A and B).

The X-ray should be carefully examined for hypercementosis or ankylosis of the roots (Figs 6.19 A and B)

***d. Shape of crown*:** Teeth with large square crowns and prominent cusps are more difficult to remove than teeth with small crowns and flat cusps. The size and shape of the crown of third molar acquire importance when the 'line of withdrawal' of the tooth is obstructed by the crown of the second molar, a condition referred to as 'tooth impaction' or 'locking of the crown' (Fig. 6.20).

In such a case the radiograph will show that the cusp of third molar is superimposed upon the distal surface of second molar. Application of force to the mesial surface of impacted tooth in an attempt to elevate it will either displace the second molar from its socket or damage its supporting structure or may fracture the mandible. This misfortune is most likely to occur when the second molar has a conical root. It can be avoided by sectioning of impacted tooth.

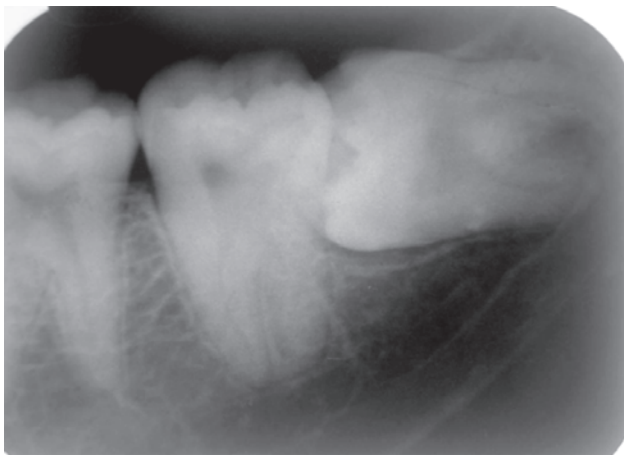
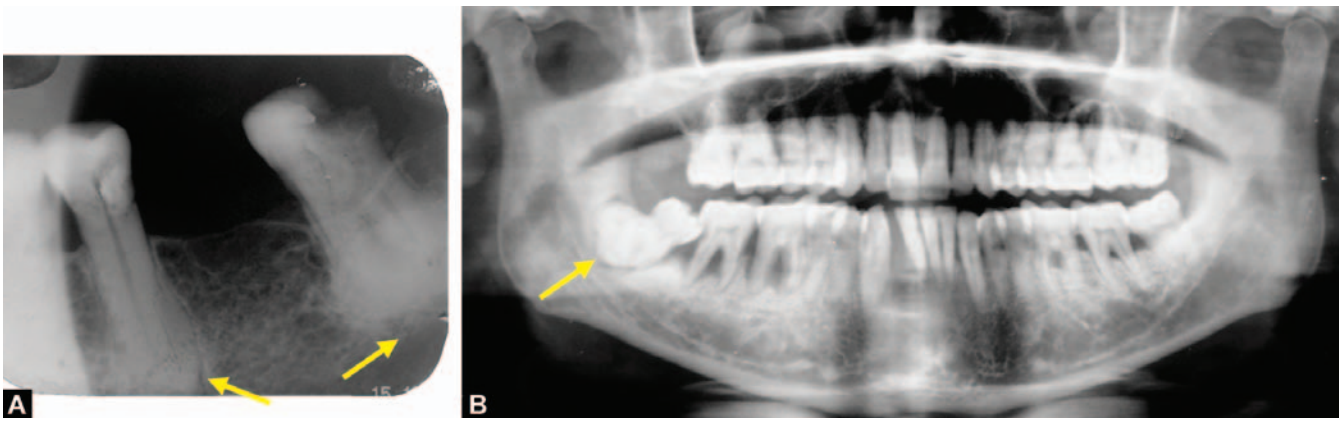


**Fig. 6.20:** 'Locking of the crown' of impacted tooth by the second molar. Note that the cusp of third molar is superimposed upon the distal surface of second molar

Rarely impacted mandibular third molar can cause resorption of the root of the second molar. This can be distinguished from 'tooth impaction' by the presence of a break in the continuity of the shadow cast by the distal surface of the second molar root.




**Figs 6.19A and B:** (A) Hypercementosis of 35 and 37 (note yellow arrows), (B) Hypercementosis of impacted 48 (yellow arrow)

***e. Texture of the investing bone:*** With advancing age the bone tends to become more sclerosed and less elastic. For accurate determination of the bone texture a rigid standardization of exposure and developing technique is mandatory. Very often this is not practical. However some clue regarding the texture of bone can be obtained by noting the size of the cancellous spaces and the density of the bone structure. If the spaces are large and the bone structure is fine, the bone is generally elastic. On the other hand, if the spaces are small and the bone structure dense, the bone is more sclerotic. The more dense the bone, the less the degree of bony expansion during luxation and more time required for its removal with a bur.

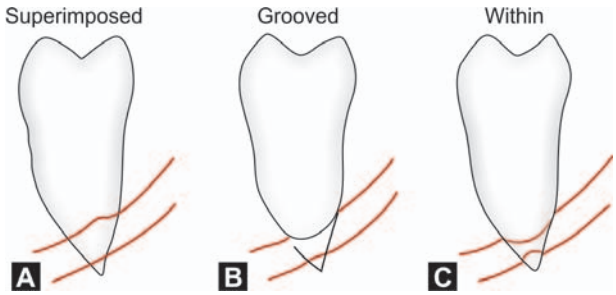
***f. Inferior alveolar canal:*** This structure is frequently seen to be crossing the roots of the third molar. Very often such an appearance is due to radiographic superimposition. But occasionally it can also be due to grooving or perforation of the root. This can be distinguished by noting whether certain signs are present or not.

1. A band of reduced radio-opacity crossing the roots and coinciding with the outline of the inferior alveolar canal indicates that the tooth root is grooved by the inferior alveolar canal. This sign is most likely due to decreased amount of tooth structure between the X-ray source and the film.
2. The compact bone forming the roof and floor of the canal is represented on the radiograph by parallel lines of radio-opacity. Break in the continuity of one or both of these lines is seen when the root is grooved by the inferior alveolar canal. Grooves are usually located on the lingual side of the roots.
3. In cases where the radiolucent band crosses the apex of the root and if only the upper white line is broken, a notching of the root is present.
4. Characteristic narrowing of the radiolucent band with loss of white lines is suggestive of perforation of the root by the inferior alveolar canal.

The following signs have been demonstrated to be associated with a significantly increased risk of nerve injury during third molar surgery (Fig. 6.21):

- Diversion of the inferior dental canal (IDC)
- Darkening of the root where crossed by the canal
- Interruption of the white lines of the canal.

In the presence of any of the above findings, great care should be taken in surgical exploration and the decision to treat is carefully reviewed. If on the initial panoramic radiograph there is a suggestion of a relationship between the roots of the lower third molar, and the IDC, a second radiograph should be taken using different projection geometry.




**Figs 6.21A to C:** Radiographic relationship of third molar root to inferior alveolar nerve: (A) Cortical outline of the canal is intact. This probably represents superimposition only. (B) There is loss of cortical outline of the nerve canal. The nerve may be grooving the tooth. (C) There is loss of cortical outline as well as narrowing and deviation of the nerve canal, denoting an intimate relationship of the nerve with the tooth and possibly perforation of the tooth root by the nerve

If the third molar is found to be in close relationship with the inferior alveolar canal, the patient should be warned in advance regarding the possibility of impairment of labial sensation following the surgical removal of tooth. Mention should be made regarding this in the case record. In such cases every effort should be made to avoid damage to the neurovascular bundle during surgery. For example if the grooving is on the lingual side of the tooth, generous amount of bone is removed on the buccal side and the tooth delivered through the resultant defect. While in cases of apical notching (frequently associated with mesio-angular and disto-angular impactions) tooth division using bur is done to avoid nerve damage. In cases where the root is perforated by the neurovascular bundle, the site is adequately exposed by the removal of buccal plate of bone. The root is then carefully sectioned using a bur at the level of the neurovascular bundle and the root fragments are then removed.

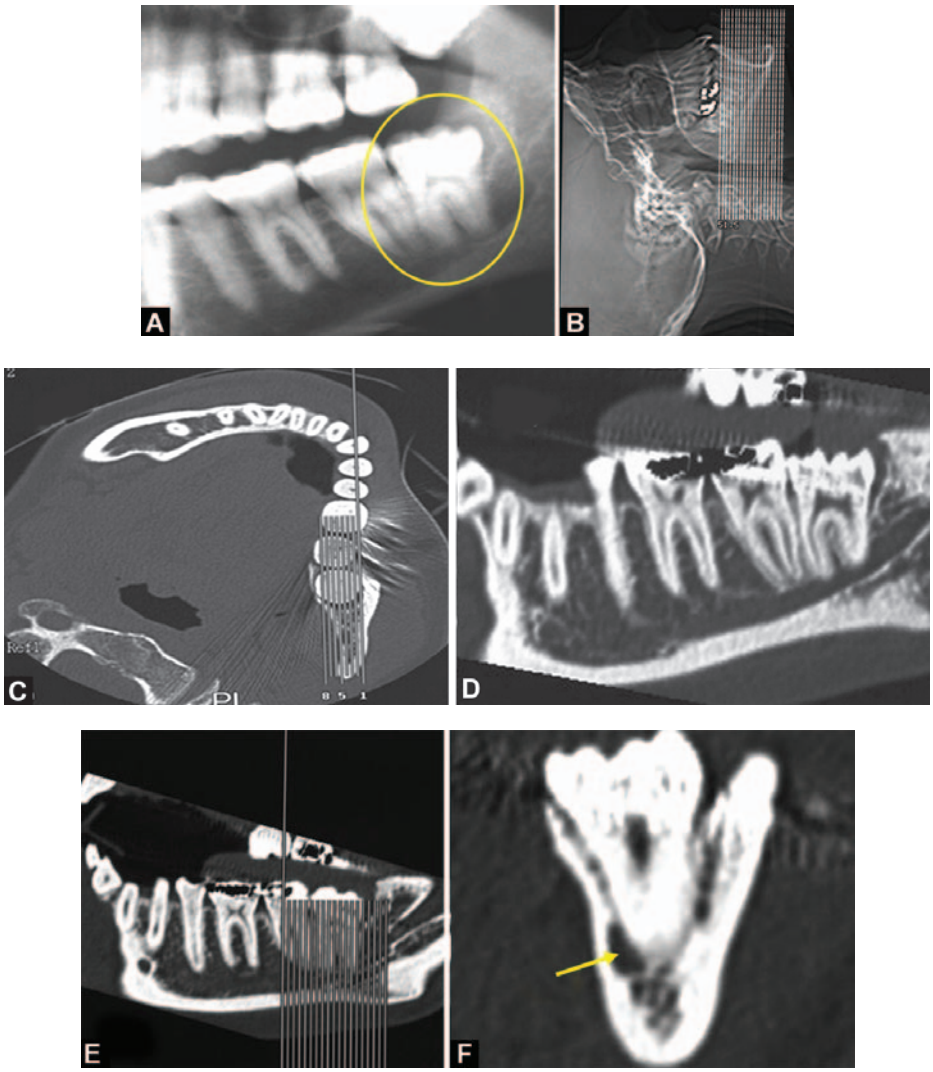
In difficult cases where it is not possible to maintain the continuity of the neurovascular bundle it may be sectioned using a BP blade. When this is attempted adequate precaution should be taken to control the brisk hemorrhage that follows sectioning. It is always preferable to do a nerve anastomosis by suturing the cut ends to facilitate nerve regeneration. Another alternative is that, the cut ends may be placed in close approximation in the bottom of the socket without suturing. Usually sensation of lower lip will be regained within six months to one year after surgery.

***g. Position, root pattern and nature of crown of second molar:*** The space between the distal surface of the second molar and the mesial surface of the impacted third molar has an impact on the ease of removal of the third molar. The closer the third molar is to the second molar, the more difficult the surgery becomes. A distal tilt of the long axis of the second molar may create difficulty in the surgical removal of impacted mandibular third molar. Moreover, if the second molar has a single conical root it can be easily displaced by an elevator applied to the mesial surface of the impacted third molar tooth. This is especially likely to occur if the first molar is missing.

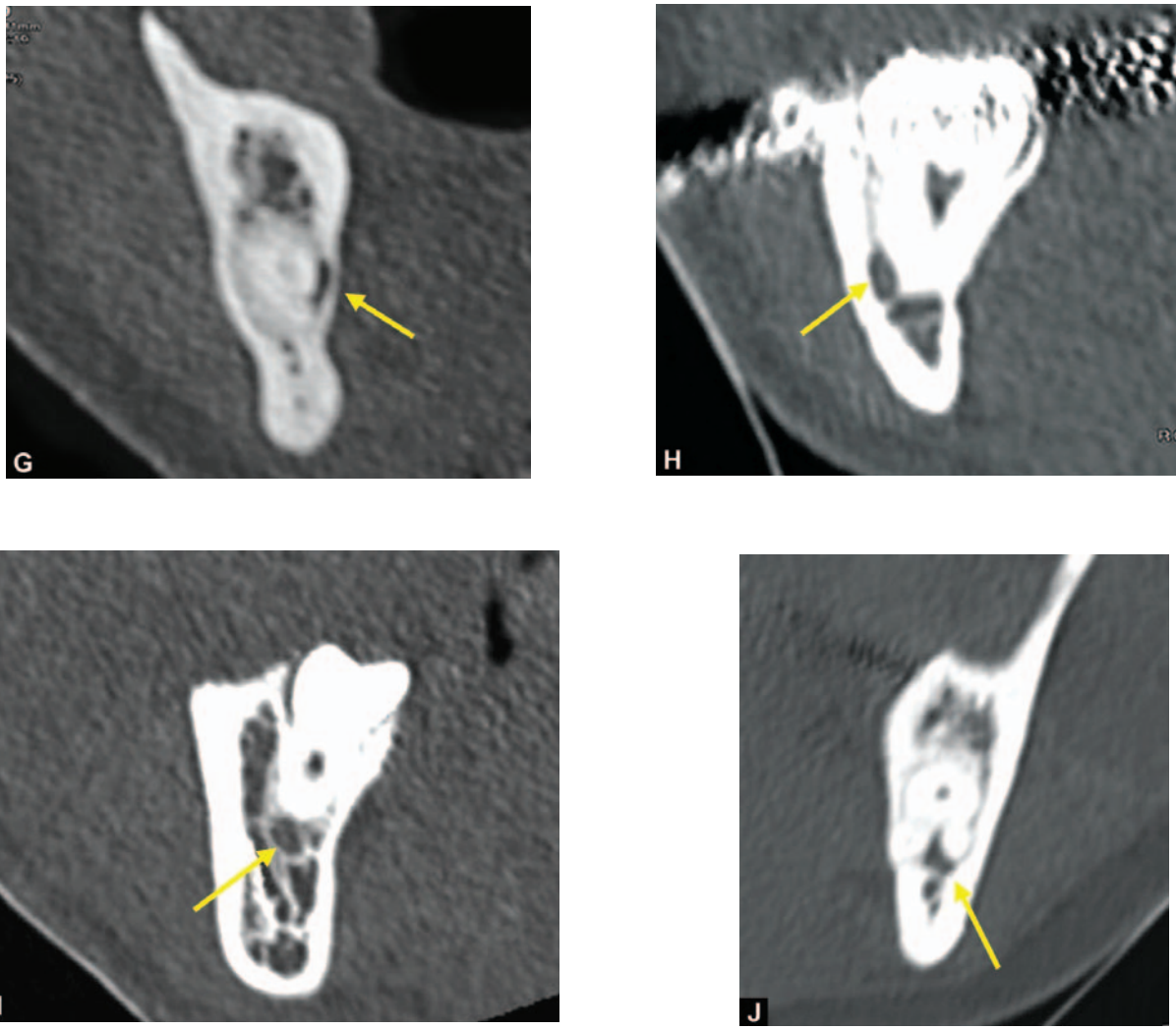
Large restorations, crown and root canal therapy in second molar teeth also pose additional risk of damage to second molar if elevation forces or direction of drilling are misdirected. Instances in which full crowns or large restorations exist in the tooth adjacent to impacted third molar, informed consent should be obtained regarding possible damage to the adjacent tooth.

## CT Evaluation (Figs 6.22A to J and 6.23A to H)

Both the conventional imaging modalities i.e. periapical radiographs and rotational panoramic radiographs have




**Figs 6.22A to F:** Shows the steps in generating reformatted CT image. (A) Panoramic radiograph showing the 3 M, (B) CT scout image with planning slices, (C) Panoramic radiograph showing the 3 M, (D) Reformatted sagittal image of 3M, (E) Reformatted sagittal image used to plan cross-sectional imaging, (F) Reformatted cross-sectional image showing the inferior dental canal in relation to 3M (Adapted with kind permission from Mahasantipiya et al. Narrowing of the inferior dental canal in relation to the lower third molars. Dentomaxillofacial Radiology. 2005; 34: 154-163)



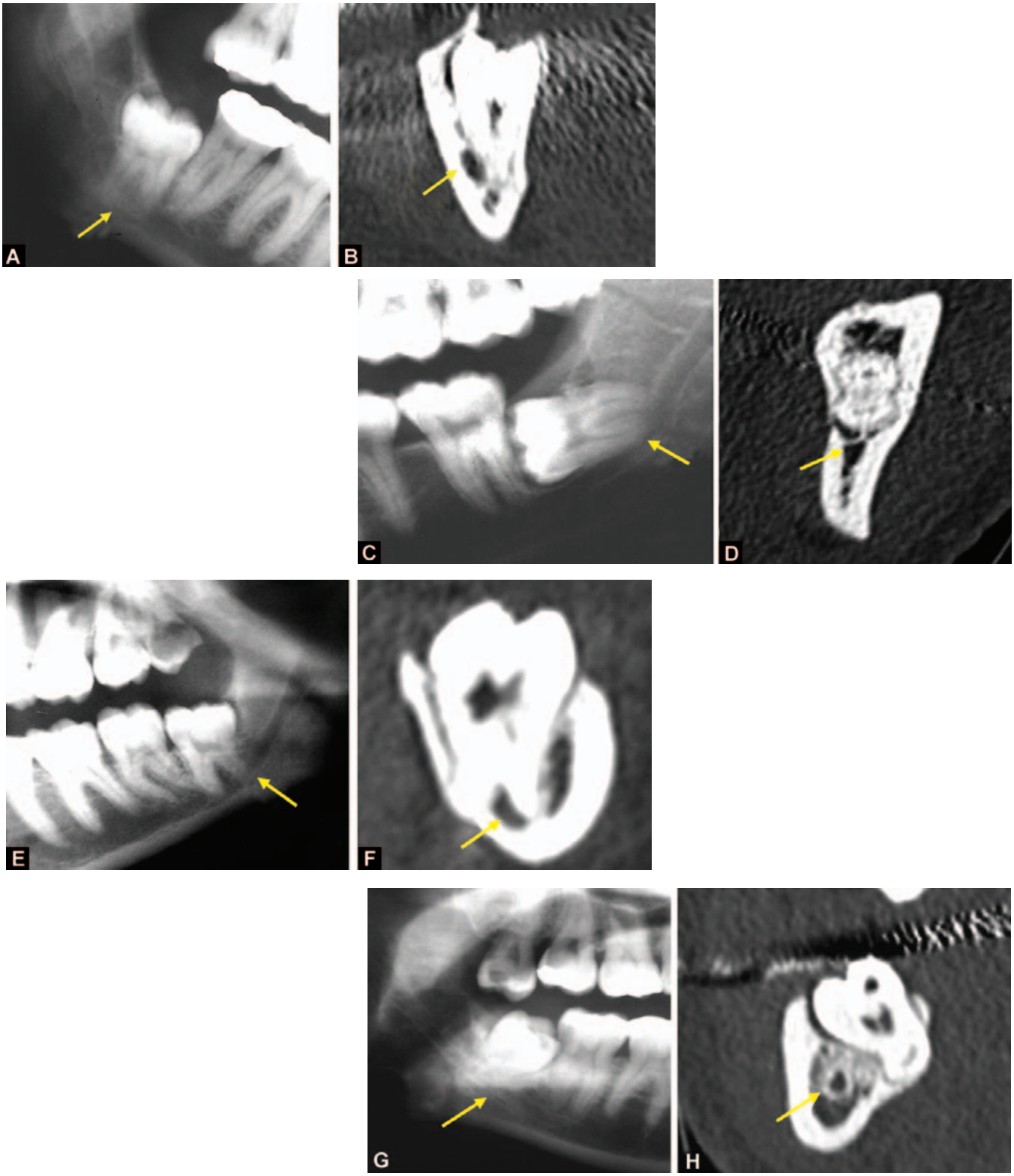

**Figs 6.22G to J:** Reformatted CT images showing various relationships between the inferior dental canal and the lower third molar roots. (G) Lingual positioning and narrowing of the canal and thinning of the adjacent cortex, (H) Buccal positioning and minor thining of the adjacent cortex, (I) Inferior positioning of the canal without narrowing, (J) The canal between the roots and with narrowing (Adapted with kind permission from Mahasantipiya et al. Narrowing of the inferior dental canal in relation to the lower third molars Dentomaxillofacial Radiology. 2005; 34: 154-163)

their limitations; but perhaps the greatest limitation is the lack of three-dimensional information provided. Even though OPG offers a speedy, relatively inexpensive radiograph of the jaws it has the following disadvantages:

- Does not provide a coronal view of the third molar area.
- Does not show the relationship of the root apices to the inferior alveolar canal in all planes of space.
- Does not provide predictable evidence of bone density.

The judicious use of CT scan provides valuable information on the above aspects.

Because of the limitations of conventional imaging when assessing the relationship between the inferior dental canal (IDC) and the lower third molar roots, the use of computed tomography (CT) is increasing. The advent of multislice CT scanners has greatly enhanced the capability of CT to demonstrate the location and morphology of the inferior dental canal. Multislice




**Figs 6.23A to H:** Compares the radiographic markers on panoramic radiographs with the corresponding cross-sectional CT image. (Adapted with kind permission from Mahasantipiya et al. Narrowing of the inferior dental canal in relation to the lower third molars. Dentomaxillofacial Radiology. 2005; 34: 154-163)

scanners are much faster than conventional CT scanners and the reformatted images are as sharp as the directly acquired images. Consequently, there has been a significant increase in the number of cases being referred for pre-surgical evaluation of the relationship between the inferior dental canal and the lower third molar roots. Over the past few years, with the increased use of CT to assess the inferior dental canal in cases of impacted third molars, it has been noted that (Mahasantipiya et al, 2005)[1] in a relatively large number of cases, the inferior dental canal appears to be compressed between the roots of the adjacent third molar and the lingual or buccal cortex. It has also been noted that if there is apparent canal compression there appears to be an intimate relationship between the roots and the cortex. Furthermore, in a number of cases, there is thinning of the buccal or lingual cortex because the canal lies partly within the cortical plate. All cases of impacted lower third molars demonstrating a close relationship between the canal and at least one lower third molar on a panoramic radiograph are ideal cases for CT evaluation. However, CT evaluation should not be done indiscriminately.

## Steps in CT Evaluation (Mahasantipiya, et al 2005)[1]

CT imaging is to be performed using a multislice spiral CT with 0.5 mm axial slices (0.5 mm/0.5 s of table feed and 0.5 mm interval reconstructions) beginning inferior to the body of the mandible and extending superiorly to the middle of the rami. The exposure factors are to be set at 135 kV and 75 mA and a low frequency filter cut-off is to be used in the reconstruction algorithm. Datas are acquired in the axial plane, but reformatted images are generated in the corrected sagittal and coronal planes to best demonstrate the location of the inferior dental canal.

Mahasantipiya et al 2005[1] following their study concluded that CT evaluation is an excellent method for localizing the canal and its relationship to lower third molar roots as reformatted images can be generated through the mandibular body in any plane. Narrowing of the inferior dental canal as shown on CT is very common when the roots of the lower third molars appear in close relation to the canal on panoramic radiographs. On all occasions when there is narrowing of the canal, the canal was in intimate contact with the roots of the adjacent third molar and the buccal or lingual cortex. On numerous occasions there was also thinning of the cortex owing to the canal lying partly within the cortex.

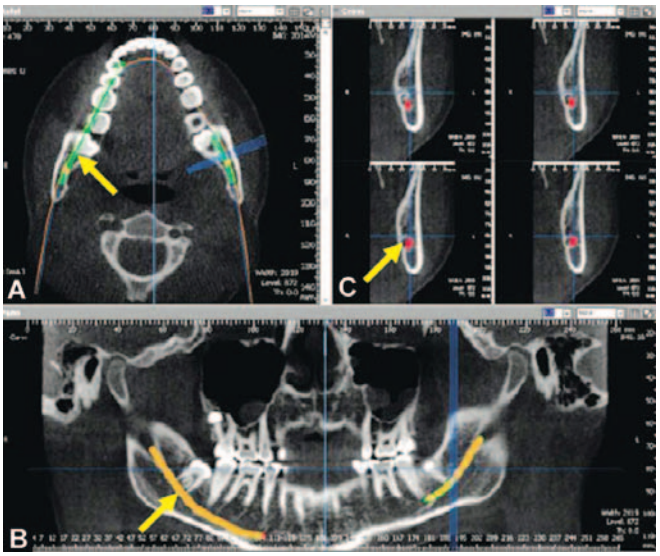
The significance of narrowing of the inferior dental canal as demonstrated on CT is unknown.(Mahasantipiya et al, 2005).[1] Narrowing of the canal may also result in non-specific symptoms in the lower third molar regions in the absence of pericoronitis if the neurovascular bundle is compressed. However, it can be implied that nerve damage is more likely during surgical removal of the third molar when narrowing of the canal is present. Deviation of the canal on a panoramic radiograph is the most reliable predictor when there is narrowing of the canal. When there is superimposition of the canal over the third molar roots or deviation of the canal in relation to the third molar roots a close relationship between the canal and the third molar is very likely.

However, for a number of reasons, including cost and radiation dose, CT is not usually considered the first radiographic technique of choice.

**Cone beam computed tomography (CBCT):** Development of multiplane low dose cone beam CT (3-D imaging systems) specifically for dental use now provides an alternative imaging option (Fig. 6.24).

Using this modality, accurate three-dimensional imaging can be performed to demonstrate the relationship between the roots of the third molar and the inferior alveolar nerve (IAN). The current recommendation is that when the OPG suggests a close relationship between the roots of the lower third molar and IAN, cone beam CT scanning should be advised. The information regarding the distance between the canal and teeth on dental CT scans is useful for predicting the risk of inferior alveolar nerve damage. Danfort et al (2003)[2] reported two cases to compare the role of CBCT to the other imaging

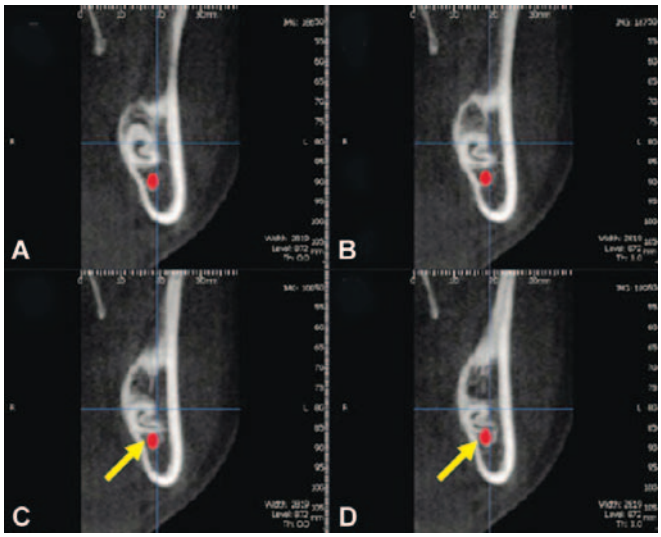
**Fig. 6.24:** CBCT machine




**Figs 6.25A to C:** CBCT images (A) horizontal, (B) parallel, and (C) cross images showing the relationship of IAN (colored and yellow arrows) to third molar roots

options and to illustrate how multiplane visualization can assist the pretreatment evaluation and decision-making process for complex impacted mandibular third molar cases. The computer-assisted imaging provides multiplane viewing and tracking of the mandibular canal through various image planes (Figs 6.25 and 6.26).

Recent articles on the topic reiterate that cone beam CT is significantly superior to panoramic images, in both sensitivity and specificity, in predicting neurovascular bundle exposure during extraction of impacted mandibular third molar teeth. Such quality imaging




**Figs 6.26A to D:** CBCT cross images showing the intimate relationship of IAN during its course (marked red with yellow arrow) to the impacted third molar

capabilities not possible with standard film radiography or tomography are available with CT, but at a higher patient dose and examination fees. The patient effective dose from CBCT is comparatively less than conventional scan and also at a lower expense.

## Advantages of CBCT Scanner over Regular Medical CT Scanner

- X-ray radiation exposure to the patient is 10 times less than a regular CT scanner. It is almost at the same level as 10 panoramic images or at the same level as full mouth series with periapical film.
- Much faster scan time for CBCT. Scan on a CBCT takes 10 to 40 seconds, while on a regular CT scanner it takes a few minutes.
- Cheaper, average price of a CBCT scan could be up to 50% less than a regular medical CT scan.

## Locating the Lingual Nerve

Locating the lingual nerve clinically and by imaging is more problematic. Lingual nerve injury though less common than inferior alveolar nerve (IAN) injury is often more debilitating to the patient. Loss of taste, slurring of speech, lack of sensation of tongue and trauma to tongue are much less tolerated by the patients than the consequences of IAN injury. The anatomic course of the lingual nerve is highly variable. Even the position of the nerve on one side did not have a statistical relationship to the position of the nerve on the opposite side. Unlike the IAN, imaging of the lingual nerve is rarely necessary in the preparation for third molar surgery. Locating the lingual nerve is best done using MRI.

## SUMMARY

A detailed history must be taken, followed by clinical examination and radiological investigations. Radiological evaluation provides information about the third molar and the surrounding structures. If there appears to be a close relationship between the roots of the lower third molar and the inferior dental canal, a second radiograph using different projection geometry should be taken.

The following are the radiographs of choice:

- Intra-oral periapical view
- Orthopantomogram: Radiographic examination of choice when more than one of the third molar teeth requires to be assessed or when there is a pathology associated.
- Oblique lateral view of the mandible.

Computed Tomography (CT scan): CT scan is indicated where there is a complex relationship between the third molar and the inferior dental canal or when there is an associated pathology. However, the benefits have to be weighed against the risks of high radiation exposure.

The following radiographic signs have been associated with an increased risk of inferior dental nerve injury during third molar surgery:

- Diversion of the inferior dental canal
- Darkening of the root where crossed by the canal
- Interruption of the white lines of the canal.

## Preoperative Evaluation of Difficulty of Removal

Various methods have been proposed for the preoperative evaluation of difficulty, but these have often been of limited value. Prediction of operative difficulty before the extraction of impacted third molars allows a design of treatment that minimizes the risk of complications. Both radiological and clinical information must be taken into account. Garc´ýa-Garc´ýa et al (2000)[3] showed that the Pell-Gregory scale(1933)[4] which is widely cited in textbooks of oral surgery, is not reliable for the prediction of operative difficulty. Pederson (1988)[5] proposed a modification of the Pell-Gregory scale that included a third factor, the position of the molar (mesioangular, horizontal, vertical, or distoangular; Table 6.1). The Pederson scale is designed for evaluation of panoramic radiographs.

**Table 6.1:** Criteria and scores of the Pederson scale

| *Criterion* | *Value* |
|---|---|
| **Position of the molar** | |
| Mesioangular | 1 |
| Horizontal | 2 |
| Vertical | 3 |
| Distoangular | 4 |
| **Relative depth** | |
| Class A | 1 |
| Class B | 2 |
| Class C | 3 |
| **Relation with ramus and available space** | |
| Class 1 | 1 |
| Class 2 | 2 |
| Class 3 | 3 |
| **From the table difficulty index can be arrived as follows:** | |
| *Difficulty score* | *Total* |
| Easy | 3-4 |
| Moderate | 5-6 |
| Difficult | 7-10 |

Although the Pederson scale can be used for predicting operative difficulty, it is not widely used because it does not take various relevant factors into account, such as bone density, flexibility of the cheek, and mouth opening. Other more complex preoperative scales such as the WHARFE scale(MacGregor,1985)[6] have been proposed, but in view of their complexity are rarely used in routine practice. Yuasa et al (2002)[7] proposed a new scale that takes into account not only relative depth (the A-C subscale in the Pell-Gregory classification) and relation with the ramus of the mandible (the 1-3 subscale in the Pell-Gregory classification), but also width of the root, considered the most important factor. These authors also point out that curvature of the root is an unpredictable factor, as it is often not visible in radiographs. Hence, scales for the prediction of operative difficulty should take into account the anatomy of the root also. It is possible that the low predictive values of the Pell-Gregory and Pederson scales are attributable to the fact that they do not take this into account.

In a study by Larsen et al (1991) found that the depth of impaction and the type of overlying tissue was the most predictable in determining the length of time for impaction surgery The following factors also complicate the surgical removal:

1. Unfavorable root morphology: Excessive curvature, divergent roots, hypercementosis, proximity to canal- more difficult procedure
2. Locking of the crown beneath second molar
3. Condition of the impacted tooth (Carious or with filling)
4. Condition of second molar- carious or with filling/ crown or any resorption
5. Sclerosis of adjacent bone - makes removal difficult. Chisel should not be used in such cases since the likelihood of fracture mandible to occur is more. Use bur with irrigation. Operating time is prolonged in older age group where bone is sclerosed.
6. Mouth opening: Accessibility is reduced in case of trismus or small oral commissure.
7. Large follicular sac around the crown: Makes procedure easier. Undue increase in the space between the crown of the impacted tooth and surrounding bone indicates cyst formation. The remnant of the follicle, especially if cyst formation has started, should be removed.
8. Width of the periodontal membrane: In patients past middle age the space containing it is much smaller

than in young patients. This makes removal difficult.

9. Existing fracture of the jaw.
10. Local or systemic pathologic conditions
11. Age of the patient: Below 20 years the procedure is easier. This is because of incompletely formed roots, large follicular space, incompletely formed roots separated from inferior alveolar canal and greater elasticity of bone. In young patients the bone texture is usually soft and resilient, but in older adults the bone becomes progressively more dense, hard and brittle. Hence the extraction of a partially erupted / impacted tooth in an elderly adult with sclerotic bone may cause considerable difficulty. While a tooth with adverse root morphology in soft, resilient bone of a young adult can be elevated expeditiously. Added to this is the possibility of medical problems complicating surgery in older patients.

To summarize, the degree of difficulty of surgery is determined by three major factors: (1) Depth of impaction (2) Type of overlying tissues, and (3) Age of the patient

As a general rule, the more difficult and time consuming the surgical procedure is, the more difficult and prolonged is the postoperative recovery period.

Once the preoperative assessment is completed the dental surgeon must decide whether the case can be performed by himself or refer the case to an oral and maxillofacial surgeon in the best interest of the patient. If the dental surgeon plans to perform the surgery himself, the operative plan should be so designed to avoid complications or manage the complications foreseen during the preoperative assessment.

## Assessment of Risk

Risk assessment associated with third molar surgery focuses on potential short term sequela and long-term complication that occurs after surgery. Patients frequently enquire about (a) postoperative pain, (b) when they can return to gainful activity, and (c) other health-related quality-of-life (HRQOL) issues. Postoperative complications such as dry socket, bleeding, nerve injury and sequelae like pain, swelling, trismus should be explained to patients before the operative consent is signed.

Currently patient's demand for knowledge is no longer limited to a description of complications of the surgical procedure. A higher level of understanding is required before consenting to treatment. This is because these are important not only for the patients but also for their family, employers and other patient associated affiliations. For example, patients will need to know what they can expect during recovery, when he/ she will be able to return to gainful activities or work or school.

Similarly risks to the surgeon and surgical team should also be considered.

Hence, it is prudent and necessary to consider risk assessment for surgical removal of third molar for three inter-related constituencies, viz. the patient, the society and the operating team.

## Patient Risk Factors

Surgeons may initially provide patients with an overview of the remote and common intraoperative and postoperative sequelae/complications related to third molar surgery and then stress the heightened risk for the individual patient. It is well known that patients over 40 years have an increased risk in removal of third molars. Female patients reported a longer recovery period. Surgery time of 30 minutes or longer or having all third molars below the occlusal plane was found to prolong the recovery period. Adults who undergo third molar surgery and who miss work due to convalescence impose a greater expense to society than a teenager who is absent from school or a part-time job.

It has been generally observed that for the average, lean, healthy teenager with tissue impaction who has a positive psychosocial makeup and surgeon- friendly head and neck anatomy there is a high likelihood that the surgery will proceed rapidly with minimum post-operative sequelae. On the contrary, for the obese older patient with full bony impaction, dense bone and dilacerated roots intimately related to the inferior alveolar canal is more likely to experience more intraoperative trauma and a protracted postoperative course. Obese patients usually have large tongue and are more likely to have sleep disturbances like obstructive sleep apnea. Such patients frequently suffer from several systemic diseases like hypertension, diabetes that increases the surgical risk. Moreover the increased girth interferes with the chair side positioning of the operative team, poor visibility and compromised surgical access.

Patients in the older age group are more likely to be medically compromised, have prolonged recovery period following surgery, poor recovery from nerve injury and have atrophic mandible which predisposes to jaw fracture.

If a patient is older the odds are increased for prolonged recovery, postoperative complication/ sequela and pain. Female patients with surgery time longer than 20 minutes are likely to experience more post surgical pain.

It is prudent and imperative to inform and advice high-risk patients that they should expect a protracted and painful postoperative period.

## Social Risk Factors

Retaining asymptomatic impacted third molars may increase the risk of periodontitis in susceptible patients with the associated local and systemic complications. Generally, 22% of patients may be at risk for delayed clinical healing after third molar surgery. The effects of protracted postoperative recovery after third molar surgery have an impact on the patient's family life, social life, on the patient's employer and other gainful commercial interactions. Hence, this aspect also should be considered and discussed with the patient at the time of planning surgery.

## Surgical Team Risk Factors

Repetitive physical and mental strain involved in third molar surgery can be deleterious to the operator and to the assistants when accumulated over time. Patient factors such as obesity and difficult surgical access also should be evaluated during the preoperative visit. Communicable diseases of the patient are an additional risk to the operative team.

## Informed Consent

Once fitness for surgery is established, informed consent must be obtained.

Informed consent is the legal embodiment of the concept that the right of a person over his own person is inviolable except under certain conditions. Section 13 of Indian Contract Act defines consent as "the two or more persons are said to consent when they agree upon the same thing in the same sense". The law protects the individual's right to give informed consent by requiring the disclosure of information by the party to whom consent is given. In the case of doctor-patient relationship the onus of disclosure of information lies with the doctor and the right to decide the manner in which his/her body will be treated lies with the patient. So the doctor is duty bound to disclose information as to the risks, which can arise from the treatment of the patient. Risk may be defined as "exposure to a chance of an injury or loss." Medical informed consent law requires the disclosure of risks of and alternatives to suggested medical procedures to enable patients to make knowledgeable decisions about the course of their medical case.

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Consent is an act of reason accompanied with deliberations, the mind weighing as in a balance, the good and bad on each side. The consent that is given must be intelligent and informed and should be given after understanding what is given for and the risks involved. None is allowed to give consent to anything intended to cause his/her death. Currently the courts nearly unanimously treat lack of informed consent as a matter of negligence of the physician to disclose necessary information to patients. As in all other substantive areas of tort law, there must be a causal link between the defendant's failure to disclose the risk and the injury suffered by the plaintiff/patient.

## General Principle

There is more to consent than getting a patient's signature on a consent form. The principle forming the corner stone of informed consent is enunciated by Lord Scarman in the case of Sidaway Vs Board of Governors of Bethlehem Royal Hospital.

- It is a basic concept that an individual of adult years and sound mind has a right to choose what shall happen to his/her body.
- The consent is the informed exercise of a choice and that entails an opportunity to evaluate knowledgeably the options available and the risks attendant on each.
- The doctor must therefore disclose all material risks. What risks is material is determined by the prudent patient test, which determines what a reasonable patient in the position of the patient would attach significance to in coming to a decision on the treatment advice given.

There is however a therapeutic privilege for the doctor to withhold information, which is considered to be to the "psychological detriment" of the patient. It will be advisable not to emotionally disturb or rather upset the patient by explaining all sorts of risks and

complications involved. It is advisable to enjoin the close relatives if needed, and the consent has to be obtained from then also in such situations. There is no requirement in law that every possible complications and side effects should be informed to the patients. However recent court cases show a trend by the judges to require more detailed explanations to be given than earlier.

## Types of Consent

A. Implied Consent: It is a situation where a patient by virtue of his action gives consent. When a patient approaches a dental doctor for tooth extraction, it implies his willingness to get his tooth extracted by the doctor. However, it is always safer to get a written consent showing the position of the tooth to be extracted.

B. Express Consent: Express consent is given when a patient states agreement in clear terms, orally or in writing to a request. A perfectly valid consent may be given orally. However a written consent is preferable as it provides documentary evidence of the agreement. Legal action regarding consent may take place years after the consent was given and it will be difficult to remember the terms of the consent. It is always better to get a written informed consent where any treatment or procedures carry some risk of injury. It also would be advisable to seek written consent in the case of those whom the physician regards as troublesome patient.

C. Blanket Consent: Some hospitals when admitting the patients obtain consents to the effect that they are willing to undergo any type of treatment including surgeries without mentioning any particular procedure. These are known as blanket consents. However, these consents have no legal validity as they do not mention any specific procedure or their complications.

D. Proxy Consent: It is a situation when some other person is responsible for giving consent for a patient who is unable to give the consent. This is so in the case of a legal guardian who is giving the consent on behalf of a minor or a near relative of an unconscious patient. Proxy consent is not legally valid if the patient is a major, is of sound mind and is in a position to give the consent himself/herself.

E. Informed Consent: In medical practice anything beyond the routine would require this type of consent. Here the doctor explains to the patient relevant details regarding the nature of his disease, the diagnostic procedures involved, the course and alternatives to the treatment proposed, risks involved and the prognosis. The relative chance of success or failure is explained so that the patient can take an intelligent decision after attaining a comprehensive view of the situation. Yet in practice things are not that simple. The patient may be in dire need of treatment, but revealing the risks involved—the law of "full disclosure" may frighten him to a refusal. This situation calls for the common sense and discretion of the doctor. What should not be revealed may at times be a problem. In such situation "Therapeutic privilege" is an exception to the rule of "full disclosure". The doctor may in confidence, consult his colleagues to establish that the patient is emotionally disturbed. Apart from this, it is good for the doctor to reveal all risks involved, in confidence to one of the close relatives and involve them in decision-making. Informed consent has now become a must in all operation, anesthetic procedures, complicated therapeutic procedures and any procedures, which carry some risk. In the years to come, with the great advances in science and awareness of people regarding their rights with respect to treatment and consent, the importance of informed consent will increase only.

In an informed consent the doctor explains to the patient regarding the nature of his disease, the diagnostic procedures involved, the course and alternatives to the treatment proposed, risks involved and the prognosis.

## Obtaining Consent

Whichever consent is obtained, whether express or implied, oral or written, the paramount consideration is that care should be taken to explain the intention, nature and purpose of what is proposed so that the party signing it truly comprehends what is involved when his/her agreement is sought. It would not be realistic to insist upon a written request for all examination and procedures and common sense is required in deciding whether the consent should be evidenced in writing. It is prudent to seek written consent for procedures involving general anesthesia and surgeries and for more complex and hazardous procedures and in any procedures which carry some risk. It is advisable to make the person who is giving the consent to write in his own handwriting so that the validity of the consent cannot be questioned later on. In many cases consent is really too important a topic to be delegated to junior staff or others since it often calls for careful clinical judgment and explanation.

Where two or more procedures are planned it is necessary to have consent for each. Sometimes when the procedures which was envisaged was amended, some

hospital staff have the habit of crossing the original description and adding the amended procedure without getting it re-signed by the person giving the consent. This consent has no validity. If a change is made to a planned procedure, it must be explained to the patient and a new form should be completed, signed and witnessed. Never get blanket consents from the patient.

It is advisable to make the person who is giving the consent to write in his own handwriting so that the validity of the consent cannot be questioned later on.

To conclude, a proper informed consent is a must for every procedure which carries some risk. Many cases have been lost by the doctors in various judicial forums due to failure to get a proper informed consent even though there is no fall in the professional standard of care given by them. The courts in UK, US, and India have failed to enunciate clear limits as to the level of disclosure of information that would constitute informed consent. It can be concluded that no physician can absolutely avoid liability under the informed consent laws unless he or she discloses every known risks and alternatives to every patient.

Summary of risk factors in mandibular third molar surgery:

The following risk factors have been shown to influence the occurrence of postoperative complications following third molar surgery:

- **Age**

Patients above 25 years of age show significant increase in postoperative complications

Older patients tend to report more intense post-operative pain and are at higher risk of extended operation time.

- **Gender**

Female patients appear to be more prone to post-operative complications such as pain and dry socket especially women on oral contraceptives.

- **Pre-existing pathology**

There is a significant increase in postoperative complications if there are signs of pericoronal inflammation or infection of the impacted teeth prior to surgery.

- **Depth of impaction and position**

Deeply embedded teeth that require removal of bone show higher incidence of postoperative complications. The position of the impacted teeth relative to the inferior dental nerve has a significant influence on the post-surgical nerve dysesthesia or paresthesia. Possibility for lingual nerve dysesthesia is greater when the impacted tooth is lingually angulated.

- **Oral hygiene**

Patients with poor oral hygiene preoperatively have higher pain level postoperatively.

- **Choice of Anesthesia**

Local anesthesia carries less risk and is associated with less patient stress. Postoperative complication rate following third molar surgery ranges from 8.2% (general anesthesia) to 12.6% (local anesthesia). While removal of third molar under general anesthesia shows greater incidence of nerve injury, no link has been established between the choice of anesthesia and nerve damage during lower third molar removal. The incidence of lingual dysesthesia is greater when the surgery is performed under general anesthesia.

- **Experience of the operator**

Experienced surgeons are able to predict the difficulty of surgery and the factors that could delay postoperative recovery.

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CHAPTER

# 7 Instrument Tray Set-up

The instruments used for surgical removal of impacted teeth are essentially a combination of instruments used for transalveolar extraction and soft tissue surgery in the mouth. There are only a few special instruments that are required. Very often the selection of instruments is a matter of personal preference. The following description of instruments and equipment is intended for the guidance of the dental surgeon who is new in the field, since an experienced person will have his own concept of an instrument tray set-up. It is essential that the bare minimum instruments are used depending on the case with provision to meet exigencies. This is because a large collection of unfamiliar instruments and an elaborate tray set-up will cause embarrassment for both the patient as well the operator and interfere with efficient progress of the surgery. The instrument tray set-up can be considered under the following headings:

1. Local anesthesia
2. Instruments to incise mucoperiosteum
3. Instruments to reflect mucoperiosteum
4. Instruments to retract mucoperiosteal flap
5. Bone cutting/tooth division instruments
6. Instruments for irrigation and suction
7. Instruments for removal of tooth and debridement of surgical site
8. Instruments for closure of mucoperiosteal flap
9. Other equipment

***1. Local anesthesia:*** Local anesthetic containing vasoconstrictor (e.g. lignocaine 2% with adrenalin) ensures adequate analgesia as well as reduces bleeding. Moreover, it helps in defining tissue planes. Whether to use local anesthetic available in vials or in cartridges is a matter of individual preference. While operating under general anesthesia, use of local anesthesia can compliment the analgesia effect of the anesthetic. Hence, its use is recommended. However, it is essential to seek the permission of the anesthetist before injecting solution containing adrenalin since adrenalin in local anesthetic can precipitate cardiac arrhythmias when halothane or similar drug is used as the general anesthetic.

***2. Instruments to incise mucoperiosteum:*** Usually No.15 scalpel blade on a No.3 Bard Parker handle is used for incising the mucoperiosteum. Some operator's advice the use of the curved No.12 blade while making the posterior cut distal to the third molar and also for buccal cervical margin. If the pointed No. 11 scalpel blade is used care should be taken not to inadvertently injure the angle of the mouth or buccal mucosa.

***3. Instruments to reflect mucoperiosteum:*** Mucoperiosteum is reflected using periosteal elevator. Howarth periosteal elevator which was originally designed for use as a nasal raspatory is an ideal instrument for reflecting the mucoperiosteum (Fig. 7.1). The sharp end of the instrument is inserted in the vertical component of the incision to verify that that the incision is down to the bone and the opposite broad curved end used for raising the mucoperiosteal flap. This instrument can also be used as a retractor of the mucoperiosteum on the buccal as well as the lingual aspect of the third molar.

Other periosteal elevators like Burser periosteal elevator (Fig.7.2) is useful in elevating the mucoperiosteum, the sharp end of the instrument is inserted into the incision margin of mucoperiosteum and the blunt end is used to elevate it. While a Freeier periosteal elevator (Fig.7.3) is useful in subperiosteal tunneling. A #9 Molt periosteal elevator (Fig.7.1) is most widely used for elevation of subperiosteal flaps and for completing dissection in all subperiosteal planes.

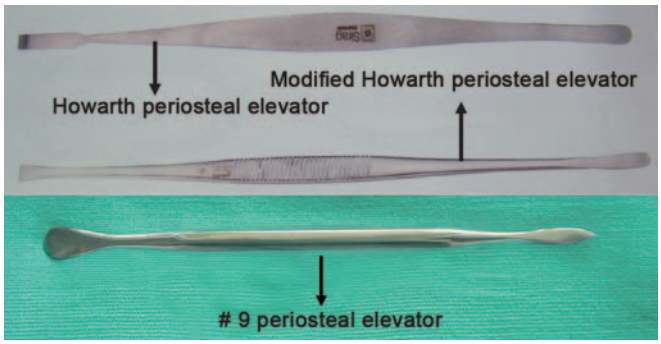



**Fig. 7.1:** Howarth periosteal elevators and #9 Molt periosteal elevator

**Fig. 7.2:** Burser periosteal elevator

**Fig. 7.3:** Freeier periosteal elevator

***4. Instruments to retract mucoperiosteal flap:*** Numerous instruments are available for this purpose. The array of instruments available indicates that a perfect retractor has not been introduced so far.

Some of the useful retractors are the Austin's retractor for retracting the flap (Fig. 7.4), Kilner retractor for holding the lip, Lack's tongue depressor for retracting the tongue (Fig. 7.10) and Rowe's lingual retractor. Malleable stainless steel/copper strips (Fig. 7.5) of varying width which can be bend to desired shapes are also useful instruments for retraction of the flap in third molar surgery. Retractors are now available with suction tip which help the operator to retract and at the same time aid in suctioning (Fig.7.9).

Other retractors now available are Minnesota retractor, Cawood-Minnesota (Figs 7.6 and 7.7) retractor for retracting the mucoperiosteal flap and Weider tongue retractor for retracting the tongue (Fig. 7.8). In addition to the above a number of other retractors (Fig. 7.10) are also available which aid in third molar surgery.

**Fig. 7.4:** Austin's retractor

**Fig.7.5:** Stainless steel malleable retractor


**Fig. 7.6:** Minnesota retractor

**Fig. 7.7:** Cawood-Minnesota retractor

**Fig. 7.8:** Weider tongue retractor

**Fig. 7.9:** Austin's retractor with attached suction tip

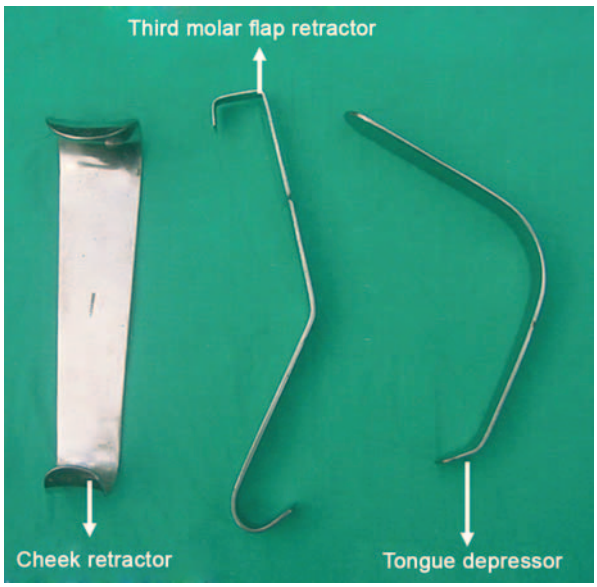



**Fig. 7.10:** Various types of retractors useful in mandibular third molar surgery

**Fig. 7.11:** Chisel for bone removal. The width of tip varies from 3 to 6 mm. Stainless steel chisels require frequent sharpening while those with tungsten carbide tips retain their sharpness for a longer time

A flat bladed retractor should always be employed to hold the mucoperiosteal flap from site when bur is used to remove bone. Otherwise, the bur may injure the soft tissue flap.

***5. Bone cutting/tooth division instruments:*** Chisel and bur are used for the removal of bone. It is a debatable issue as to which is the ideal one among these two. Chisel has the advantage of rapidity, no production of heat and no generation of bone dust. It is a quick clean method for removing young elastic bone. However, while operating under local anesthesia use of chisel and mallet is an unpleasant experience for the patient. Hence, it is best avoided and the instrument of choice then is bur. Nevertheless chisel is an excellent instrument for use while doing surgery under general anesthesia. In cases where the mandible is thin and atrophic or when the bone is brittle or sclerosed as in old patients it is prudent to use bur since injudicious use of chisel can result in splintering of bone or fracture of mandible. Similarly, when the access is limited for the use of chisel as in case of a deeply impacted tooth, bone removal is best accomplished by use of bur. Use of bur has the disadvantage of generation of heat and bone debris during drilling. Both these can be avoided by the use of continuous irrigation and suction. It is important to note that the handpiece should never be introduced or taken out from the patient's mouth while the bur is still revolving due to the possibility of causing inadvertent injury to the soft tissues.

A rational approach will be selection of the chisel or bur technique depending upon the case or a combination of the two.

**Use of chisel and mallet:** The chisel should be preferably of 5 to 6 mm width with tungsten carbide tip with sharp edge (Fig. 7.11).

The shaft should be sufficiently long enough (nearly 17 cm) to project from mouth and to ensure adequate visibility of operative site. Care should be taken to avoid lip chafing while using the chisel. The operator should ensure that the tip of the chisel is maintained razor sharp. This is because blunt end of the chisel not only mutilates the bone but also heavier blows that will be required for blunt instrument may result in fracture of mandible. Surgical mallet that is used along with the chisel ideally should weigh 255 gm (Fig.7.12). Mallet may be all metal or with non-metallic inserts for its head to reduce noise during its use. Give short, sharp, light taps with the mallet

**Fig.7.12:** Surgical mallet–Fry's pattern

by wrist movement and not heavy blows. To be effective the mallet should be used with a loose, free-swinging wrist motion that gives maximum speed to the head of the mallet without introducing the weight of the arm into the blow.

The formula for kinetic energy is KE = ½ $MV^2$, where KE is the energy possessed by a moving body, M the mass of the moving body and V its velocity. It may be noted that since the velocity is squared, it is a highly important factor. Hence, instead of a free-swinging wrist motion if the assistant adds the weight of the hand and arm to the blow (e.g. a carpenter's blow), the mass is increased but there is a great reduction in velocity. The net result is that the patient is severely jarred, but the blow may be totally ineffective from a clinical viewpoint.

The chisel should be carefully held and properly controlled during use to avoid slippage and injudicious injury.

Like in wood, bone also has a 'grain' which is most marked in young adults and it decreases as the age advances. The carpenter first determines the direction of the grain of the wood before using the chisel. Similarly, the operator should pay attention to the direction of the grain of the bone while using the chisel. In the lower third molar region, in both the lingual and buccal cortical plates the grain runs in anteroposterior direction. Hence, a vertical stop cut is made at the mesial end of the portion of the bone to be removed to avoid accidental splintering of the buccal cortical plate (Fig. 7.13).

A chisel has a beveled and a flat surface (Fig.7.14). The two surfaces of the chisel affect the direction of bone cut. One basic principle that should be remembered when the chisel is driven into the bone by a mallet is that it moves towards the direction of its plane or flat surface. In practice this means that with the bevel superiorly, a deeper cut will result. To plane the bone, the chisel is used with the bevel facing towards the bone to be removed. The chisel should be held at right angles to bone surface to avoid splintering of bone.

An important point to be remembered while using the chisel and mallet is that there is certain amount of loss in force if the jaw is left unsupported. Hence, it is a safe practice to support the mandible by the assistant while chiseling is being done. This will also avoid damage to the temporomandibular joint.

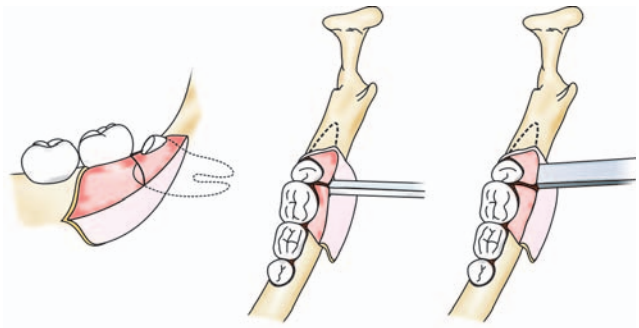


**Fig. 7.13:** Bone removal using chisel in the third molar region is performed utilizing the grain of the bone

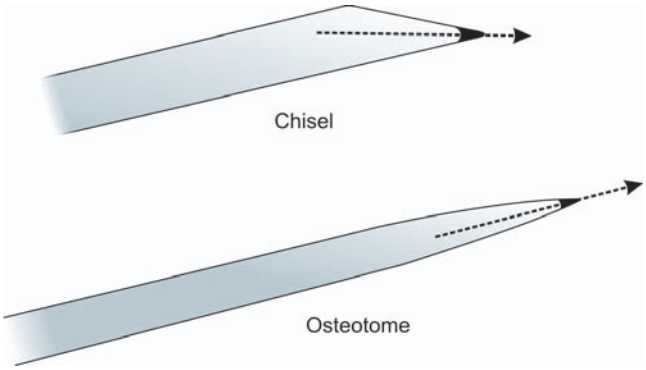



**Fig. 7.14:** Cutting edge and line of cut of a chisel and an osteotome

Osteotomes are bibevelled chisels and are not usually used. However, they can be used for splitting a tooth vertically through the buccal groove. Sometimes the tooth may not split and it is then safe to use bur for sectioning the crown. Using an osteotome like a chisel for bone removal has to be avoided because of increased possibility of mandibular fracture. This is because osteotome cuts in a direct line and acts as a wedge causing mandible to split.

**Use of micromotor and bur:** The electric dental engine (hanging motor) with cable arm which was in use previously has been replaced with micromotor and handpiece. The introduction of the latter has completely 'revolutionarized' the surgical removal of impacted mandibular third molar. The modern day instrument set-up is incomplete without micromotor, straight handpiece and bur (Fig.7.15).

Similarly air driven handpiece (Fig. 7.16) which was used before the introduction of micromotor handpiece has fell into disrepute since it has the disadvantage of causing surgical emphysema as well as driving the tooth and bone particles into the soft tissues. Retention of such debris in the soft tissues can result in postoperative infection also.

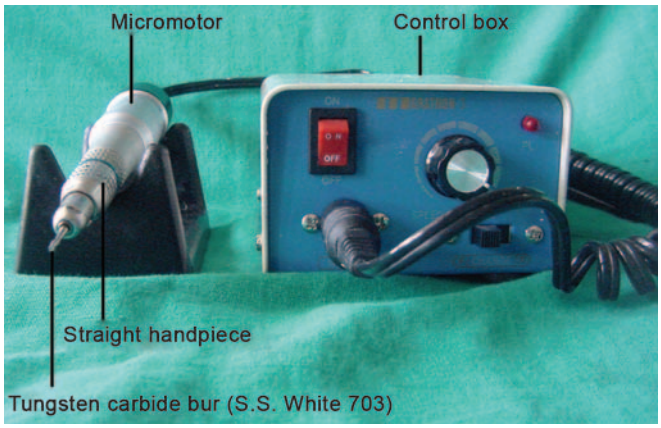



**Fig.7.15:** Relatively inexpensive micromotor, straight handpiece and control box (without inbuilt saline irrigation facility). When this is used irrigation of the surgical site has to be done using saline taken in a syringe

**Fig. 7.16:** 45º High speed fiber optic handpiece with connector. Push button bur release uses standard friction grip burs. The manufacturer claims that the exhaust air exits at the back of handpiece and there is no air jet into the surgical field

Joji Sekine et al (2000)[1] reported a case of bilateral pneumothorax with extensive subcutaneous emphysema in a 45-year-old man that occurred during surgery to extract the left lower third molar, performed with an air turbine dental handpiece. Computed tomographic scanning showed severe subcutaneous emphysema extending bilaterally from the cervicofacial region and the deep anatomic spaces (including the pterygo-mandibular, parapharyngeal, retropharyngeal, and deep temporal spaces) to the anterior wall of the chest. Furthermore, bilateral pneumothorax and pneumo-mediastinum were present. The authors concluded that the emphysema was probably caused by pressurized air being forced through the operative site into the surrounding connective tissue.

Even though the standard dental burs are not designed for surgical purpose, they have found wide spread acceptance in surgical removal of impacted tooth. The Meisinger burs which are designed exclusively for the surgical purpose has the advantage of long shank which permits better access. However, they are expensive. Tungsten carbide dental burs are less expensive compared to Meisinger series. The tungsten carbide fissure bur (# 703, SS White) now commonly used has sufficient cutting surface to enable bone cutting and sectioning of tooth compared to the round bur (rose head bur) of the same manufacturer. Hence, the former is now widely used in oral surgery.

Some operators use small Ash's acrylic trimmers (vulcanite burs) for bone removal around the impacted tooth ('guttering') and also for smoothening the rough edges of bone (Fig. 7.17).

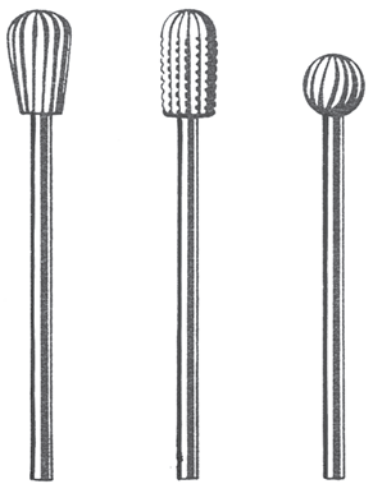


**Fig. 7.17:** Ash's acrylic trimmers (patterns 8,6, 20R)

Others use fissure bur in an angled handpiece (Fig. 7.18). But it is preferable to use a straight handpiece (Fig. 7.19) since, it is easier to control during use as well as effortless to clean, maintain and sterilize after use.

***6. Instruments for irrigation and suction:*** The overheating of bone and generation of bone dust during the use of bur can be totally avoided by the use of continuous irrigation with saline or sterile water. A practical method is to use a saline filled syringe with its needle directed towards the revolving bur. An alternative method is to use a system with inbuilt saline pump and irrigation facility connected to the handpiece like that in a physiodispenser (Fig. 7.20) used in implant surgery. But they are considerably more expensive than the standard micromotor set. Certain authors advocate the use of saline irrigation from a bottle hanging from a drip stand where the flow is provided by gravity. Whatever may be the method used, the aim is to provide continuous cooling of the bur and avoid heating of bone. Undue heating of bone can result in necrosis of viable bone cells and subsequent osteomyelitis (Fig. 7.21) which has to be avoided.

While using saline irrigation to cool the bur it is mandatory to use a suction apparatus (Fig. 7.22) for effective drainage of the irrigant and blood as well as to clear the surgical site off the debris. It is the duty of the

**Fig. 7.18:** Angled handpiece with provision for continuous saline irrigation

**Fig. 7.19:** Straight handpiece with provision for continuous saline irrigation

**Fig. 7.20:** Micromotor system with facility for continuous saline irrigation (Physiodispenser)

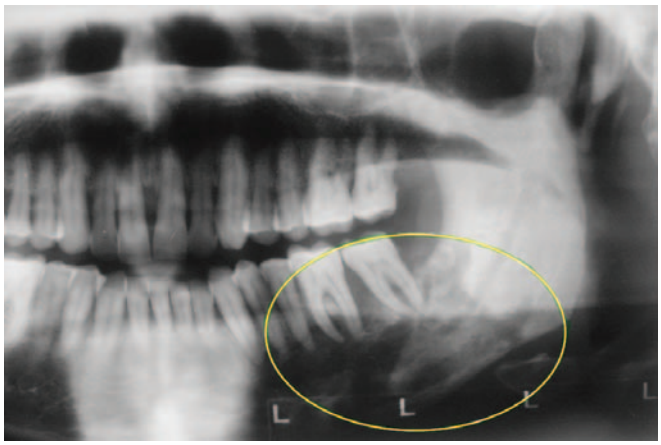


**Fig. 7.21:** OPG showing osteomyelitis that occurred following surgical removal of impacted 38. Note the bony changes in the yellow circle


**Fig. 7.22:** Suction apparatus

assistant to hold the suction tip connected to the suction apparatus without obstructing the view of the surgeon and at the same time held not too close to the bur. It should be held at the most dependant part of the wound to ensure complete drainage of the irrigation and debris. Moreover the suction should not be used to suck pieces of crown or root or solid debris as this can block the suction tip as well as confuse the operator as to where it has disappeared.

A powerful suction also helps to keep the surgical field free of blood especially in the event of a torrential hemorrhage due to accidental injury of inferior alveolar vessels.

Sterilization of micromotor, handpiece and bur- Handpiece and bur can be generally sterilized by autoclaving or by methods suggested by the manufacturer. Burs can be sterilized by cold sterilization methods also. Handpiece must be properly cleaned after every use and well lubricated with oil before autoclaving to ensure that the bearing of handpiece is smooth. Handpiece with damaged bearing can be identified by excessive sound during its running as well as by the reduction in speed. Use of such handpiece can result in generation of heat during use which in turn will burn the cheek of the patient. Moreover, it will indirectly hamper the life of the micromotor also.

Generally micromotor and its connecting electrical cord cannot be sterilized by autoclaving since it will be damaged. Hence, they are covered with a sterile sleeve before use to ensure sterility of the equipment (Fig. 7.23).

**Fig.7.23:** Micromotor and electrical cord (unsterile) covered with sterile sleeve with the handpiece and bur exposed (which are sterile)

However, in new generation micromotors like that used in implantology (e.g. Satellac, France) the micromotor with the electrical cord can be autoclaved without damage. Hence, such systems can be used without a sterile sleeve.

***7. Instruments for removal of tooth and debridement of surgical site:*** Once, adequate amount of bone has been removed to relieve the tooth of its obstruction, only slight force with an elevator is usually sufficient to deliver it. Dental extraction forceps in general are not advisable for the removal of impacted tooth since its use can result in fracture of mandible. Similarly cross bar elevators which work on wheel and axle principle like Winter's cross bar elevator (Fig. 7.24) also generate tremendous force because of its mechanical advantage and hence should be avoided. Moreover their beaks can cause perforation of thin lingual plate pushing the fractured root piece into the lingual pouch during its attempted removal.

Elevators like straight elevator, Coupland elevator and Creyer elevator (Fig. 7.25) may be used with caution.

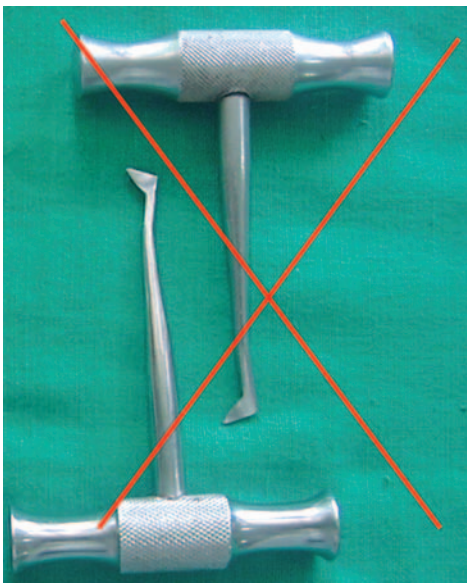


**Fig. 7.24:** Winter's cross bar elevators. Use of these elevators should be avoided


**Fig. 7.25:** Elevators that may be used with caution in third molar removal

Instruments that can be safely used are elevators with small mechanical advantage like Warwick James elevator (Fig. 7.26).

After the tooth has been removed, proper debridement of the wound is necessary to ensure uneventful healing. Curved mosquito hemostat is used to remove follicular remnants and bone pieces. An angulated curette also may be used to clean the socket off the debris. Smoothening of rough edges of bone is achieved either using bone file or acrylic trimmer (Fig. 7.17) on a handpiece. The socket and the soft tissue flap are once again thoroughly irrigated with saline taken in a syringe to wash off the debris.

***8. Instruments for closure of mucoperiosteal flap:*** For suturing the wound the ideal needle is a medium sized triangular cutting needle with 11/16 circle. Advantage of this type of needle is that the tip always points upwards after it has passed through the tissues and it does not injure adjacent structures such as the cheek or the tongue. On the other hand while using half circle needle which is popular with most dental surgeons, greater effort is required to suture without injuring the adjacent structures. The needle holder that is being used should have a long shaft to suture the wound in the posterior part of the mouth. Similarly toothed dissecting forceps of adequate length (approximately 15 cm) is required. Suture material of 3-0 size, which can be either of black silk, linen, catgut or vicryl is used.

**Fig. 7.26:** Warwick James elevator, curved–right and left

***9. Other equipment:*** Accessory equipment like operating loupe with fiberoptic head light (Fig. 7.27) help

**Fig. 7.27:** Operating loupe with fiberoptic head light

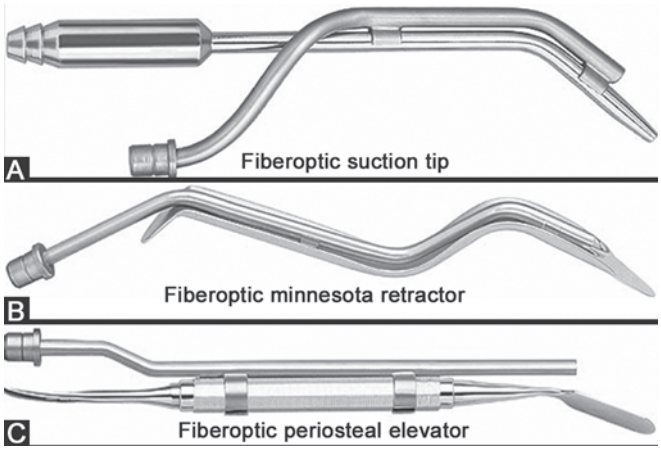



**Fig. 7.28:** Fiberoptic instruments

in better visualization of the surgical site. Fiberoptic attachments to suction tip, periosteal elevators, and retractors (Fig. 7.28) augment illumination provided by the standard dental or operating room lighting. Use of mouth prop (Fig. 7.29) during the procedure helps patients to bite on it and this markedly reduces the fatigue of the jaw. All these contribute greatly to perform the surgery in a speedy and efficient manner.

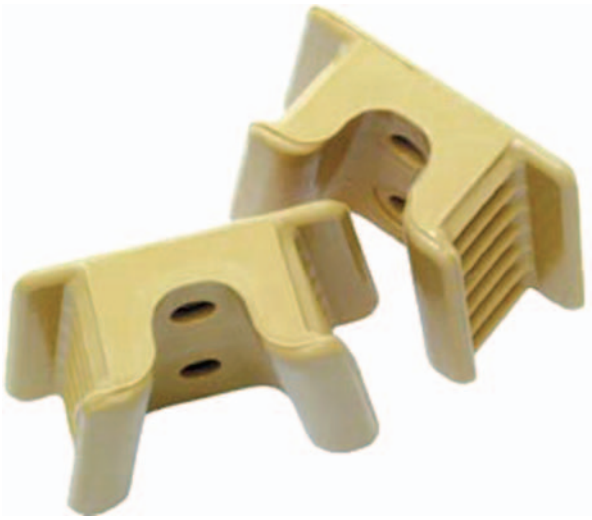


**Fig. 7.29:** Autoclavable silicone mouth props

## Use of operating loupe in third molar surgery

Use of operating loupe with 2 × or 3 × (Fig.7.27) magnification is extremely useful in third molar surgery especially in locating fractured root tip and its removal. The author has found it to be of an invaluable tool in many occasions. A little difficulty may be experienced initially with the operating loupe; but with time it can be overcome.

## REFERENCE

1. Joji Sekine, Akihiko Irie, Hiroyo Dotsu, Tsugio Inokuchi. Bilateral pneumothorax with extensive subcutaneous emphysema manifested during third molar surgery. A case report. Int J of Oral and Maxillofac Surg 2000; 29(5): 355-57.

CHAPTER

# 8 Operative Procedure

## PATIENT POSITIONING

The dental chair is adjusted in such a manner which is comfortable for the patient and at the same time enables the operator and the assistant to have a clear view of the surgical site (Fig. 8.1). Generally, for operative procedures in mandible the occlusal plane of lower teeth should be parallel to the floor and for the maxillary teeth the occlusal plane of the upper teeth at 45° angles to the floor.

The instruments are arranged in a rational order of their intended use (not cluttered) on a sterile towel placed over the instrument tray of the dental chair or more preferably on a separate instrument trolley (Figs 8.2 and 8.3).

If there is delay in starting the surgery, the instruments should be covered with another towel to avoid contamination and to maintain the sterility of the instruments.

The surgeon and the assistant then wear cap and face mask. This is followed by scrubbing the hands up to the elbow level. Rings, watches, bangles and bracelets harbor microorganisms causing infection and hence they are removed before starting the scrubbing. A scrubbing time of three to five minutes is ideal. After scrubbing it is best to wear a sterile gown by the surgeon and the assistant or at least the front portion of the dress is covered by a sterile towel fixed at the level of the shoulder by two towel clips (Fig. 8. 1). This followed by donning of sterile gloves.

**Draping the patient:** Ideally the head and the front part of the body of the patient should be draped, thus exposing only the face. For this the patient's head is covered with a sterile towel, the edge of which is brought under the chin and fixed with towel clip. This ensures that the head, neck and shoulders are covered and only the face is exposed. Some authors compare this draping to that of a nun's veil or coif. Another easier and less cumbersome alternative is to cover the head of the patient with a disposable cap (as worn by the surgeon). Another sterile towel is used to cover the patient's chest, arms and lap. This towel is secured with two towel clips at the level of the shoulder clipped to patients clothing or fastened around the neck with a towel clip.

**Preparation of the surgical site:** Before preparing the intraoral surgical site it is always desirable to wipe the patient's face with an antiseptic solution like povidone-iodine (Betadine). The third molar area is then swabbed with 0.5% solution of chlorhexidine or betadine. Alternatively the patient can be given a mouth wash of the above antiseptic. This is followed by the administration of local anesthetic injection.

**Fig. 8.1:** Patient seated in dental chair and draped. Note the position of the surgeon and the assistant

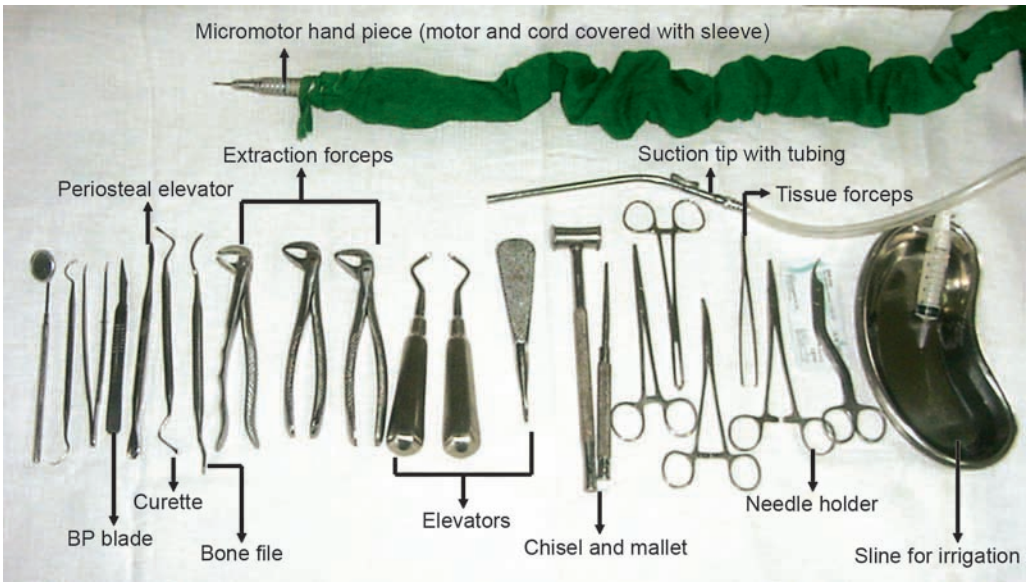



**Fig. 8.2:** Instruments arranged on an instrument trolley

**Fig. 8.3:** Bare minimum instruments required for impaction surgery arranged over the instrument tray of the dental chair. No surgery should be undertaken without these instruments

## Choice of Anesthesia

Methods of anesthesia for the surgical removal of impacted tooth include local anesthesia, local anesthesia with intravenous sedation, and general anesthesia. In general dental practice, the former two methods are considered appropriate. Adequate training and facilities should be available while using intravenous sedation. General anesthesia may be needed for complex and lengthy procedures as well as for apprehensive and uncooperative patients. But it must be recognized that general anesthesia carries greater risk compared to local anesthesia.

## Palpation of Anatomical Landmarks

Before starting the surgical procedure, palpation of the region and locating the anatomical landmarks is essential. The pterygomandibular fold covering the pterygomandibular raphe is usually very prominent when the mouth is opened wide. The external oblique ridge is then located. Next, the anterior part of the ramus with the coronoid notch and medially the retromolar fossa should be identified followed by the medial tendon of temporalis. The lingual shelf is palpated. Locating the anatomical landmarks will give information regarding the underlying bone and will help the operator as to where the incision is to be given.

The standard operative plan can be divided into the following stages:

1. Incision to gain access to the area
2. Removal of adequate amount of bone
3. Sectioning and delivery of tooth from the socket
4. Debridement
5. Closure of the incision

### *1. Incision and Designing the Flap*

The first step in removing the impacted tooth is to reflect a mucoperiosteal flap. The flap should be of adequate size to permit access, allow adequate visibility and to ensure unhindered healing without periodontal pocket formation distal to second molar. It is needless to point out that all the basic surgical principles involved in designing a flap should be observed here also. The most important factor in designing the flap is the position of the third molar which in turn dictates the amount of bone removal required and the need for tooth sectioning. As a general rule, the deeper the third molar, the more extensive is the bone removal required and the necessity for tooth sectioning. In such instances, flaps with vestibular extensions are recommended. More over, due consideration should be given for the lingual nerve, buccinator muscle and the periodontium distal to second molar while designing the flap.

The most commonly used flap is the envelope flap (Fig. 8.4), which extends from just posterior to the position of the impacted tooth anteriorly to the level of the first molar. The posterior end of the incision is directed buccally along the external oblique ridge.

If greater access is required to remove a deeply impacted tooth, the envelope flap may not be sufficient. In such cases, a release incision is given on the anterior aspect of the incision, creating a triangular flap (Fig.8.5). This incision is started from a point approximately 6 mm down in the buccal sulcus and then extended obliquely upwards to the gingival margin to a point at the junction of the posterior and middle thirds of the second molar (Fig. 8.5).

Experience has showed that the envelope incision is usually associated with fewer complications and tends to heal more rapidly that the triangular flap. A small

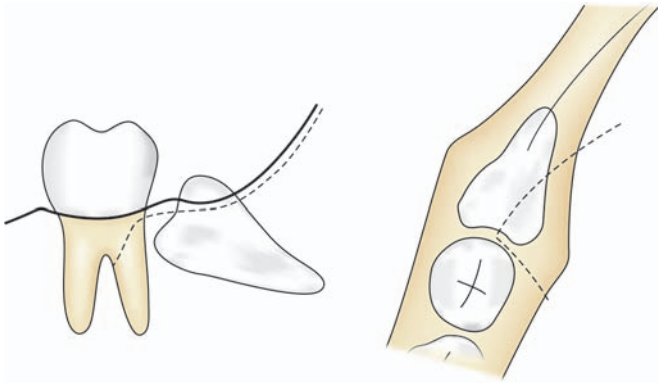


**Fig. 8.5:** Standard triangular flap with a release incision in the anterior aspect. Note that the incision should not be continued posteriorly in a straight line, because the mandible diverges laterally

artery, the buccal artery, is sometimes encountered while giving the releasing incision, the injury of which will lead to mild bleeding. In cases where more exposure is needed the vertical incision can be placed between the second and first molar as shown in the Figure 8.6.

The incision then passes cervically behind the second molar to the middle of its posterior border. It is then extended posteriorly and laterally along the anterior border of the ramus for a maximum of 2.5 cm depending on the exposure required. (Extension of the incision further posteriorly may result in prolapse of buccal pad of fat or lead to marked trismus and swelling post operatively). The incision should not be continued posteriorly in a straight line, because the mandible diverges laterally. If the incision is extended straight, the knife will enter the sublingual space and is likely to damage the lingual nerve. The lateral extension also avoids small vessels emerging from the retromolar fossa.

The sharp end of the periosteal elevator is inserted in the region of vertical incision to ensure that the incision has reached up to bone. If not, the sharp tip of the

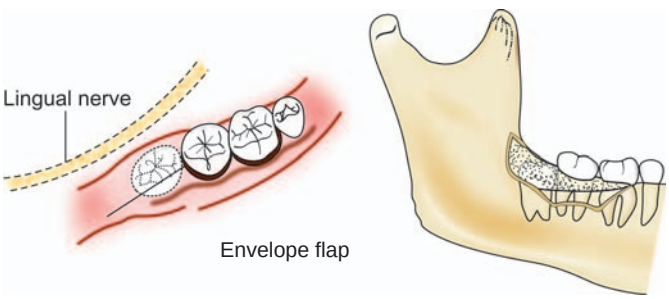



**Fig. 8.4:** Envelope flap design. Note the position of lingual nerve

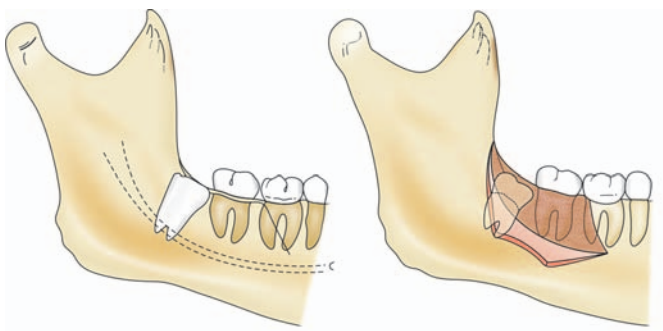


**Fig. 8.6:** Where more exposure is needed the vertical incision of the triangular flap is placed between the second and first molar

instrument is employed to sever the remaining attachment. The blunt end of the instrument is then passed beneath the mucoperiosteum to reflect the soft tissue in the correct plane. Care should be taken not to strip the periosteum from the mucosa while reflecting. The mucoperiosteal flap is then reflected laterally to the external oblique ridge with a periosteal elevator and held in this position with an Austin's retractor (third molar retractor). The flap reflection should be limited to external oblique ridge laterally, because reflecting beyond this area leads to increased dead space resulting in more edema postoperatively.

Certain authors advice the use of a 'Minnesota retractor' to hold the flap (Fig. 7.6). This retractor is placed just lateral to the external oblique ridge and is stabilized against the lateral surface of the mandible. The retractor should be held using a few fingers at its distal end so that it can be toed out laterally without the hand holding it blocking the vision of the operator.

Reflection of lingual mucoperiosteum is kept to the minimum to avoid injury to lingual nerve. When reflected the retractor should be held carefully to avoid compression of the lingual nerve.

Extensive reflection of flap is avoided to reduce post-operative pain and swelling. A clinical trial was carried out by Clauser et al (1994)[1] to evaluate the influence of incision and reflection of flap on pain after the removal of partially erupted mandibular third molars. The patients underwent bilateral extraction of partially impacted mandibular third molars with a standard incision on one side (control) and without incision (test) on the other side. The nonsurgical approach did not increase the operating time and appeared to be an effective way of reducing postoperative discomfort after extraction of partially erupted third molars.

### *2. Bone Removal*

The next major step is to remove the bone around the impacted tooth. The amount of bone removal varies with the depth of impaction. As stated in the previous chapter, the bone removal around the impacted tooth can be accomplished either by use of bur, or chisel and mallet or a combination of the two methods. Whatever may the method used (which may be of individual preference), the aim is to remove sufficient amount of bone to free the tooth from obstruction and to provide a point of application for the elevator.

The most recent advance is the use of high speed, high torque electric drill, which significantly reduce the time required for bone removal and tooth sectioning. Electric drill (micromotor and handpiece) is considered the instrument of choice in the present day impaction surgery. It has the advantage of rapid bone cutting with minimal discomfort to the patient. At the same time the possibility of the development of emphysema associated with an air driven handpiece is avoided.

A few surgeons still prefer to use chisel and mallet or air driven hand piece for bone removal.

The most common technique using a chisel is the 'lingual split bone technique' introduced by Ward (1956)[2] in which a section of bone lingual to the wisdom tooth is fractured off to facilitate the removal of the impacted tooth. This technique in which the socket is saucerized was developed to reduce infection at a time when this was common and fatalities were not unknown.

In a 20 year retrospective audit on removal of 2088 teeth by lingual access method for third molar surgery under general anesthesia conducted by Moss CE and Wake MJC (1999)[3] it was noted that a lingual approach does not appear to be associated with higher post-operative morbidity. Chisels were the preferred instruments for bone removal. When a broad Hovell's retractor was used instead of a Howarth's elevator, lingual nerve morbidity was lower. Lingual nerve morbidity in all cases was temporary; was present after 16 of the 2088 lingual retraction procedures, i.e. 0.8%. The authors concluded that the lingual approach should be used only by specialists and should be audited, and other operators should use only a buccal approach.

In a study reported by Absi et al (1993),[4] on one side the lingual split method by chisel was used to remove impacted mandibular third molars. On the other, the buccal approach using surgical bur was used to remove the tooth. There were no statistically significant differences between the two methods in relation to pain, facial swelling, sensory loss, infection, or periodontal pocket depth distal to the second molar. There were also no statistically significant differences between duration of procedures; mean operating time with burs was 8.28 min (range 4-15 min) and with chisels 7.57 min (range 4-15 min). This study provided no evidence of difference in either efficiency or outcome between two standard methods of removing lower third molars.

In a recent study by Praveen G et al (2007)[5] morbidity rates following the use of different surgical techniques were assessed. The techniques employed were surgical bur technique, lingual split technique and simplified split bone technique. The conclusion of the study was that the lingual split technique was more painful than the other two techniques. Surgical bur technique had more swelling than the other two. The simplified split bone technique had the least morbidity than the lingual split and surgical bur technique. However, as stated previously most of the patients may not tolerate the jarring effect of chisel and mallet while operating under local anesthesia. Hence it will be preferable to opt for rotary instruments for bone removal and tooth sectioning for surgery under local anesthesia.

When an air driven hand piece is used it is essential that the hand piece exhausts the air out of the surgical site to prevent emphysema or air embolism.

The hand piece used should be sterilized, usually in a steam autoclave. Copious irrigation using cold saline or distilled water is done to prevent heating of bone and subsequent bone necrosis. Cooling the bone by way of irrigation will also reduce the postoperative pain and edema. The use of a high vacuum suction to clear the surgical site while irrigation is used can not be over emphasized.

The buccal cortex contributes greatly to the strength of the mandible. Hence buccal bone removal should be kept to minimum to avoid weakening of the mandible and subsequent fracture. The bone on the buccal and the distal aspect of the impacted tooth is removed down to the level of the cervical line. Further bone removal if required is done in a manner not detrimental to the strength of mandible and at the same time not sacrificing the efficiency of surgery. This is achieved by drilling a deep vertical gutter alongside the buccal aspect and if required on the distal aspect of the tooth. This 'guttering method ' will ensure that the height of the buccal plate is maintained without weakening the mandible and at the same time adequate space is created around the tooth to permit its free movement (Fig. 8.7).

While using this method, as the bur reaches the apex of the tooth, the inferior alveolar canal may be inadvertently opened. This will result in brisk hemorrhage from inferior alveolar vessels, which can be controlled with pressure pack or bone wax. But sometimes damage to the inferior alveolar nerve can occur resulting in anesthesia over the distribution of mental nerve. In rare

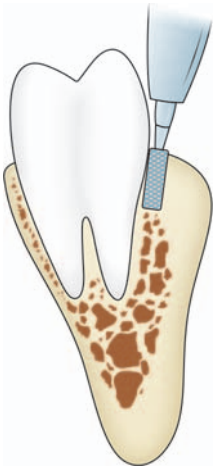


**Fig. 8.7:** "Guttering method"—A deep vertical gutter using bur is made alongside the buccal aspect and if required on the distal aspect of the tooth

instances, the mandibular canal may be buccally placed and at a more superior level than normal. In such cases injury to contents of the canal will occur more easily.

Bone covering the mesial aspect of the impacted tooth is also removed by this method. Drilling in the region of the mesial surface of impacted tooth should be kept to the minimum to avoid damage to the distal aspect of the adjacent second molar. While removing bone on the distolingual aspect extreme care is taken to protect the lingual nerve from bur by way of proper retraction. It is advisable not to remove any bone on the lingual aspect due to the likelihood of damage to the lingual nerve. A variety of burs can be used to remove bone, but the most commonly used are the #8 round bur and a #703 fissure bur.

Besides exposing the tooth and removing the obstructions, an additional aim of bone removal is to create a point of application for the elevator. When this has been achieved moderate force alone is sufficient to displace the tooth. If the tooth is still resistant the operator should discard the elevator and plan for further bone removal or consider tooth sectioning.

Elevation of tooth from the socket: If adequate amount of bone covering the tooth has been removed, an attempt can be made to elevate the tooth from the socket. An excessive force should not be used for this purpose. Application of a great amount of force without adequate bone removal can result either in fracture of the tooth or fracture of the mandible. Due to the above risk dental extraction forceps and elevators with great mechanical efficiency like cross bar elevators are contraindicated for

the removal of impacted third molar. Once the obstructing bone has been removed, only a slight amount of force alone is needed to deliver the tooth. Elevators with less mechanical efficiency like Warwick James elevator (straight and curved type) and Coupland chisels are recommended for this purpose. The # 301, Crane pick and Cogswell B elevators also serve this function well. Paired, sharp pointed elevators such as the Winter's cross bar elevators are capable of applying extreme force, and their use should be avoided. This is because excessive force can result in unfavourable root fracture, buccal or lingual bone loss, damage to the adjacent second molar or even fracture of mandible. These elevators are also useful in removing bone in the furcation that is retaining a root fragment. But a root fragment so elevated is pushed against an intact wall of bone and is more likely to fracture or defy removal than it would if removed in a mesial direction with the assistance of a well placed purchase point as required (Figs 8.8A and B).

It is a common practice to use a broad elevator between the buccal surface of the impacted tooth and the external oblique ridge in order to elevate a tooth or root fragment. This technique places the external oblique ridge, one of the buttresses of the mandible and the lingual plate at risk of fracture. If such a fracture is unrecognized, a substantial late presenting sequestrum or immediate lingual nerve injury is possible (Farish and Bouloux, 2007)[6]. Delicate instruments (e.g. Warwick James elevator) alone are needed to luxate/to remove impacted mandibular third molar if adequate exposure, bone removal and sectioning of tooth are performed.

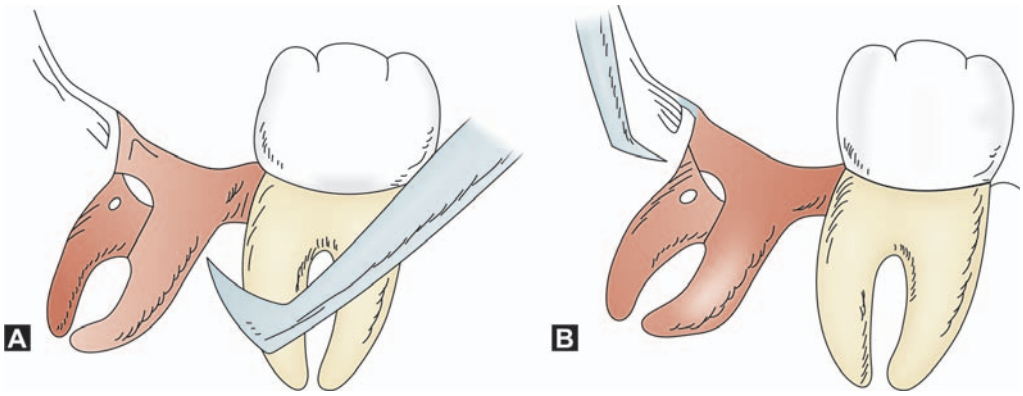
Elevators with less mechanical efficiency like Warwick James elevator (straight and curved type) and Coupland's chisels are held between the thumb and fore finger like a 'pen grasp' and not a 'palm and thumb grasp' used for holding straight elevator. When used correctly these instruments exert adequate leverage to luxate and remove the tooth and at the same time prevent the possibility of a mandibular fracture. At the time of elevating the tooth, the index finger of the operator's left hand should rest on the occlusal surface of the wisdom tooth to judge its movement and the other fingers support the mandible.

Because the impacted tooth has never sustained occlusal force, their periodontal ligament space is wider and less tenacious and they can be easily displaced if adequate bone is removed and elevation forces are applied in a proper direction.

In order to apply the elevator, a point of application (purchase point) is required. This is prepared either in the bone as described previously or a bur cut of sufficient size is made on the tooth by drilling. The point of application for the elevator is decided on the basis of the angulation of the tooth and the curvature of the roots. This should be deep enough and placed in substantial portion of tooth structure so that the elevation of segment occurs rather than fracture. Certain authors' advice the use of Cogswell B elevator which has a smooth surface at the tip and is less likely to cause fracture when used to engage a purchase point.

### *3. Sectioning and Tooth Delivery*

Once the tooth has been sufficiently exposed and if it is still resistant to the use of elevator it is time to consider tooth sectioning. The tooth is sectioned into appropriate




**Figs 8.8A and B:** (A) Attempt to elevate the remaining root fragment using a Cryer elevator in a distal direction removes interdental bone but forces the root against the intact distal socket wall, where it resists removal. (B) A well placed purchase point in the distal root fragment allows a Cogswell B elevator to guide the root mesially, where it meets no resistance to removal

pieces for easy delivery from the socket. Sectioning of tooth reduces operating time and also avoids the need to remove additional amount of bone to accommodate the elevated tooth. Tooth sectioning is performed either with a bur or a chisel. In the standard technique, first section is generally done at the neck of the tooth using bur. This will facilitate the removal of the crown followed by the roots in one piece. However, in cases where the roots are divergent or have conflicting path of withdrawal, the roots may have to be divided and removed separately.

It may be noted that the manner of sectioning of crown and root will vary depending on each case and there can be deviation from the standard technique.

Farish and Bouloux (2007)[6] stated that the following key points should be observed while performing tooth sectioning:

1. When it is determined that a tooth should be sectioned vertically (for example in a case of mesioangularly impacted mandibular third molar), the line of sectioning is first planned and it is them moved approximately 1.5 to 2 mm more anterior than initially felt necessary. This adjustment helps to prevent inadvertently sectioning the tooth too distally, which often occurs as a result of the obstructing position of the second molar.
2. While sectioning, the tooth is generally divided into three quarters of the way from the buccal to the lingual aspect using bur. The reminder is then split with a straight elevator or a similar instrument. This not only prevents injury to the lingual cortical plates but also reduces the possibility of damaging the lingual nerve.
3. Vertical cuts should be placed carefully so that the line of sectioning of crown/tooth does not angle from the perpendicular. If the sectioning line varies from the perpendicular and is directed posteriorly (Fig. 8.9) the sectioned segment will be wider at the bottom than at the top. In such cases, elevation is hindered.
4. While sectioning the tooth in the superior to inferior direction if the bur is carried to the full width of the tooth to reach its 'bed', there is a possibility of damaging the contents of the canal (Fig. 8.10). If such a mishap occurs, there will be brisk bleeding from the inferior alveolar vessels. If the inferior alveolar nerve is injured, this will later lead to anesthesia in the distribution of mental nerve. Hence the entry of bur is limited to three fourth of the width of the tooth. The rest of the tooth is separated with leverage using an instrument like curved Warwick James elevator.

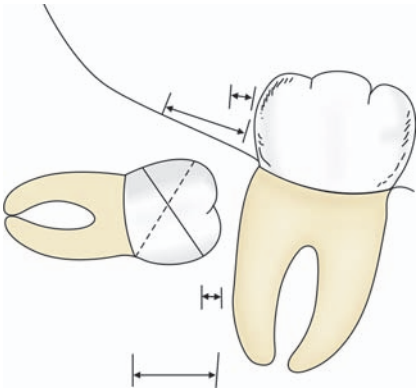


**Fig. 8.9:** Incorrect sectioning of crown (broken line) leaves a segment that is wider at the bottom than the top. Its subsequent removal is blocked. Correct line of section is shown as continuous line

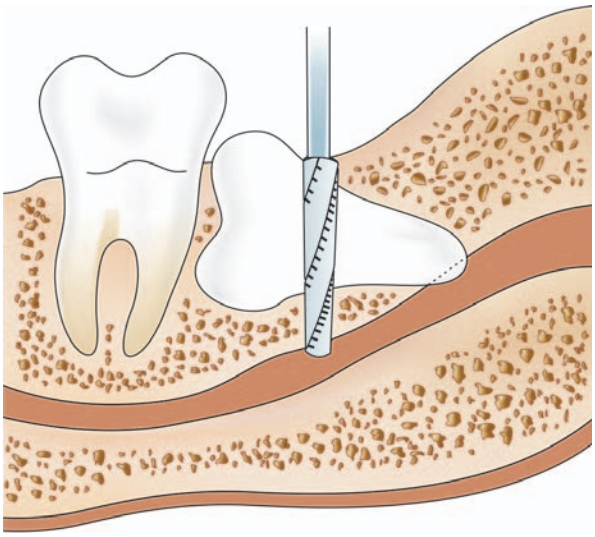


**Fig. 8.10:** Possible damage to inferior alveolar neurovascular bundle if the bur is carried to the full width of the tooth inferiorly. Hence bur is used to cut only three fourth width of the tooth and the rest of the tooth is separated using a suitable instrument like Warwick James elevator

## Modifications for Removal of Impacted Tooth

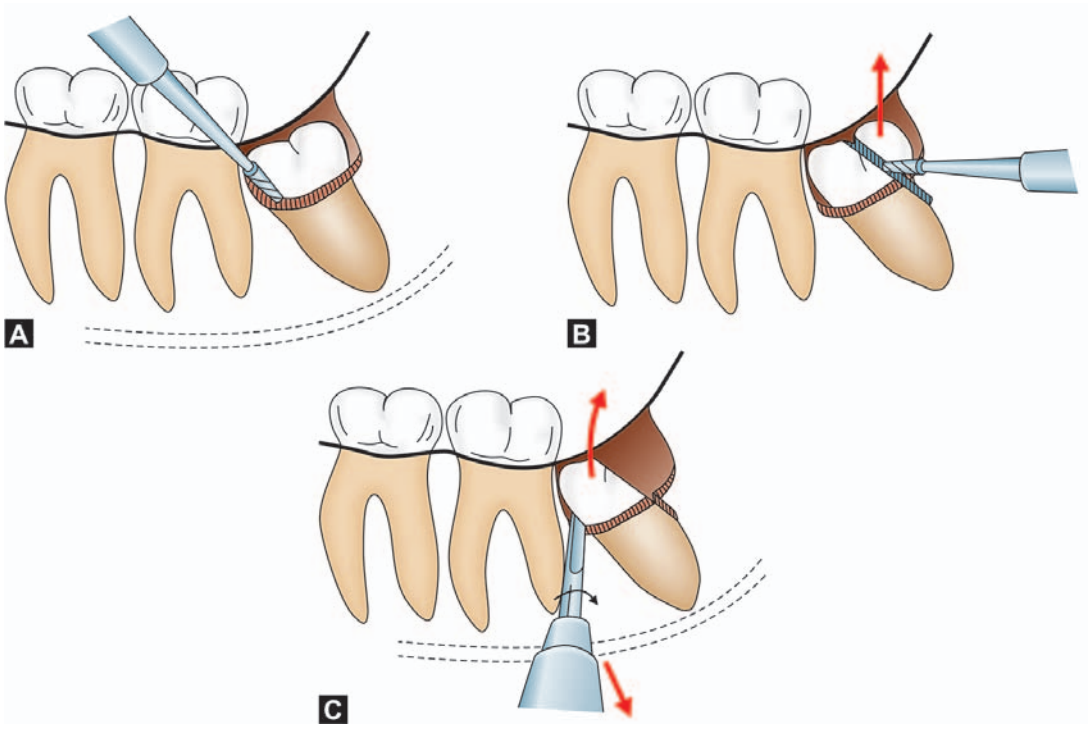
Even though the principles involved in the technique of third molar removal is fundamentally the same, some modifications have to be made depending upon the angulation of the tooth. This is because the path of withdrawal of third molar is along the line of least resistance and hence the site of application of elevator is

dependant upon the angulation of the tooth i.e. mesioangular, horizontal, vertical and distoangular impaction.

The mesioangular impaction (Figs 8.11A to C) is usually considered to be the least difficult to remove. After reflecting the mucoperiosteum and exposing the crown, the buccal gutter is extended mesially to reach the mesial surface of impacted tooth beneath the cementoenamel junction. This will ensure that when the elevator is introduced, the tip of the elevator can engage beneath the cervical cementum on the mesial aspect. Using the interdental bone as the fulcrum when the elevator is rotated, the tooth turns distally. This distal movement of the tooth converts the initial mesial angulation of the tooth into a vertical position. Use of further force with the elevator will deliver the tooth. In certain instances, the mesially inclined molar will assume a vertical position following elevation, but further movement can be hindered by the distal bone. In such cases any of the following method can be used to take out the tooth:

a. Removing necessary distal bone using bur and dislodging the tooth a little more distally. Then the tooth is removed.
b. Sectioning the distal half of the crown from the buccal groove to just below the cervical line on the distal aspect of tooth. This portion of the tooth is removed, and then the reminder of the tooth is delivered with a small straight elevator placed on the mesial aspect.
c. Purchase point of the elevator is changed to buccal side and a firm upward force is exerted. A purchase point on the buccal side of the tooth can be prepared with a drill and then a Cryer's elevator is used to deliver the tooth.

In cases, where the mesioangular tooth is 'locked' beneath the distal convexity of the crown of the second molar, tooth division is done at the cervical region to section the crown. The coronal portion is then ejected out of the socket by applying force below its inferior surface. The roots are then loosened by engaging the bifurcation and it is also taken out.

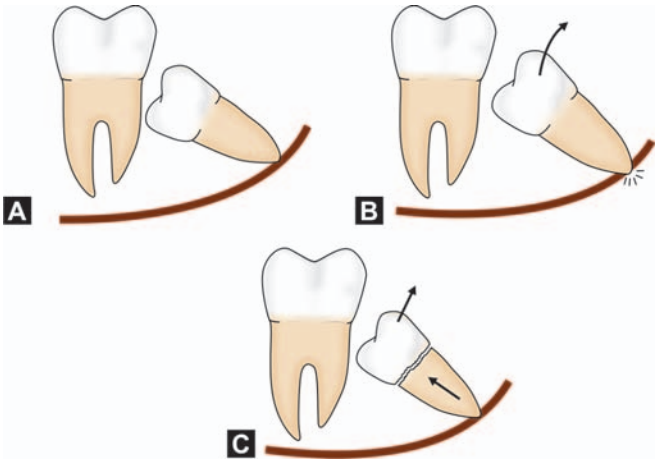



**Figs 8.11A to C:** Steps in the surgical removal of mesioangular impaction. (A) Bone removed up to cervical line using bur, (B) Sectioning of tooth, (C) Tooth delivery using elevator

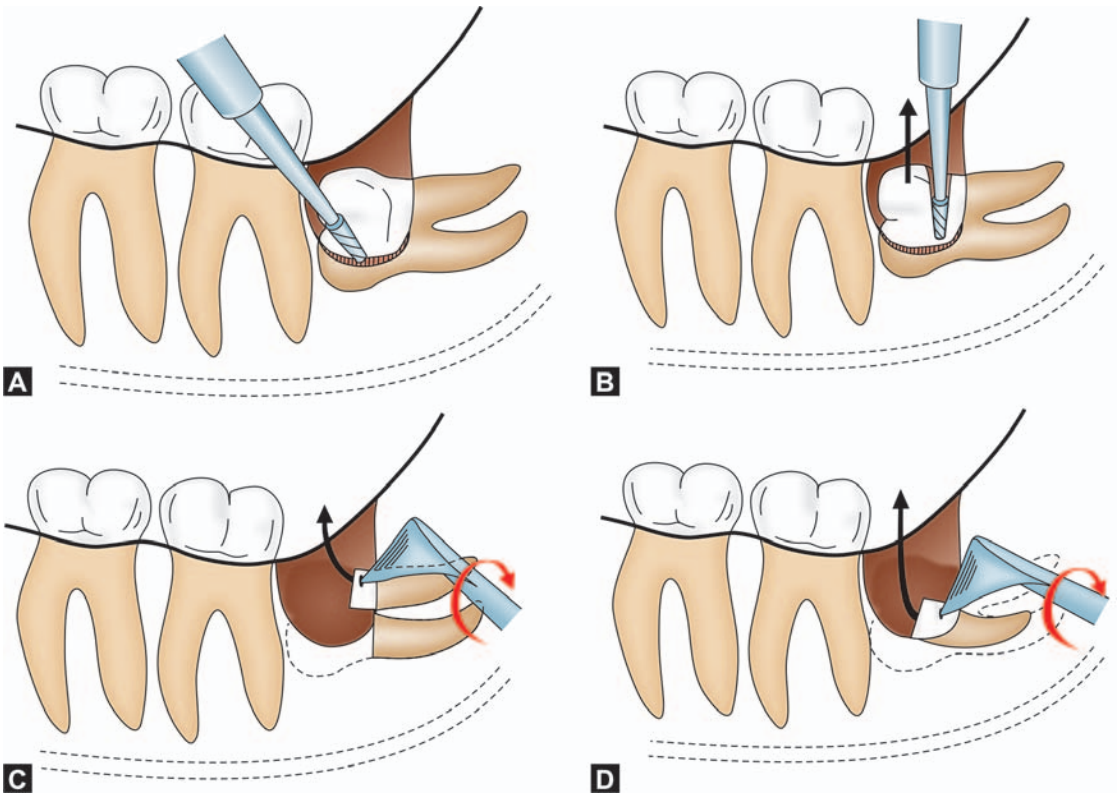
Moreover, if leverage is applied to a mesioangular tooth whose roots are in close contact with the mandibular canal, the apex of the root will be forced downwards crushing the neurovascular bundle. In such instances, crown sectioning will prevent damage to canal contents, since roots can be moved forwards and upwards into the vacant space previously occupied by the crown (Figs 8.12A to C)

While applying elevator mesially care should be taken not to dislodge restoration or fracture the crown of second molar already weakened by dental caries. Similarly the operator should be vigilant not to denude the bone on the distal aspect of the second molar while inserting the elevator mesial to the impacted third molar.

The horizontal impaction (Figs 8.13A to D) usually requires removal of more bone than the mesioangular impaction. When the tooth is deeply impacted it usually engages either the crown or root of the second molar which makes its removal difficult. Adequate bone is removed superiorly to expose the whole width of the




**Figs 8.12A to C:** Need for sectioning to avoid injury to mandibular canal. (A) Mesioangular impaction with roots in close relation to mandibular canal, (B) Mesial application of force using an elevator forces the root into mandibular canal, (C) Division of the tooth avoids damage to contents of the canal.




**Figs 8.13A to D:** Steps in the surgical removal of a horizontally impacted mandibular third molar. (A) Bone removal to expose the width of the crown and the upper third of the root, (B) Crown sectioned at the cervical region, (C) After removal of the crown, the distal root sectioned at the furcation is brought forwards into the space occupied by the crown, (D) Removal of the mesial root

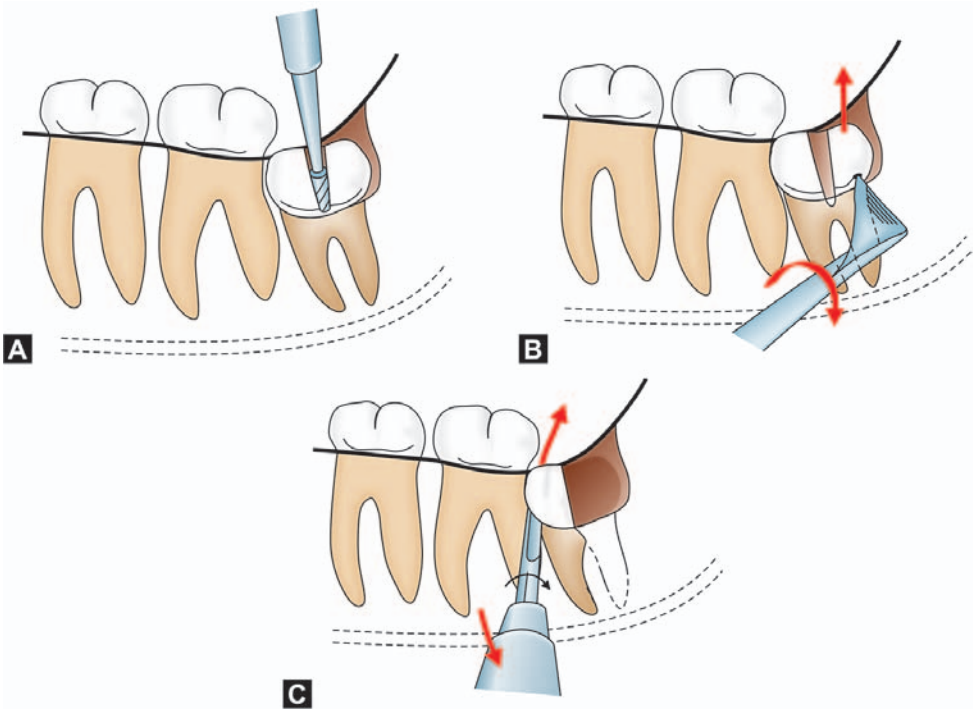
crown and the upper third of the root. The point of application of elevator is procured below the mesiobuccal aspect of the impacted crown. The tooth is then sectioned at the cervical region and the crown is removed from the socket. The root is then brought forwards into the vacant space previously occupied by the crown and it is then removed either in a single piece or after sectioning.

In cases where the impacted tooth is not locked beneath the distal convexity of the crown of the second molar and when adequate amount of distal bone has been removed, it is possible to turn the tooth into a vertical position by application of force in the mesial aspect. This is similar to the procedure already described for the removal of mesioangular impactions. Use of further force with the elevator will expel the tooth out of the socket or force can be applied on the buccal side to remove the tooth.

In all cases of sectioning, the cut should be kept within the tooth structure to prevent damage to the lingual tissues and the inferior alveolar canal.

The vertical impaction (Figs 8.14A to C) is one of the more difficult ones to remove, especially if it is impacted very deeply. The procedure for bone removal and sectioning is similar to that of a mesioangular impaction. Here also the bone is removed first from the occlusal, buccal, and distal aspect. The distal half of the crown is then sectioned and removed, and the tooth is elevated by applying a small straight elevator at the mesial aspect of the cervical line. Another alternative is to make a purchase point on the buccal side of the tooth as in mesioangular impaction and the tooth is then delivered using a Cryer's elevator.

In less deep vertical impactions, where a wide follicular sac exists behind the third molar mesial application of force with an elevator can easily dislodge the impacted tooth out of the socket and no bone removal is required. When adequate bone removal is not performed on the distal aspect of the crown or when there is no follicular sac behind the third molar, application of excessive force on the mesial aspect of the impacted tooth with an elevator can result in fracture of mandible. In cases where the roots are widely divergent, crown is divided first followed by sectioning of roots and its subsequent removal.

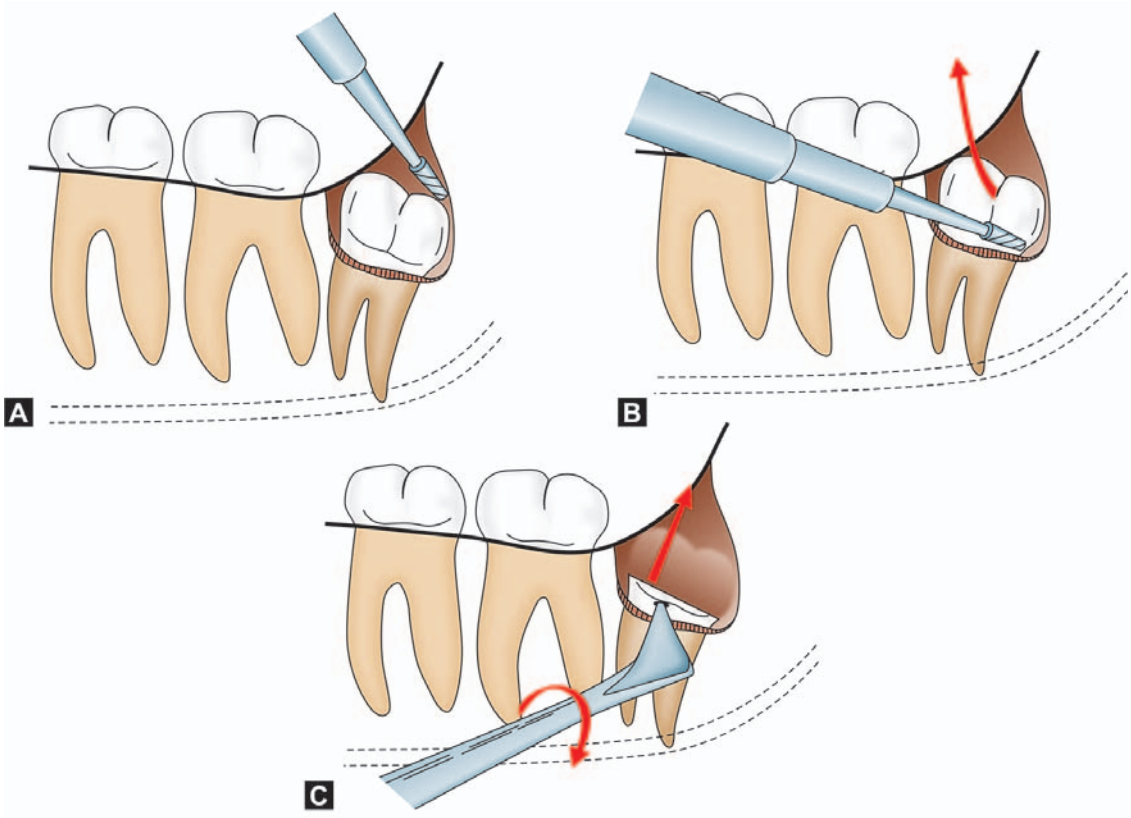



**Figs 8.14A to C:** Steps in the surgical removal of a vertically impacted mandibular third molar. (A) Bone removal to expose the width of the crown, (B) Distal half of the crown sectioned up to the furcation and it is removed along with the root, (C) Mesial half of the tooth is elevated by mesial application of force at the cervical line

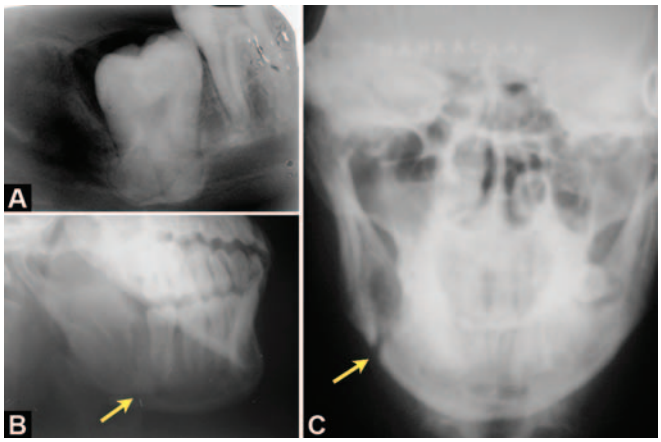
A deep, vertically impacted third molar below the cervical line of the second molar and fully covered with bone present a difficult challenge for the surgeon. In such cases, the tooth should be exposed and a buccal and distal trough created. The tooth is then elevated en mass with subsequent sectioning of crown in a horizontal fashion. The roots can be elevated in one piece or sectioned and removed as separate pieces with the elevation of distal preceding that of the mesial. It is important that the operator should attempt to preserve as much root structure as possible to serve as a 'handle' for elevation. This is because, dealing with small segments that have not been luxated is where most difficulty is encountered in third molar removal.

The distoangular impaction (Figs 8.15A to C) is considered to be the most difficult tooth to remove. This is because the pathway of delivery for an elevated distoangular impaction is into the vertical ramus of the mandible. The goal of the technique for removal of these teeth is to create an adequate buccal and distal trough (guttering) around the full crown of the tooth to a depth below the cervical line. This will permit to create a point of application of elevator on the buccal aspect of the tooth. Then using the buccal cortical plate as the fulcrum, force is applied to elevate the tooth out of the socket upwards and distally. If some movement is obtained, the distal portion of the crown or the complete crown can be sectioned in a horizontal fashion from the roots and removed. The sectioned crown may be sectioned again if inadequate space is available for its removal. It is preferable in this case to section the tooth segments further as needed rather than to remove more bone. This will ensure preservation of the structural integrity of the mandible. The roots are then delivered together or sectioned and delivered independently with a Cryer's elevator.

Generally in distoangular impaction, surgery is more difficult than other angulations because more distal bone must be removed, to permit the distal rotation of the tooth. The tooth tends to be elevated posteriorly into the ramus




**Figs 8.15A to C:** Steps in the surgical removal of a distoangularly impacted mandibular third molar. (A) Bone removed to expose the full crown of the tooth to a depth below the cervical line, B) Crown sectioned in a horizontal fashion from the roots and removed, (C) Roots are then delivered together or sectioned and delivered independently with a Cryer's elevator




**Figs 8.16A to C:** (A) Intraoral periapical X-ray of a distoangularly impacted (complete bony impaction) 48 with the apex close to the mandibular canal. Attempted extraction of the tooth without adequate bone removal by a general dental practitioner resulted in fracture of mandible (note the yellow arrows in B and C)

of the mandible. Attempt to exert more force when resistance is encountered will result in fracture of the mandible (Figs 8.16A to C).

In cases where tooth sectioning is required, the distal root should be elevated first followed by the mesial root.

Once the tooth is delivered, do not throw it away. Examine it carefully to note whether it has come out in full or any part of the fractured root or crown is there in the socket. Only after full satisfaction the tooth is discarded. The tooth may be shown to apprehensive and suspicious patients and their by stander. This is a practice that can be considered depending on the case.

### *4. Debridement*

Once the impacted tooth is delivered from the alveolar process the surgeon must pay strict attention to debriding the wound of all particular bone chips and other debris. This is best accomplished by mechanically debriding the socket and the area under the flap with a periapical cruet. A bone file is used to smooth any rough and sharp edges of the bone. Instead an acrylic trimmer on a handpiece also can be used. A mosquito hemostat is employed to remove any remnant of the dental follicle in order to prevent the formation of a cyst later on. Fractured interdental septum or large pieces of bone is also removed using a hemostat. In certain instances a fractured portion of lingual plate may remain. Using a hemostat it is palpated to determine whether it is mobile. If it is having adequate attachment it may be left as such. If the vitality of the fractured piece is doubtful it may be detached gently from the periosteum without causing injury to lingual nerve which may be lying nearby. Finally the socket and the wound margins (including under surface of mucoperiosteum) is irrigated with saline to remove bone and tooth debris. It has been observed that, the more irrigation is used, the less likely the patient is to develop a dry socket, delayed healing, or other complications.

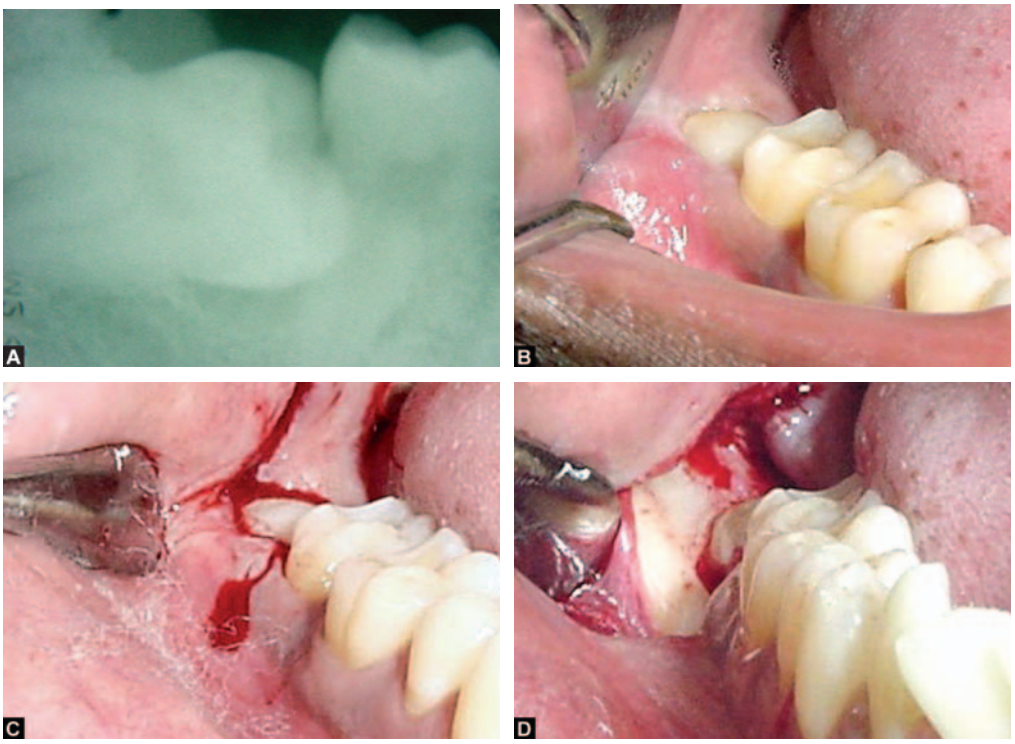
### *5. Wound Closure*

Bleeding from the socket is completely arrested before attempting closure. Troublesome bleeding from the socket can be controlled using bone wax, surgicel or gelfoam. Post operative bleeding from the depth of the socket coupled with a tight suture will cause the blood to escape into surrounding tissue spaces leading to buccal or lingual hematoma or ecchymosis. The flap is then returned to its original position and the initial suture placed just distal to the second molar. It is opined that this suture reduces the possibility of the development of periodontal pocket distal to the second molar. The needle is passed from the buccal to the lingual side. Certain authors advice the other way. Additional sutures are then placed as necessary. The sutures should be just tight enough to hold the flap. Over tightening is avoided at all costs. The vertical component of the incision is left unsutured since it will act as a wound toilet. In cases where the anterior vertical incision has been carried forwards up to the mesial aspect of second molar, the wound is closed with two sutures. Here the first suture is placed between the first and second molar by passing the needle from lingual to buccal side through the interdental space between the two. After this the second suture is placed in the usual position distal to second molar. If the flap is not repositioned properly and sutured correctly it may be heaped up over the crown of the second molar. This will lead to its ulceration due to impingement of the upper teeth during closure of the mouth and final breakdown of the wound.

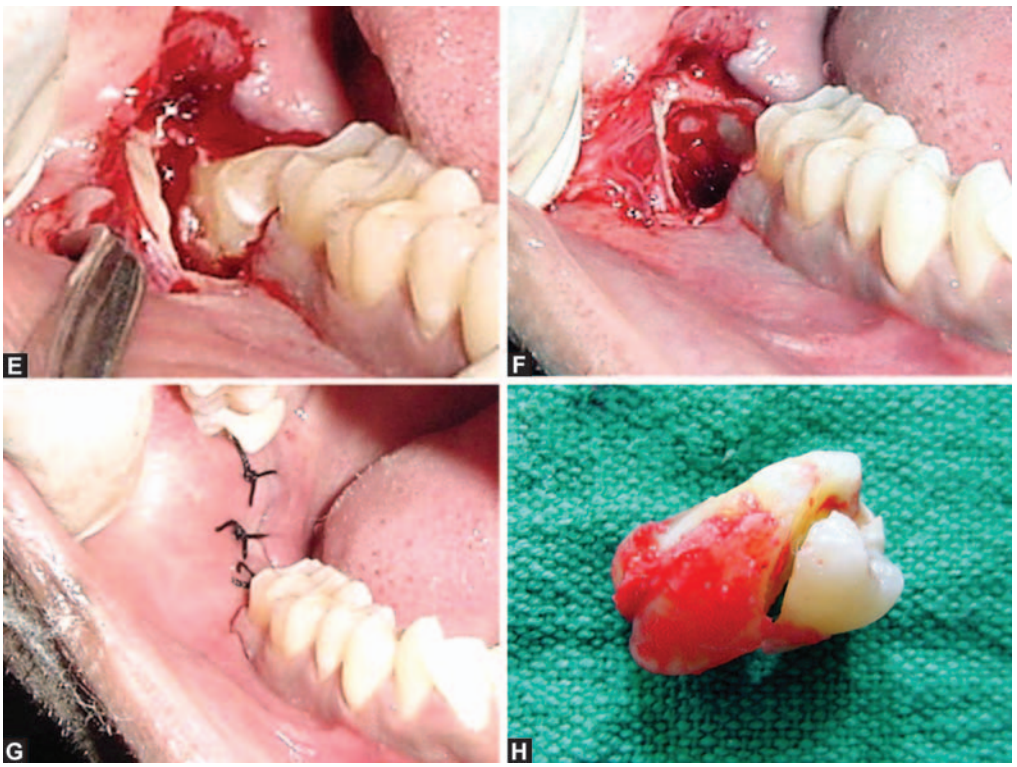
The patient is then asked to bite firmly on a gauze piece for 30 mts. to one hour or till the bleeding stops.

Following the procedure oral and written post-operative instructions can greatly help the patient and also ensure better patient compliance.

**Removal of Impacted Mandibular Third Molar in an Edentulous Mandible:** The basic principles regarding




**Figs 8.17 A to D:** Steps in the surgical removal of horizontally impacted right mandibular third molar tooth. (A) Periapical radiograph, (B) Pre operative view of impacted tooth, (C) Incision marked, (D) Mucoperiosteum reflected




**Figs 8.17E to H:** Steps in the surgical removal of horizontally impacted right mandibular third molar tooth contd. (E) Bone removal and tooth division, (F) Surgical site after debridement, (G) Suturing completed, (H) Specimen

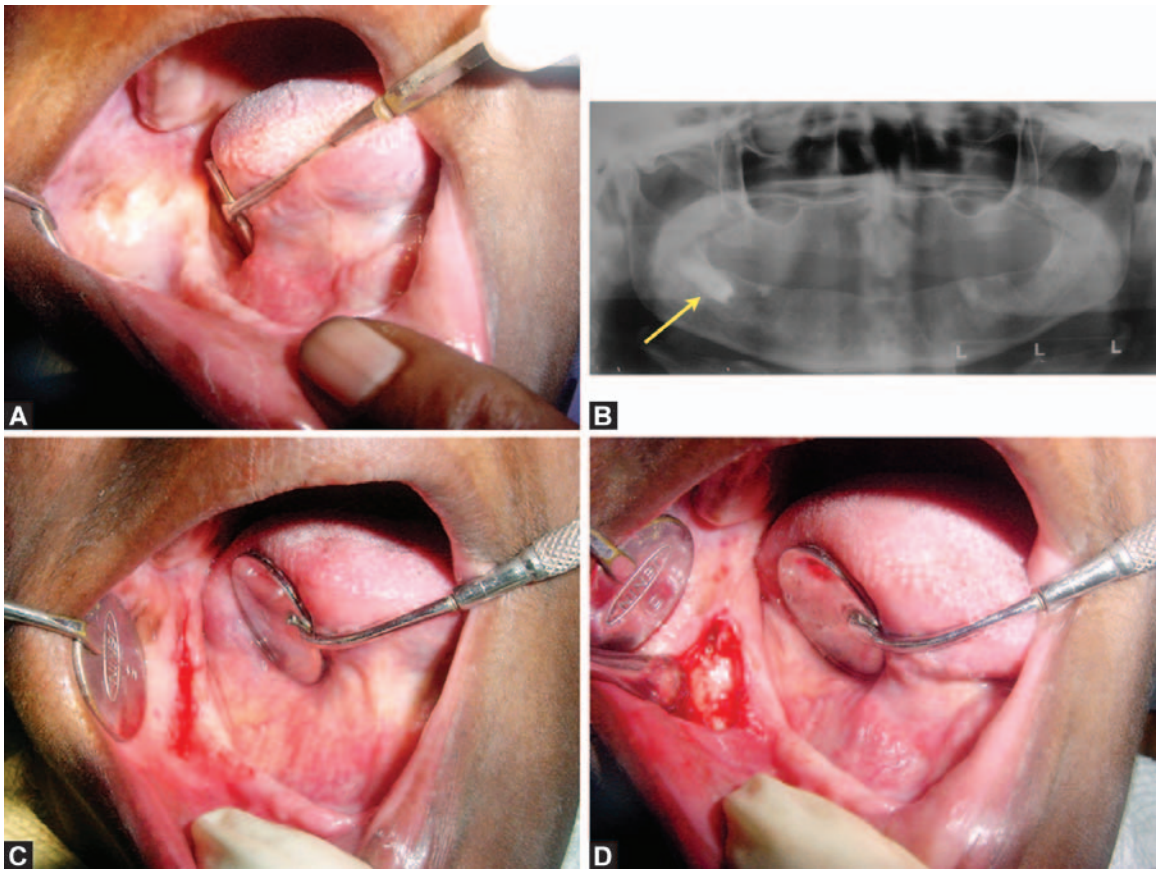
**Figs 8.17A to H:** shows the steps in the surgical removal of a horizontally impacted right mandibular third molar.

the removal remain same in this situation also. However, technically the surgery is more difficult due to the following reasons:

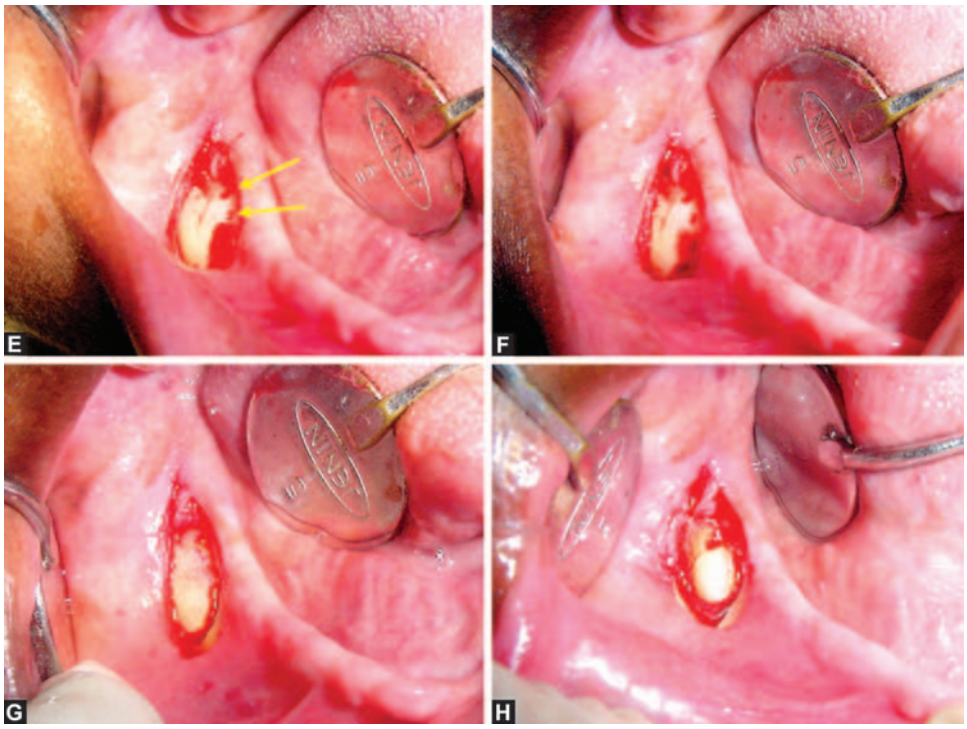
- Patient is often elderly and hence the bone is more sclerosed and less elastic.
- Absence/reduced periodontal tissue for the tooth.
- Associated systemic diseases which may complicate the surgical procedure.
- Vertical height of mandible is reduced due to resorption following loss of teeth.
- Major part of the angle of mandible is replaced by the impacted tooth, thus reducing the overall strength of the jaw making it more prone to fracture.
- Use of chisel for removal of bone and for splitting of tooth should be avoided to prevent the possibility of fracture of mandible. Instead use of bur with continuous saline irrigation is employed for the above purpose.

In cases where the patient has been using complete denture for some time, the impacted third molar may slowly erupt into the oral cavity causing pain and ulceration. Removal of such tooth is easier than deeply impacted ones which very often remain symptom less.

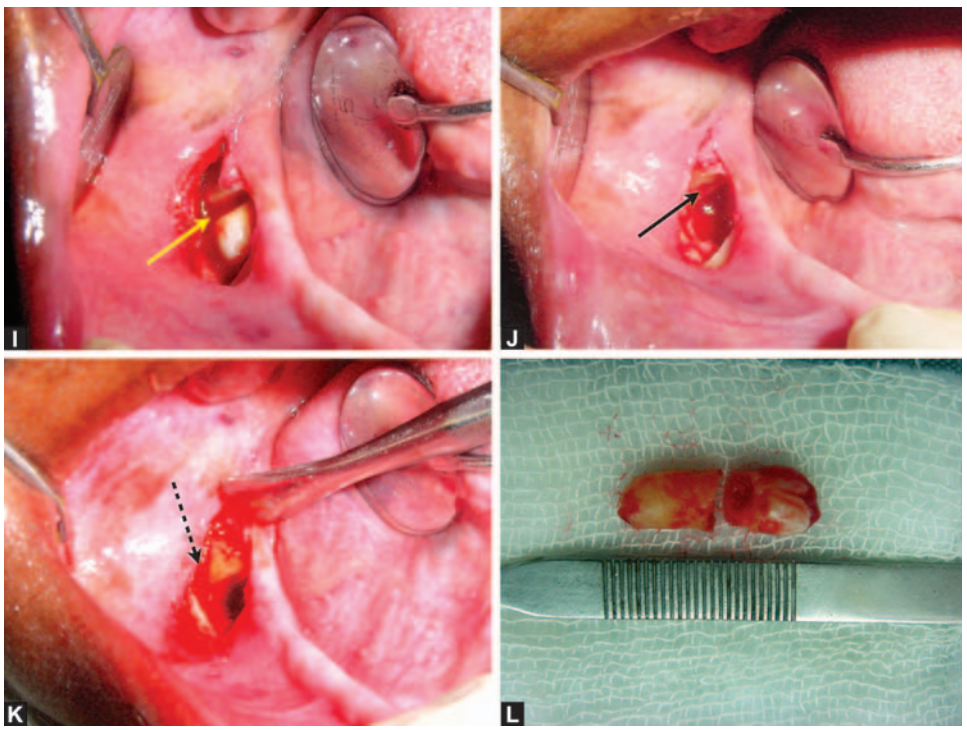
Patients should undergo a proper preoperative physical examination to rule out the possibility of any systemic disease which may modify or complicate the planned surgical procedure. Radiographic examination should include periapical, occlusal, OPG and if required a lateral oblique film of mandible. X-rays should be of good quality to reveal the position, size and shape of the impacted tooth including the root and also the investing bone. In deeply impacted tooth periapical X-rays are often inadequate to visualize the tooth completely including the roots. Hence in such cases OPG or extraoral X-rays are mandatory. While evaluating the radiograph, due consideration should be given to the amount of bone



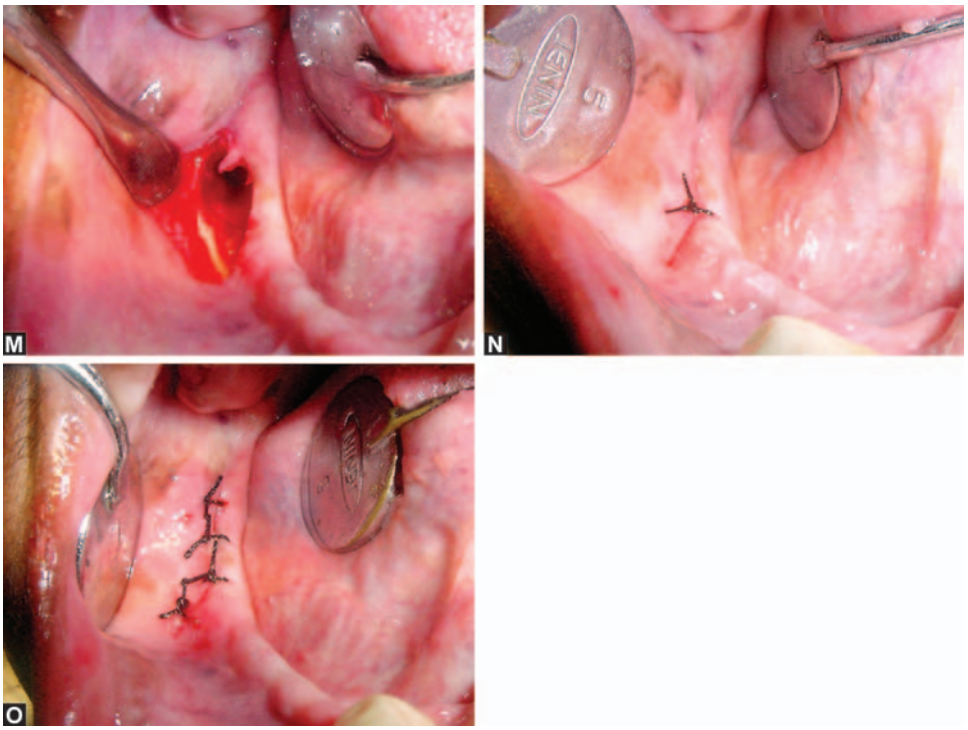

**Figs 8.18 A to D:** Steps in the removal of an impacted mandibular third molar in an edentulous jaw- (A) Third molar region of edentulous mandible-right side, (B) OPG showing horizontally impacted right third molar (yellow arrow), (C) Incision placed, (D) Mucoperiosteum reflected to expose the bone




**Figs 8.18E to H:** Steps in the removal of an impacted mandibular third molar in an edentulous jaw contd. (E) Drill holes made in the buccal cortical plate overlying the impacted tooth (yellow arrows), (F) Multiple drill holes made in the cortical plate, (G) Drill holes connected using bur (chisel can also be used to connect the drill holes), (H) Buccal cortical plate removed to expose the crown




**Figs 8.18 I to L:** Steps in the removal of an impacted mandibular third molar in an edentulous jaw contd. - (I) Crown sectioned at the cervical margin, (J) Sectioned crown removed (note the black arrow pointing towards the root), (K) Root pushed into the space (note interrupted arrow) created by the removal of the crown and the root is then removed, (L) Specimen




**Figs 8.18 M to O:** Steps in the removal of an impacted mandibular third molar in an edentulous jaw contd. - (M) Socket after debridement, (N) First suture placed, (O) Suturing completed

**Figs 8.18 A to O:** Show the surgical steps in the removal of an impacted mandibular third molar in an edentulous jaw

between the inferior border of the mandible and the apex of the tooth as well as the thickness of the buccal and lingual cortical plates.

Intraoral versus extraoral approach: The type of approach to be employed is dictated by the amount of bone overlying the impacted tooth. If the tooth is superficial with minimum bone coverage it can be considered for removal via intraoral approach under local anesthesia. If on the other hand there is considerable amount of bone superior to the impacted tooth (i.e. the tooth is situated closer to the lower border of mandible), removal of that much amount of bone to access the tooth intra orally is likely to further weaken the mandible leading to fracture of the jaw intra operatively or post-operatively. In such cases a wiser option is to remove the tooth by an extraoral approach (submandibular approach) under general anesthesia by an experienced oral and maxillofacial surgeon.

Before attempting surgical removal of impacted mandibular third molar in an edentulous jaw it is always prudent to inform the patient regarding the possibility of jaw fracture and obtain the consent.

## Summary of Surgical Procedure

Any associated infection should be treated pre operatively with systemic antibiotics, chlorhexidine mouth rinses, local dressing and lavage prior to surgery.

The surgical procedure generally involves raising of soft tissue flaps for exposure, removal of bone using either chisel or bur with water-cooled irrigation, delivering the tooth with or without division, and wound toilet.

The surgical procedure to be carried out depends on the following:

- Status of eruption of the tooth
- Type of impaction
- Proximity to surrounding structures e.g. relationship of the inferior dental and lingual nerves.

While the raising of tissue flaps is always associated with post-operative pain and trismus a smaller incision with minimal reflection will result in less pain and swelling. Removal of the impacted teeth through the buccal approach without lingual tissue retraction minimizes the risk of lingual nerve damage. When the surgery is performed with lingual split technique together

with lingual flap retraction, the incidence of lingual nerve injury appears to be even greater. The placement of a periosteal elevator or lingual nerve retractor to protect the lingual tissue during surgical removal of impacted wisdom teeth appears to increase the incidence of lingual nerve damage. However, lingual nerve injury associated with lingual flap retraction is found to be temporary. There is conflicting evidence as to the most appropriate form of protection for the lingual nerve. Generally, minimal interference to the lingual soft tissue is associated with a low incidence of lingual nerve injury. Retention of the lingual plate gives optimum protection to the lingual nerve during removal of impacted third molar. Exposure or intra-operative opening the mandibular canal during surgery greatly increases the incidence of inferior alveolar nerve paresthesia. Excessive removal of bone and vertical sectioning of the impacted teeth may lead to inferior alveolar nerve injury. Any suspicious pathological material should be sent for histopathological examination. Occasionally, a small fragment of the apical root of a vital tooth may be left behind if its removal carries a greater risk of complication than retention. In these situations, the patient should be informed and recorded in the case notes.

Specific methods may vary among dental surgeons based on training and experience, but they all should correspond to basic and established principles of surgical techniques. It is sensible not to be too dogmatic in one's approach to the problem.

The experienced and the mature surgeon knows when it is in the best interest of the patient to defer an operation for detailed planning or refer it to a specialist. How many impacted teeth should be removed in one operation will depend upon the difficulty of the operative procedure as well as upon the age and the physical condition of the patient. To be on the safer side, if all the third molars are impacted, it is better to perform the surgery in two sittings.

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CHAPTER

# 9

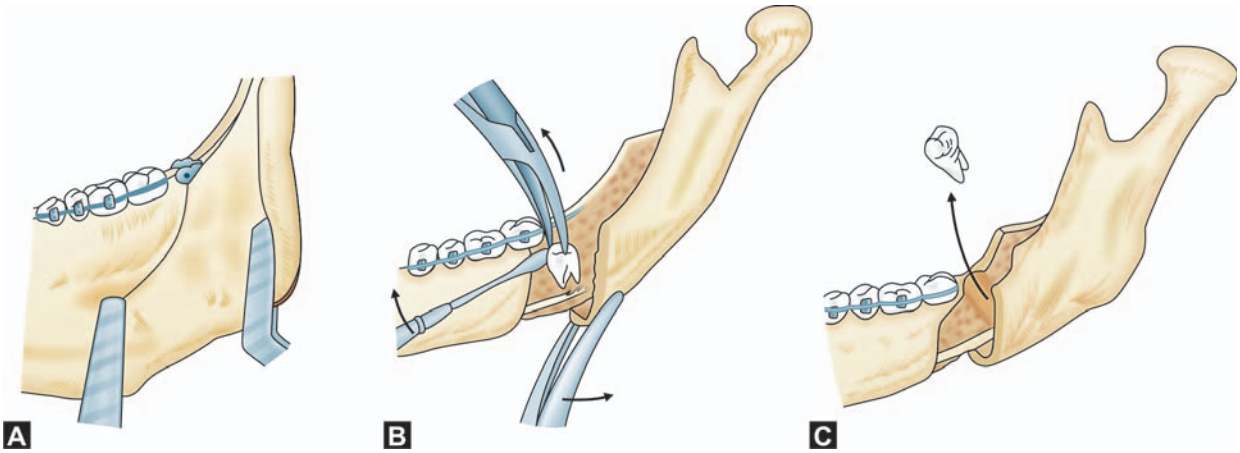
# Other Methods for Removal of Impacted Lower Third Molar

The standard surgical technique of removal of impacted third molar has been described in the previous chapter. However there may be instances where other methods of surgical removal also have to be considered. This is because, no technique is suited to every case and it will be ideal to learn the different methods and choose the appropriate one depending upon the case.

**1. Sagittal split ramus osteotomy:** This technique has been conventionally used for the surgical correction of mandibular excess (push back) and for mandibular deficiency (advancement). Recently this has been used to remove deeply impacted mandibular third molars as reported by Amin (1995)[1] and Toffanin (2003)[2] and Jones (2004)[3]. This is not done as a standard procedure for removal of impacted tooth, but performed when indicated. The various steps involved in the procedure are given in Figures 9.1 A to C.

In a case reported by Jones et al (2004)[3] a 48-year-old man who, after a 5 year history of recurrent infection and intermittent trismus associated with a deeply impacted lower right third molar tooth, presented to the accident and emergency department with severely limited mouth opening, extensive facial swelling and pyrexia. The lower right third molar was later removed successfully through a sagittal split ramus osteotomy approach. This case shows that the sagittal split osteotomy have a valuable role in the removal of deeply impacted lower third molars, particularly when they are in close proximity to the inferior alveolar nerve.

In another case reported by Amin (1995)[1] elective sagittal splitting of the mandible was used to gain access




**Figs 9.1A to C:** Schematic diagram showing steps in the surgical removal of impacted mandibular third molar by sagittal split ramus osteotomy. (A)Incision in the buccal sulcus extending posteriorly along the coronoid process, (B) Sagittal splitting of the ramus showing the impacted third molar inside, (C) Removal of impacted tooth

to an impacted lower third molar, which was intimately involved with the inferior alveolar nerve.

The main disadvantages of conventional surgical technique if used in the above case reports are: the great extent of bone to be removed, limited visibility, high risk of injury to the inferior alveolar nerve, and fracture of the mandible. In comparison, sagittal split ramus osteotomy gives good access, conserves bone that would otherwise have been removed, and allows the nerve to be seen and avoided. However, the osteotomy puts the occlusion at risk (although this is rare) and there is a risk of an unfavorable split in either the proximal or distal segment (2%). This is about twice as high if the third molar is impacted. The published incidence of disturbance of the inferior alveolar nerve is high: as much as 58% at six months, and 35% at one year postoperatively.

**2. Buccal corticotomy:** An alternative approach that offers access to deeply impacted mandibular teeth is by buccal corticotomy A trapezoidal mucoperiosteal flap is raised in the mandibular molar region, and a rectangular window is made over the deeply impacted tooth using a narrow fissure bur, with the mesial and distal cuts almost reaching the inferior border of the mandible (Fig. 9.2). The buccal corticotomy window is removed with an osteotome. The deeply impacted molar is exposed, divided with a bur and removed. The alveolar nerve bundle is often in close proximity and may be seen after the tooth has been removed. The bony fragment removed at buccal corticotomy is replaced and secured with wires or plates and screws at the mesial and distal edges, and the wound is sutured.

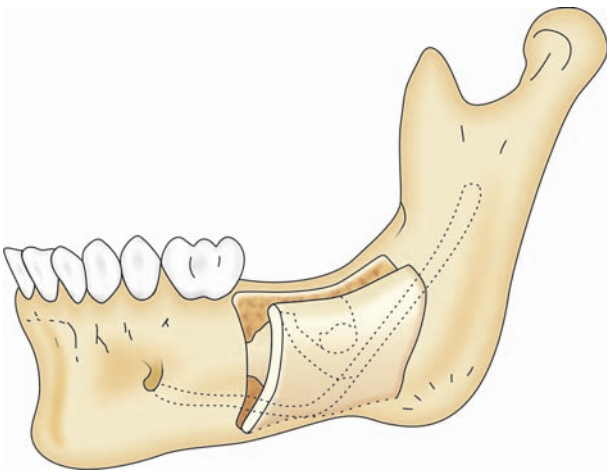
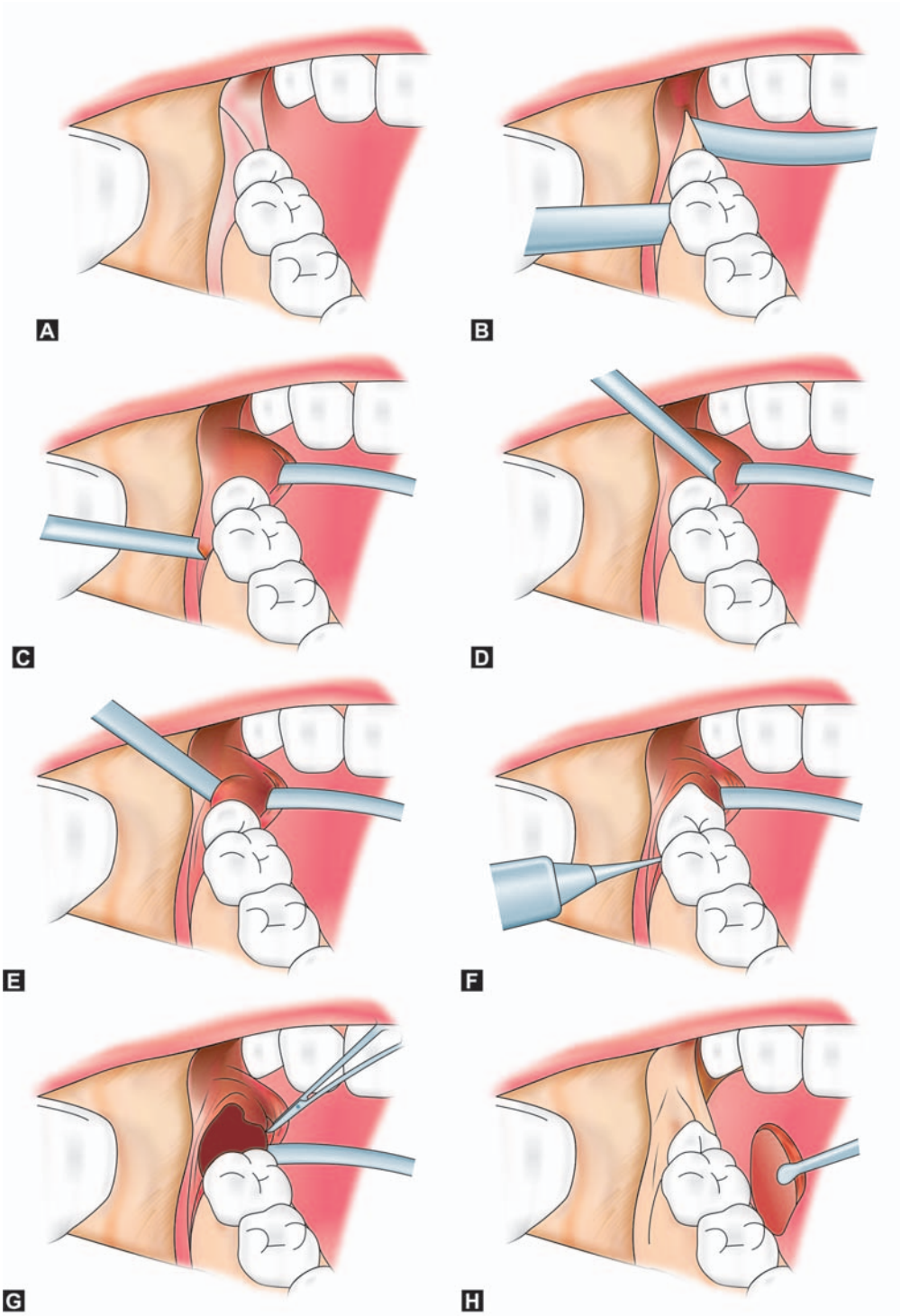


**Fig. 9.2:** Showing bone cut in buccal corticotomy.

Tay (2007)[4] reported 2 cases; a 17-year-old girl with a deeply impacted left lower second molar and another a 12-year-old boy with a deeply impacted left lower first molar and a complex odontome in place of the left lower second molar. In both cases, computed tomograms showed the location of the mandibular canal in relation to the deeply impacted teeth and the buccal cortex. The deeply impacted teeth (and odontome in the second case) were completely removed piecemeal and both patients recovered well and showed evidence of bony healing on radiography 6 months later. The second patient had mild paresthesia of his left lower lip and chin, which resolved after a month.

**3. Lingual Split technique (Figs 9.3A to H):** This technique was first described by Ward in 1956[5]. The technique continues to be popular in the United Kingdom but has not gained wide acceptance in the United States (Farish and Bouloux, 2007).[6] The method involves the use of a chisel and mallet to remove or displace the lingual plate of bone adjacent to lower third molar. A small amount of buccal bone is often removed to facilitate exposure of the crown and provide a point of application for an elevator. Although tooth division is usually not required, it can be achieved with a chisel. Several minor modifications to the original technique have been reported. Although the lingual split technique is well suited to patients being operated under general anesthesia or sedation, it is not appropriate for surgery conducted purely under local anesthesia. This procedure is suitable mainly for young patients where the bone is elastic and where the grain is prominent. Surgery is comparatively quick and clean if the case selection is correct. Moreover, this technique has the advantage of reducing the size of the blood clot by means of saucerization of the socket. Possibility of development of transient lingual nerve anesthesia (rarely permanent) in the postoperative period is considered a major disadvantage. This may be the reason for the lack of popularity for the technique. The exact cause and the timing of lingual nerve injury are not well understood and may be multifactorial. Most studies that evaluate lingual nerve injury are retrospective, involve small sample sizes or are poorly controlled for multiple confounding variables and should be interpreted with some caution. Temporary lingual nerve injury has been reported to vary from 0.8% to 20%, where as permanent injury has been reported to vary from 0% to 1%.




**Figs 9.3A to H:** (A) Incision marked, (B) Reflection of lingual mucoperiosteum and placement of chisel for buccal vertical stop cut (C) Horizontal bone cut to the distobuccal aspect of third molar for removal of buccal bone, (D) Positioning of chisel on the distolingual aspect of the crown of the third molar held at an angle of 45° to the bone surface and pointing in the direction of the lower second premolar of the opposite side. (E) Excising bone on the distal aspect of third molar, (F) Application of a straight elevator on the mesial aspect of third molar to elevate the tooth. (G) Fractured lingual plate is grasped with a fine artery forceps and is freed from its soft tissue attachments by blunt dissection, (H) Closure of the wound after debridement, irrigation and hemostasis. A single suture placed distal to the second molar is sufficient for adequate closure. The vertical incision in the anterior part is left unsutured

## Steps in the Surgical Procedure

Position of the operator: When removing a lower third molar on the right side, the operator must stand on the right side of the patient. While for the removal of a lower left third molar the surgeon must stand on the left side of the patient (Farish and Bouloux, 2007)[6]. This is in contrast to the bur technique, which is usually performed with the surgeon standing on the right side of the patient for all third molar teeth.

The surgical technique remains relatively the same regardless of the Pell and Gregory classification of impaction. Occasionally a bur may be needed to facilitate tooth division and bone removal. A rubber mouth prop is placed between the teeth on the side contralateral to surgery.

a. Standard incision (as shown in the figure) is given. The buccal flap is then raised in a subperiosteal plane using a #9 periosteal elevator. The flap should be extended just slightly beyond the external oblique ridge to prevent excessive dead space beneath the flap. A 2-0 silk traction suture is then placed through the apex of the triangular flap. The suture should be clamped with a heavy hemostat 6 to 8 inches from the flap, which is then allowed to rest on the skin of the cheek so that the flap is kept retracted.

   Attention is then directed to raising a lingual flap, which is done carefully in a subperiosteal plane. A sharp and a slightly curved periosteal elevator such as #9 Molt or a Freeier periosteal elevator is well suited for this purpose. The flap should be raised along a broad length extending from the mesial aspect of the second molar to the lingual aspect of the anterior ramus. This helps to reduce the tension placed on the lingual nerve which adheres to the periosteum. The inferior aspect of the pterygomandibular raphe, superior constrictor muscle along with a small portion of the mylohyoid muscle is included in this flap. It should be remembered that the lingual nerve enters the sublingual space by passing between the superior constrictor and mylohyoid muscles. At this point the nerve is immediately beneath the periosteum and is at risk from trauma. After the elevation of the lingual flap, a Hovell's retractor is placed beneath the flap and allowed to sit passively.

b. Using a sharp 3 mm chisel a vertical stop cut is made (with the bevel of the chisel facing posteriorly) at the anterior part of the wound just behind the level of the roots of the second molar. This cut must extend from the crest of the alveolar bone superiorly to a point inferiorly that allows buccal exposure of sufficient tooth structure to place an elevator either mesially or buccally depending on the type of impaction.

c. Then, using a 5 mm chisel with the bevel facing superiorly a horizontal cut is made backwards from a point just above lower end of the stop cut to the distobuccal aspect of third molar. The sectioned piece of the buccal bone is loosened and removed there- by exposing a portion of the third molar crown. The next step is to obtain a point of application for the elevator mesial to the impacted tooth. This is achieved using the chisel by excising a triangular piece of bone bounded anteriorly by the lower end of the stop cut and above by the anterior end of the horizontal cut.

d. The most difficult and crucial aspect of the lingual split is as follows. This step can be considered the most critical one in which the lingual nerve is at risk. Here the distolingual bone is fractured inwards by placing the cutting edge of a 5 mm chisel just posterior to (as shown in the figure) and pointing in the direction of the lower second premolar of the opposite side. In its correct position the cutting edge of the chisel will be parallel to the external oblique ridge. (On the other hand if the cutting edge is held parallel to the internal oblique ridge, the lingual split will extent to the coronoid process). Then a few light taps with the mallet will separate the lingual plate from the alveolar bone making it to hinge on the lingual soft tissue. This step will ensure that the main part of the shelf-like support to the impacted tooth is lost and thus the main resistance to its effective delivery is eliminated. The anterior aspect of the fractured lingual cortex usually extends as far as the mesial aspect of the third molar, while the posterior aspect may extend up to 1 cm distally. The posterior extend of the fracture is limited by the natural bony lingual concavity behind the third molar. The inferior extend of the fracture typically involves the mylohyoid ridge (Fig. 9.4).

   If the bone fails to split favourably, it must be presumed that the chisel is wrongly aligned. In such an event the instrument should be realigned. Incorrect angulation of the chisel blade (for example directed perpendicularly down to the inferior border or retromolar area) and use of too great a force may cause fracture of mandible distal to the third molar.

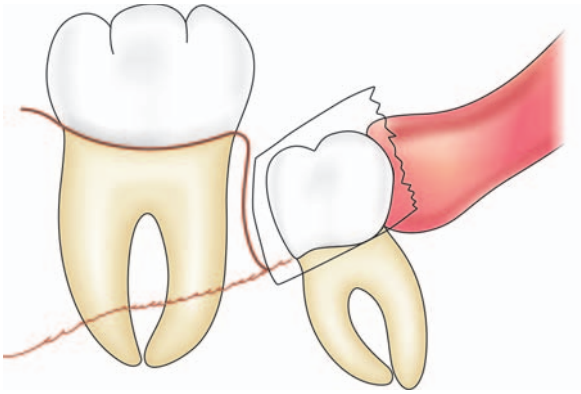


**Fig. 9.4:** When viewed from the lingual side the inferior extent of lingual cortex fracture can be seen which typically extends up to mylohyoid ridge.

e. Next, the bone that remains distal to the tooth and between the buccal and lingual cut is excised.
f. Then a fine bladed straight elevator is applied mesial to the impacted tooth and with a gentle upward and backward force the tooth is elevated out of the socket. During this backward movement of the tooth, the fractured lingual plate is displaced lingually aiding the removal of tooth.
g. The fractured lingual plate is grasped with a fine artery forceps and is freed from its soft tissue attachments by blunt dissection. Often the inferior extent of the fractured lingual plate is attached to the mylohyoid muscle, which is then removed with a periosteal elevator. This step in effect brings about saucerization of the socket which in turn reduces the size of the socket promoting rapid healing.
h. The sharp edges of the bone is then smoothened with a rongeur and bone file. Failure to do this causes areas of bony prominences leading to patient discomfort, potential bone exposure on the lingual aspect and possible injury to lingual nerve. The wound is then copiously irrigated with normal saline. The wound is then inspected for hemostasis, retraction suture placed initially removed and the wound closed primarily with 3-0 catgut. Usually a single suture placed distal to the second molar is sufficient for adequate closure. The vertical incision in the anterior part is left unsutured. This will act as a wound toilet permitting escape of blood in the event of mild oozing in the postoperative period.

Once the adequate amount of lingual plate is removed by this technique majority of impacted mandibular third molars in mesioangular and vertical position can be elevated from the socket with gentle force. However, in cases of distally tilted tooth additional bone removal may be required posteriorly. Similarly horizontally impacted teeth with their crown tightly engaged behind the crown of second molar also will pose a problem for removal. Such cases will have to be managed by sectioning of tooth.

**Modifications:** The Winter's classification and Pell and Gregory classification has some bearing on the applicability of the lingual split technique and any modification needed including the use of bur for bone removal and tooth sectioning.

**Distoangular impaction:** The position of the tooth may limit the accessibility of distolingual bone for the placement of chisel for the final osteotomy cut. This in turn results in a poorly controlled bone split. In such cases it is sensible to remove the crown or its distal part using bur to allow proper chisel placement.

**Tooth located in the ramus:** These teeth also present a problem in performing the osteotomy of the lingual plate. If the bony contour at the distal aspect of the tooth allows placement of the chisel just inside the lingual cortex so as not to cause inadvertent fracture of the ramus, then the procedure can be continued in the standard manner. If the bony morphology is such that a controlled split is unlikely, it is prudent to use bur technique.

**Tooth in Class III position:** Such teeth are deeply located in the mandible. Here the initial buccal exposure is accomplished using either a bur or chisel, the former being more useful when there is inadequate access. The further use of lingual split technique can remove the tooth.

**Mesioangular and horizontal impaction:** Even though they are readily removed using the lingual split technique, a variable quantity of bone overlying the tooth may require the use of bur before the lingual osteotomy. Because only then can the surgeon visualize the distolingual bone and correctly place the chisel to ensure a predictable lingual split.

**Sectioning of tooth (tooth division):** Sectioning of the impacted tooth may be required because of the angulation of the tooth or unfavourable root pattern, both of which decides the path of withdrawal. The two common reasons for the use of bur according to Farish and Bouloux (2007)[6] are: (1) Failure to gain adequate buccal or superior exposure of the unerupted tooth and

(2) Unfavourable relationship between the roots and inferior alveolar nerve (IAN). The IAN is almost invariably located laterally with respect to the roots of the third molar. Hence is less likely to be traumatized when the tooth is displaced lingually.

Occasionally the preoperative radiographic appearance suggests an intimate relationship between the IAN and roots or clinically the angulation of the tooth seems to suggest that the roots may be lateral to IAN. Removing the crown with a bur in combination with lingual split allows the crown to be removed lingually and the roots elevated away from IAN.

If moderate degree of controlled force fails to deliver the tooth, there is no justification to increase the force or to use powerful elevators like the cross bar elevators to dislodge the tooth. In such cases movement of the tooth may be obstructed by the anterior surface of the ramus or 'locking' of the tooth behind the second molar. This necessitates bone removal from the distal aspect of the tooth or sectioning of the crown (Figs 9.5A to C).

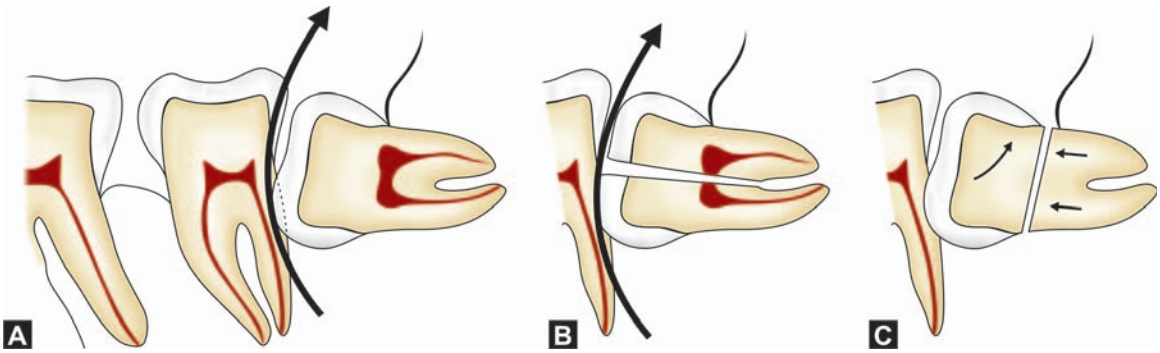
When the tooth is deeply impacted and/or when the bone is sclerotic as in old patients, it is better to discard chisel and resort to the use of bur. In a young adult because of the inherent elasticity of the bone, even horizontally impacted tooth may not need sectioning. A similar case in an aged patient will require tooth division. More over it is technically difficult to chisel small amounts of bone from the depth or around the impacted tooth in an attempt to mobilize it. And in such cases bur is a much viable alternative with regard to better access and speed of surgery.

Before planning to section the crown, it is prudent to expose the cervical one third of the root, so that its identification and subsequent retrieval will be made easy. Division of the crown can be accomplished using a bur or osteotome or a combination of both; the former being more preferable. When a wide fissure bur (SS White# 703) is used for sectioning a horizontally impacted tooth with 'locking', a space is created into which the crown can be dislodged and freed of its obstruction. In such a case, if an osteotome is used no such additional space for movement of crown is created.

Moreover, sectioning of the crown with a bur is technically easier and safer, while the use of osteotome is more dangerous. The osteotome that is being used for tooth division should be 17 cm long and 6 mm wide. For splitting the tooth longitudinally through the root bifurcation, the osteotome is placed in the buccal anatomical groove between the mesial and distal cusps at an angulation of 45° to vertical axis of the tooth (Fig. 9.6). Usually, a single blow with moderate force is all that is sufficient to effect the cleavage of the tooth.

Osteotome has the hazard of causing mandibular fracture if the site of placement of the instrument is incorrect or the force is directed in the wrong direction or the blow is of excessive force. It is safer to section a tooth which is slightly mobile in the socket, so that the full force of the mallet blow is not transmitted to the bone.

Considering the danger and sometimes the ineffectiveness of the osteotome, a better option is to employ a combination of bur and osteotome for sectioning the tooth. A small groove is drilled in the crown of the tooth and then an osteotome is used to complete the split. The bur cut will ensure a predictable line of split while using the osteotome.




**Figs 9.5A to C:** (A) When the crown of the impacted tooth is 'locked' behind the second molar its movement is obstructed when elevation is attempted. Removal of such tooth is facilitated by the division of the tooth using an osteotome (B) or sectioning of crown using bur (C); the latter being easier and less dangerous.

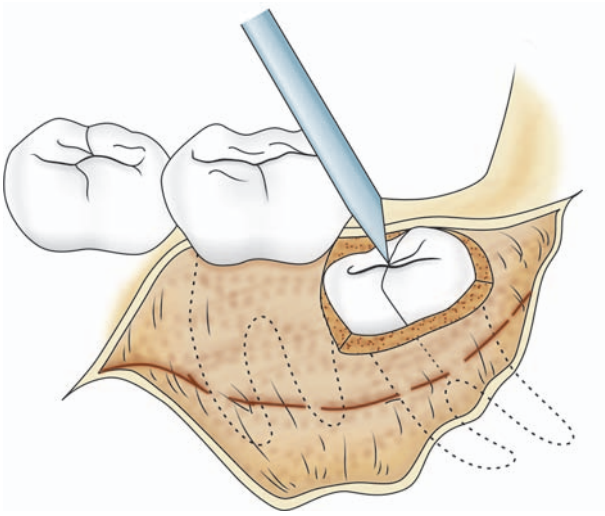


**Fig. 9.6:** Use of an osteotome for sectioning the crown.

Even though there are reports of lingual nerve injury, both transient and permanent, studies have shown that lingual split technique may avoid periodontal pocket formation compared to buccal approach using bur. A study was conducted by Chang et al (2004)[7] to compare the periodontal healing of mandibular second molars after the removal of impacted mandibular third molars using distolingual alveolectomy (lingual split technique) done using chisel and tooth division technique using bur. The results showed better periodontal healing and bone healing when distolingual alveolectomy was performed, especially in the removal of deeply impacted mandibular third molars.

## Modification of Lingual Split Technique

Ever since the introduction of this technique numerous modifications has been suggested to overcome the complications associated with the procedure.

Lewis (1980)[8] suggested a modification. He said that the creation of a buccal defect immediately distal to the second molar for the insertion of an elevator in the standard technique may cause pocketing to occur postoperatively. The method described by him minimizes periosteal reflection, almost completely avoids loss of bone, and effectively reduces the use of rotary instrumentation. The planning of the soft tissue flaps and bony cuts assists in primary wound closure, obliteration of dead space, and reduction of postoperative morbidity.

Yeh (1995)[9] reported a modification of the original technique which is based on an osteomucoperiosteal flap. The technique described is simple, and it requires less time and causes less tissue trauma than other accepted techniques. The bone exposure and bone loss are minimal. The complication rate is extremely low.

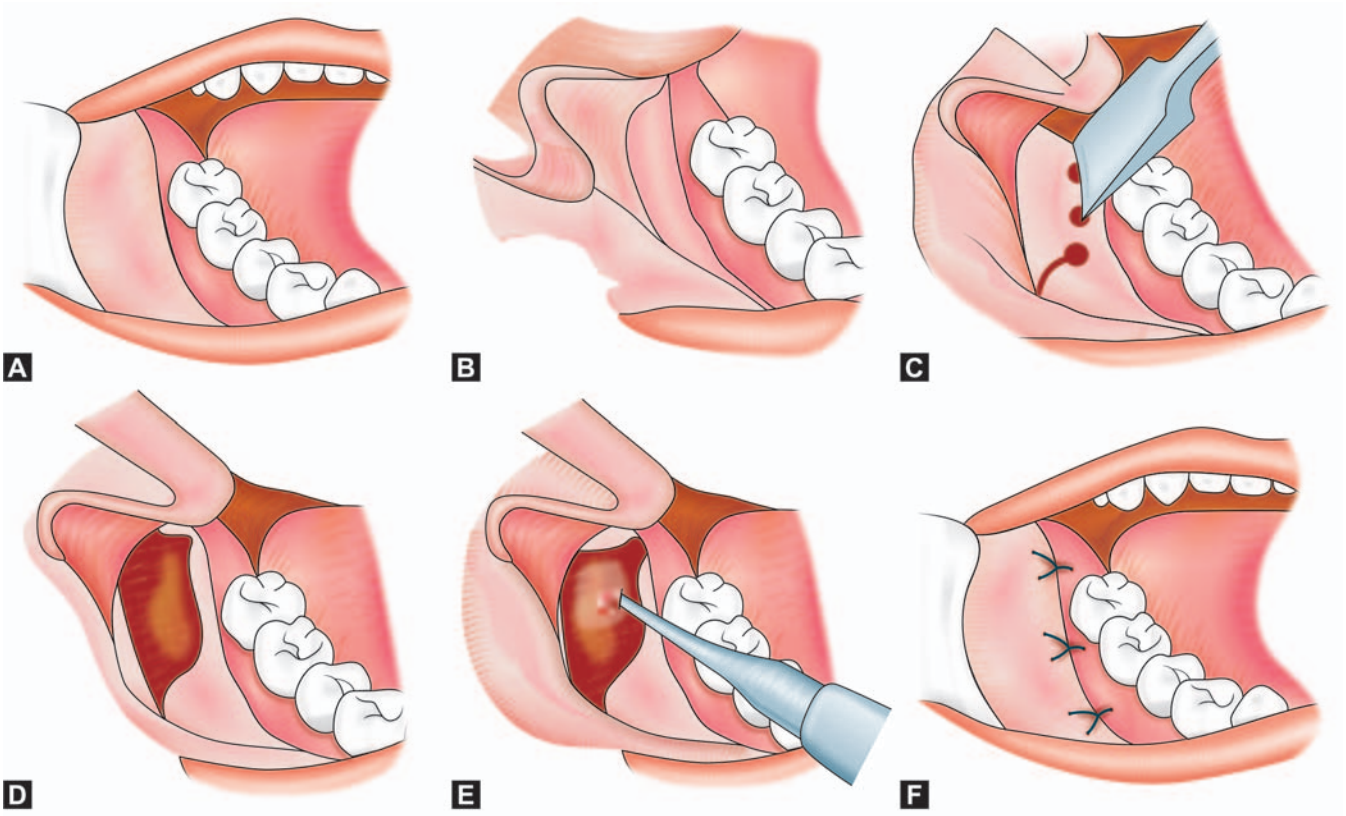
Robinson and Smith (1996)[10] recommended avoiding a lingual flap with the lingual split technique to reduce the frequency of lingual nerve injuries, though elevation of lingual flap is an integral part of the original technique.

Pichler and Beirne (2001)[11] performed a comprehensive review of literature and a meta-analysis comparing lingual split, bur technique with lingual flap and bur technique without lingual flap. They found an incidence of temporary nerve injury of 9.6%, 6.4% and 0.6% respectively. The incidence of permanent nerve injury was reported as 0.1%, 0.6% and 0.2% respectively. Although the lingual split technique seems to result in an increased incidence of temporary lingual nerve injury, the incidence of permanent nerve injury seems to be less than with the bur technique. It seems prudent to avoid a lingual flap with the bur technique because of the reported three fold increase in the incidence of permanent nerve injury. Bouloux (2007)[6] opined that careful elevation of a lingual flap with appropriate sharp periosteal elevator and placement of a suitable retractor are key factors in reducing the incidence of lingual nerve injury. Additional factors likely to influence the incidence of lingual nerve injury include age, surgical time, perforation of lingual plate, nerve exposure and surgeon's experience.

**4. Lateral trepanation technique (Figs 9.7A to E):** This technique first described by Bowdler Henry[12, 13] in 1969 is indicated to remove partially formed un erupted third molar in 9 to 18 years age group patients. The main advantages of the procedure are that the bone healing is excellent, alveolar height is preserved and there is no bony defect or periodontal pocketing distal to second molar compared to later removal of wisdom tooth by conventional methods.

## Surgical Steps

a. The external oblique ridge is palpated and an extended S-shaped incision is made from the retromolar fossa




**Figs 9.7A to F:** (A) 'S' shaped incision from the retromolar area to the first molar region, (B) Reflection and retraction of mucoperiosteum (C) Use of bur and chisel to remove the buccal bone overlying the tooth bud, (D) Exposure of tooth bud and its removal (E) Remnants of the dental follicle are curetted out or removed using a hemostat, (F) Closure of the wound using three or four sutures

directed towards the external oblique ridge. Anteriorly the incision curves down along the buccal mucoperiosteum up to the anterior border of first molar. It is important to leave a cuff of 5 mm width of mucoperiosteum distobuccal to second molar undisturbed.

b. The buccal mucoperiosteum is then reflected and held away using a Bowdler Henry retractor.
c. Using a round bur on a straight hand piece the exact position of the tooth bud / developing tooth is located. Usually this will lie more anteriorly than expected. Following this using the bur, vertical cuts are made in the buccal cortical plate anterior and posterior to the tooth crypt. The two vertical cuts are then connected at the superior aspect by a horizontal cut. A chisel is then placed in the superior horizontal cut with its bevel facing laterally and the buccal plate is out fractured. Care is taken not to disturb the roof of the crypt.
d. The fractured buccal plate is removed using a hemostat to expose the tooth bud in its crypt. A Warwick James elevator is used to eject the tooth out. In certain instances there is a tendency for the bud or the developing tooth to rotate in its crypt or the socket-like a pea in a pod. If any difficulty is experienced in effecting the delivery of the tooth, it can be overcome by excising a little more bone from the periphery of the window using a bur.
e. Remnants of the dental follicle are then curetted out or removed using a hemostat. Due to the close proximity of neurovascular bundle, curettage of the lower part of the cavity is contraindicated.
f. The bone margins are then smoothened and the wound copiously irrigated with normal saline. Closure of the wound is then done using three or four sutures.

Authors generally advice this technique of germectomy for: (a) developing third molars which are likely to get impacted in the future; (b) to gain space in the posterior segments of the lower jaw when distalization of first and second molars is necessary; (c) in case of excessive anterior-posterior mandibular growth.

There are conflicting reports in the literature, some of which favour and others differ. Chiapasco et al (1995)[14] conducted a study to analyze and compare complications and side effects after removal of 1,500 mandibular impacted third molar teeth in three age groups i.e. group A, 9 to 16 years; group B, aged 17 to 24 years; and group C, older than 24 years of age. The study showed no significant difference in the complication rate between groups A and B, but complications significantly increased in group C.

Chossegros et al (2002)[15] conducted a prospective randomized study to identify the need for lingual nerve protection for lower third molar germectomy. Data from a total of 300 germectomy procedures were included in this study. It was observed that there was no lingual nerve injury after third molar germectomy, regardless of whether or not lingual nerve protection was used.

**5. Partial Odontectomy:** Injury to inferior alveolar nerve (IAN) is a possible complication following surgical removal of impacted mandibular third molar. Hence it is advisable to carry out a technique that may reduce the possibility of injury. The technique of partial odontectomy (coronectomy, deliberate root retention) is one procedure that can be considered to protect the IAN. Even though it has been suggested by many authors in the past, currently the technique does not enjoy a strong body of support (Pogrel, 2007)[16]. Previously, the relationship between the roots of mandibular third molar and IAN were assessed radiographically using an orthopantamograph (OPG). The following radiographic features suggest an intimate relationship:

- Darkening of the root and interruption of the white line of the canal
- Narrowing of the canal
- Deflection of the roots

Studies have shown that those cases showing intimate relationship between the roots of teeth and IAN, 14% developed nerve injury. Recently with the development of low dose cone beam CT, accurate three-dimensional imaging can be performed to demonstrate the relationship between the roots of the third molar and the IAN. The current recommendation is that when the OPG suggests a close relationship between the roots of the lower third molar and IAN, cone beam CT scanning should be advised.

*Rationale:* Cases in which an intimate relationship is confirmed, the technique of partial odontectomy (coronectomy) merit consideration. The intention of coronectomy or partial root retention is that the part of the root intimately related to IAN is left undisturbed. Adequate amount of root must be removed below the crest of the lingual and buccal plates of bone to enable bone to form over the retained roots as part of the normal healing process (Pogrel, 2007)[16]. At the same time it is also important not to mobilize the roots, because of the possible damage to IAN or the mobile roots might become a foreign body initiating infection.

## Contraindications to Partial Odontectomy

- Active infection around the tooth particularly involving the radicular portion.
- Mobile teeth - any retained mobile root will act as a foreign body becoming a nidus for infection.
- Horizontally impacted tooth along the course of the nerve, because sectioning of such a tooth will damage the IAN. Hence the technique is more applicable for vertical, mesioangular and distoangular impactions.

*Technique*-Prophylactic antibiotic is administered to ensure adequate concentration of antibiotic in the pulp chamber of the tooth to be sectioned. Incision and elevation of the mucoperiosteal flap is similar to the conventional method as shown in the Figure 9.8.

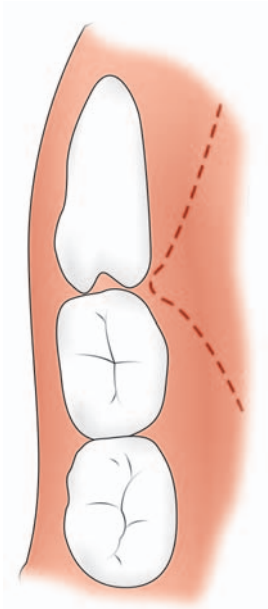


**Fig. 9.8:** Line of incision is similar to the conventional incision (broken line). It is made along the external oblique ridge to the distobuccal angle of the second molar and then a releasing incision is made into the sulcus

The flap is retained with a Minnesota-type retractor. A lingual flap is then raised without tension on the lingual nerve and the lingual tissues are then retracted with appropriate lingual retractor like the Walters- type. The crown of the tooth is then sectioned using a # 701 type fissure bur at an angle of approximately 45° (Fig. 9.9).

The crown is totally transected so that it can be removed with tissue forceps alone and does not need to be fractured from the roots. This minimizes the possibility of mobilizing the roots. Since the lingual plate of bone can be inadvertently perforated during the procedure, the use of a lingual retractor is essential during sectioning. The Walters type lingual retractor (KLS Martin, Jacksonville, Florida) is a suitable instrument because it has no sharp edges, is shaped to fit the lingual side of mandible and has an extension that engages the internal oblique ridge.

Once the crown is removed the fissure bur is used to reduce the remaining root fragments so that the remaining roots are at least 3 mm below the crest of the buccal and lingual plates in all dimensions. Thus the shaded portion as shown in Figure 9.9 is removed. No attempt is made to perform root canal therapy or any other procedure to treat the exposed vital pulp of the tooth.

If necessary, a periosteal incision can be made to advance the buccal flap to obtain a water tight primary closure of the wound using one or more vertical mattress sutures. A postoperative radiograph is taken to assess the location and size of the retained root fragment.

An alternative technique has been suggested which avoids the use of a lingual retractor. In this technique after raising a buccal flap, the sectioning of the crown using bur is done up to two thirds of the buccolingual width. Then fracture off the crown of the tooth. However, this procedure can cause mobilization of the root fragment and may require its removal in the same sitting.

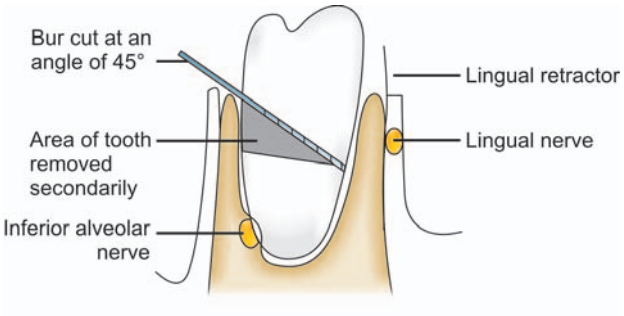



**Fig. 9.9:** Diagrammatic representation of coronectomy technique. Note the lingual retractor in place to protect the lingual nerve. The bur is directed at an angle of 45° to section the crown. Following this the gray area marked is removed to place the remaining root potion of the tooth 2 to 3 mm below the crest of bone

Studies have shown that the technique of coronectomy is a comparatively safe procedure with relatively few intraoperative and postoperative complications. Transient lingual nerve anesthesia has been reported following the use of lingual retractor. Animal studies have shown that vital root remain with minimal degenerative changes. Postoperative radiographs taken at regular intervals have shown that in approximately 30% of the cases there is an appreciable coronal migration of the root fragments away from the IAN. Follow up radiographs showed that late migration of root fragments occurs, but it is unpredictable. Even if it occurs, the roots move farther away from the IAN into a safer position from where it can be removed more easily if required. The technique of leaving the root fragments at least 3 mm below the crest of alveolus seems appropriate. Because such a procedure has shown to encourage bone formation over the retained root fragments. This has been validated in animal studies.

In summary, the technique of partial odontectomy is worthy of consideration in cases in which the OPG and cone beam CT scan shows an intimate relationship between the roots of mandibular third molar and IAN.

**6. Orthodontic extraction:** This is an orthodontic - surgical procedure that has been found to be useful for the safe extraction of impacted third molars with a high risk of neurological complication due to the close proximity to mandibular canal. The usefulness of the procedure has been reported by Checchi et al (1996)[17], Marchetti et al (2004)[18] and recently by Alessandri Bonetti et al (2007).[19]

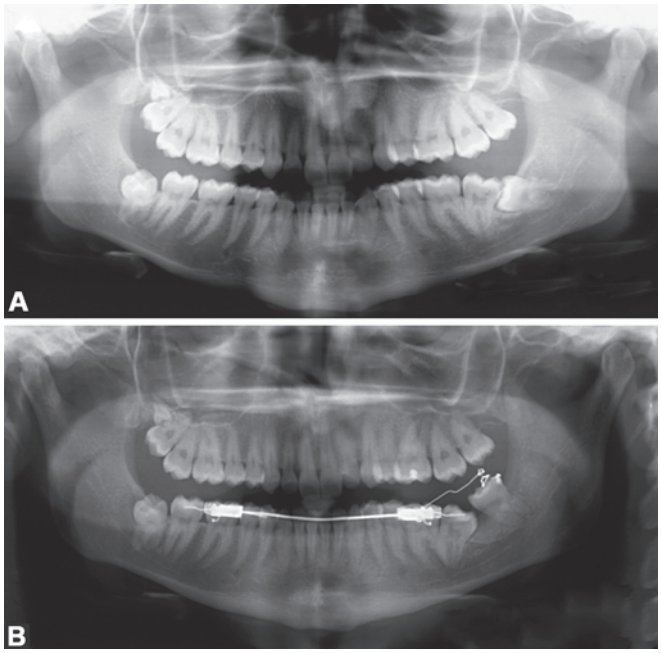
The orthodontic extraction operation comprises of six phases[19]:

| | | |
|---|---|---|
| Phase | 0 | Assessment of surgical risks |
| Phase | 1 | Creation of orthodontic anchorage |
| Phase | 2 | Surgical exposure of the third molar crown |
| Phase | 3 | Orthodontic extrusion of the third molar |
| Phase | 4 | Clinical and radiographic assessment of the extrusion level |
| Phase | 5 | Third molar extraction |

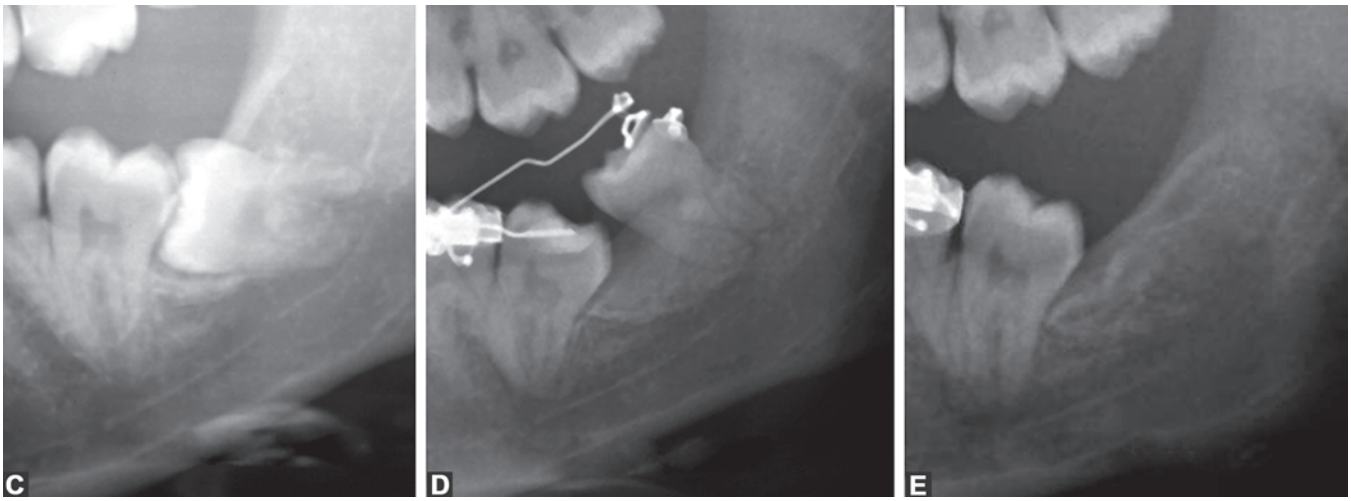
The anchorage consists of a stainless steel lingual arch welded to the first molar bands and buccally on the extrusion side, a stainless steel sectional wire tied from second molar to the first bicuspid.

A week after the surgical exposure of the third molar crown and bonding of the bracket to it, a rectangular stainless steel sectional wire is placed. This cantilever is the system's active part; placed into the auxiliary tube on the side of the first molar and tied to the bracket on the third molar. This allows the tooth to extrude, thus setting it apart from the mandibular canal. The cantilever must be untied, reshaped, and reactivated every 4 to 6 weeks.

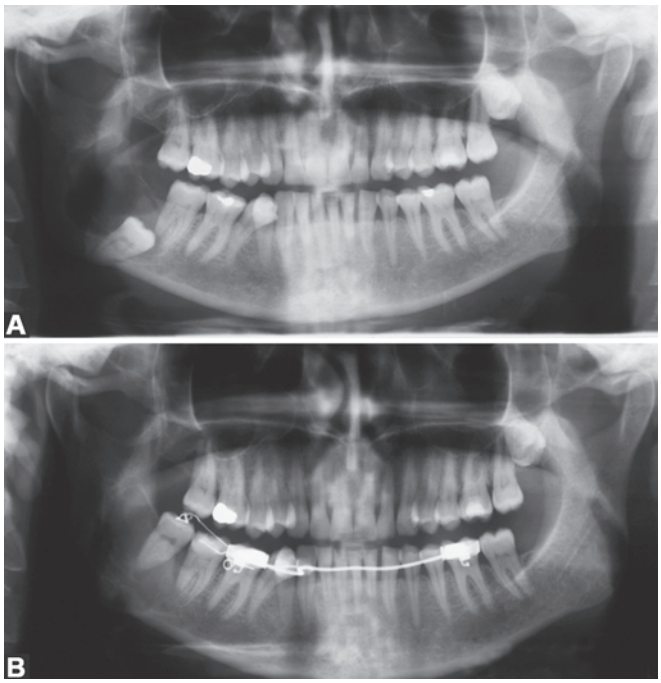
Periodic clinical and radiographic examination is conducted to evaluate the extrusion of the tooth. This allows the surgeon to determine the best time to carry out the extraction at a time when adequate bone has been formed separating the root from the mandibular canal (Figures 9.10 A to E, 9.11 A and B, 9.12 A and B; Courtesy to Dr Giulio Alessandri Bonetti, Bologna, Italy for the photographs).



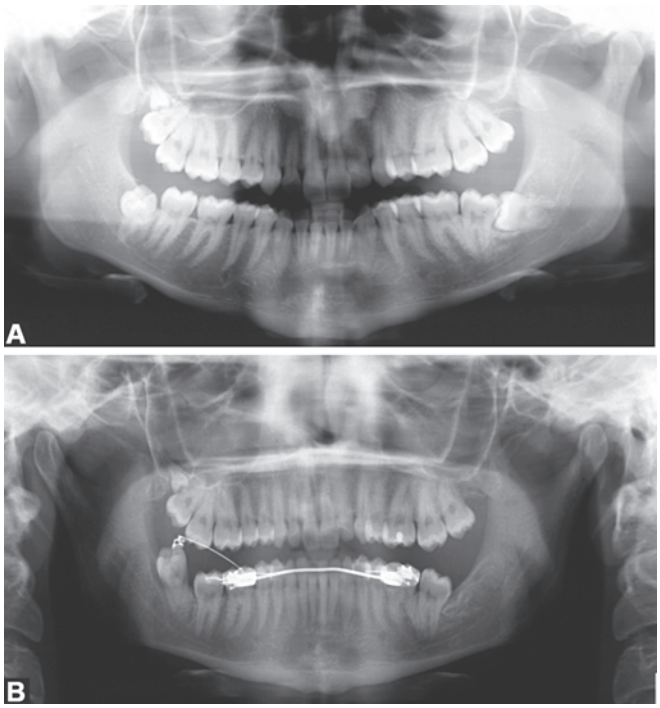

**Figs 9.10A and B:** (A) Preoperative OPG showing horizontally impacted 38, (B) OPG showing orthodontic eruption of impacted 38 completed after nine months




**Figs 9.10C to E:** Close up view of the radiograph- (A) Initial picture, (B) On completion of extrusion, (C) 6 months post extraction.




**Figs 9.11A and B:** (A) Preoperative OPG showing mesioangularly impacted 48, (B) OPG showing orthodontic eruption of impacted 48 completed after eight months




**Figs 9.12A and B:** (A) Pre operative OPG showing distoangularly impacted 48, (B) OPG showing orthodontic eruption of impacted 48 completed

The following are the advantages of this technique: (a) risk of direct trauma to the nerve is eliminated, (b) reduced need for instrumentation, (c) tooth is in a favourable position for surgery and is easily luxated, (d) quicker and easier extraction leads to less postoperative oedema, pain and trismus (e) possibility of mandibular fracture associated with removal of deeply impacted third molar is avoided, (f) development of an infra bony periodontal defect on the distal side of the adjacent second molar is prevented by this technique.

However, the technique has the following disadvantages: (a) the orthodontic appliance may cause some discomfort due to impingement on the soft tissues, (b) the procedure involves two operations ie. exposure of the third molar crown initially and later extraction of the tooth, (c) more time consuming than a surgical removal of tooth, (d) require good co-operation between the surgeon and the orthodontist, (e) more expensive because it involves a greater number of appointments.

Based on the aforementioned considerations, it is clear that the orthodontic extraction approach cannot be used on a routine basis (Alessandri Bonetti et al, 2007)[19]. Each case of impaction must be considered separately and this approach should be chosen only in carefully selected cases. Factors such as tooth position, integrity of the dental arch, overall periodontal situation, and patient's psychological profile must be carefully evaluated before attempting the procedure.

## SUMMARY

Recent contributions have shown that the risk of development of pathology in presence of impacted third molars is quite low. A certain morbidity associated with the different procedures described above may be expected. Hence a very careful risk to benefit ratio must be considered while selecting an alternate procedure, instead of the standard surgical method of removal of impacted mandibular third molar.

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CHAPTER

# 10 Surgical Removal of Impacted Maxillary Third Molar

Surgical management of upper third molars in general is less complex compared to lower third molars. They cause less discomfort, are more likely to erupt, and are simpler to remove unless unerupted and encased in bone. Removal of upper third molars results in far less postoperative morbidity, and general anesthetics are rarely required.

The commonest type of impaction in maxillary third molar is vertical (Peterson et al, 2003).[1]

**Classification of impacted maxillary third molars:** The system of classification of upper wisdom tooth is essentially same as that for impacted mandibular third molar. Nevertheless, there are some additional parameters to be considered which will aid in pre-operative assessment of the case and guide in planning the surgery for a successful outcome.

## 1. State of Eruption

1. Fully erupted
2. Partially erupted
3. Unerupted
   - Within the bone
   - Immediately beneath the soft tissues

## 2. Angulation of the Tooth (Figs 10.1 to 10.3)

1. Vertical - 63%
2. Mesioangular - 25%
3. Distoangular - 12%
4. Laterally displaced with the crown facing the cheek, horizontal, inverted and transverse positions- less than 1%
5. Aberrant position sometimes associated with pathological condition such as cyst

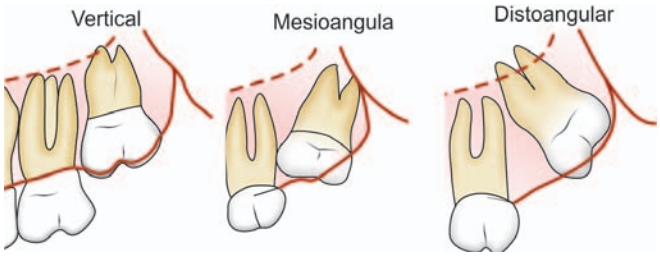



**Fig. 10.1:** Classification of impacted maxillary third molar based on angulation

**Fig. 10.2:** Periapical X-ray showing mesioangularly impacted 38

## 3. Pell and Gregory Classification

This is based on the relative depth of the impacted maxillary third molar (Fig.10.4).

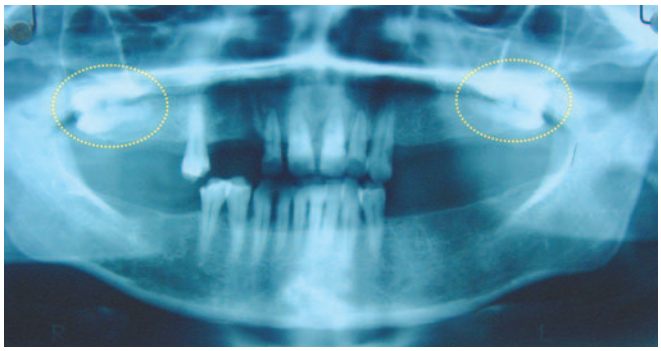


**Fig. 10.3:** OPG showing horizontally impacted maxillary third molars (yellow oval)

| | |
|---|---|
| Position A | Occlusal surface of third molar is at the same level as that of second molar. |
| Position B | Occlusal surface of third molar is located between occlusal plane and cervical line of second molar. |
| Position C | Occlusal surface of third molar is at or above the cervical line of second molar. |

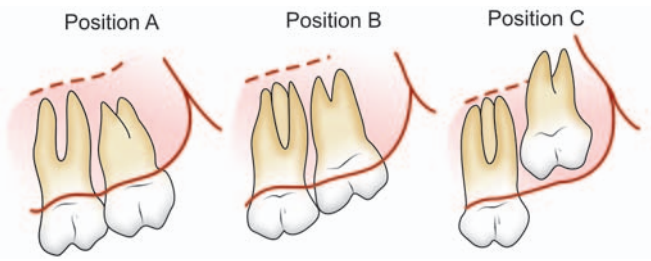



**Fig. 10.4:** Pell and Gregory classification based on relative depth of impacted maxillary third molar

## 4. Relationship of Impacted Maxillary Third Molar to the Maxillary Sinus

1. *Sinus approximation (SA)*: No bone or a thin partition of bone between the impacted maxillary third molar and maxillary sinus.
2. *No sinus approximation (NSA):* 2 mm or more bone between the impacted maxillary third molar and maxillary sinus.

## 5. Nature of Roots

1. Fused (conical )
2. Multiple—Favorable/Unfavorable

## Indications for the Removal of Maxillary Third Molar

1. Extensive dental caries which is beyond restoration and causing food stagnation
2. Recurrent pericoronitis
3. Buccally or distally erupting tooth causing the patient to adopt a bite of convenience to avoid cheek biting. (Adopting such a bite of convenience leads to temporomandibular joint pain in certain cases)
4. Tooth involved in pathological process such as cyst.
5. Over erupted and non functional upper third molar- When the opposing mandibular third molar has been removed, the maxillary third molar tends to over erupt leading to food impaction between the latter and second molar (Fig.10.5). This in turn leads to periodontal problems and dental caries of maxillary second and third molar.

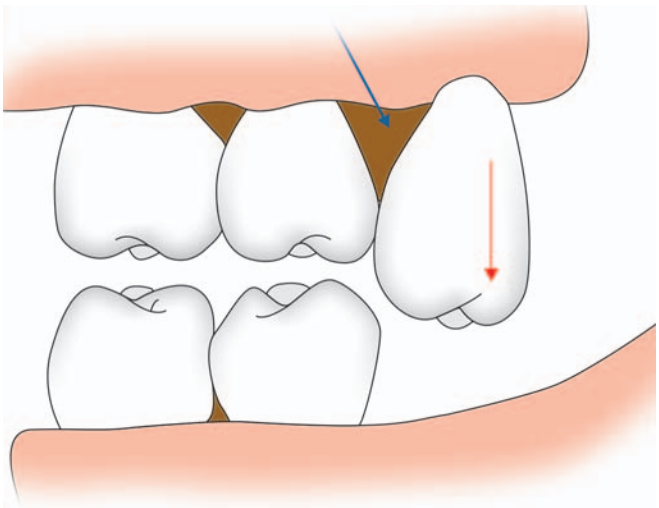


**Fig. 10.5:** Schematic diagram showing over erupted upper third molar (red arrow) leading to food impaction (blue arrow) between second and third molar tooth

Additionally because of over eruption, the upper third molar impinges on the edentulous lower third molar area upon closure of the mouth and causes ulceration (Fig.10.6).

6. Buccally erupting upper third molar impinging on the coronoid process during mandibular movements leads to pain during movement. Furthermore traumatic ulceration and hyperkeratosis of the buccal mucosa also can occur due to constant irritation.

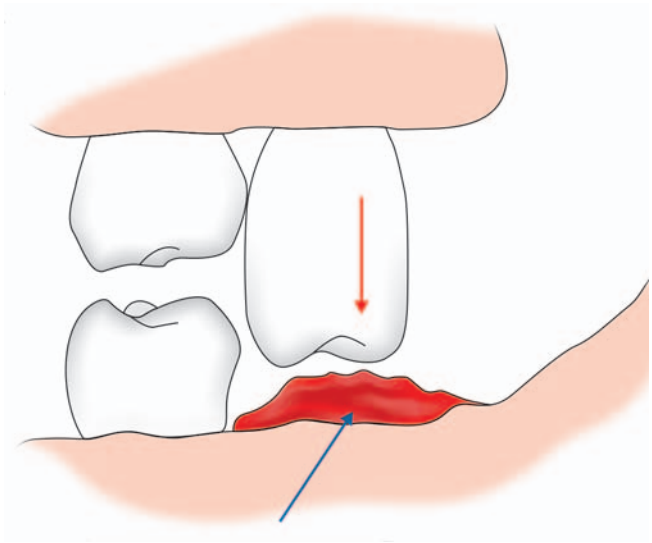


**Fig. 10.6:** Schematic diagram showing over erupted upper third molar (red arrow) impinging in lower third molar area causing ulceration (blue arrow)

7. Interference with placement of prosthesis—Erupting upper third molar will interfere with placement of a denture causing pain and/or retention problem. Hence they have to be removed.

## Local Contraindications for Removal

1. Symptom-less upper third molar completely embedded in bone.
2. Upper third molar positioned high in the alveolus—surgical removal of such teeth carry the risk of displacing the tooth into the maxillary antrum or infratemporal fossa.
3. Deeply impacted tooth, the removal of which may damage the adjacent second molar.

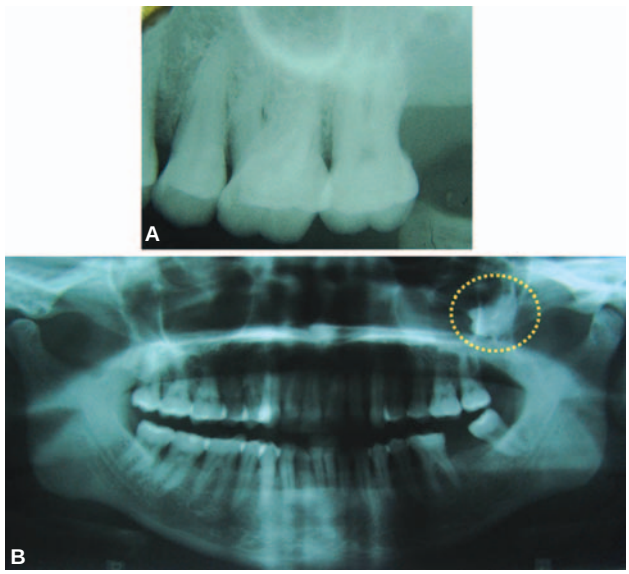
It has been observed that an impacted upper third molar tooth may begin to erupt and eventually reach the surface making its removal easy.

## Radiographic Examination

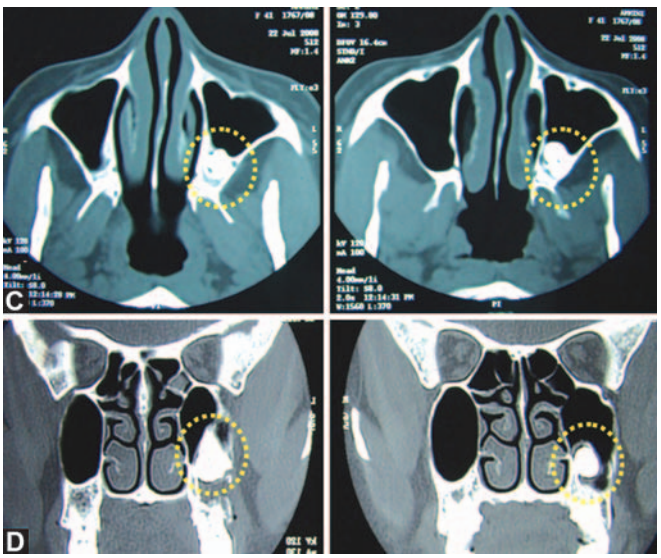
The following are the useful radiographs-

1. Periapical X-ray
2. Orthopantomogram (OPG)
3. Occlusal X-ray
4. True lateral view—occasionally helpful
5. PNS view of maxilla—if associated pathology like cyst or tumor is suspected
6. CT scan—especially if associated pathology like cyst or tumor is suspected.

Bouquet et al (2004)[2] reported that CT scan gives better qualitative and quantitative information compared to panoramic radiograph in the pre operative evaluation of impacted maxillary third molars. The CT scan was more precise than the panoramic radiograph for measurement of the level of impaction of the third molar, measurement of the third molar displacement, bone height separating the third molar roots and the sinus, and for assessing the length of roots in the sinus. The CT scan was equally accurate for measurement of the distance separating the crowns of second and third molars (Figs 10.7A to D).




**Figs 10.7A and B:** (A) Impacted left maxillary third molar not visible in the periapical X-ray, (B) OPG of the same patient showing impacted 28 placed high in the tuberosity region of the maxilla (yellow circle)




**Figs 10.7C and D:** (C) Axial CT scan of the patient showing impacted 28 (yellow circle), (D) Coronal CT scan of the patient showing impacted 28 (yellow circle)

## Determining the Degree of Difficulty of Removal

1. Angulation: While considering the angulation and degree of difficulty of removal vis - a- vis mandibular third molar, it has been found that the same angulations in mandibular third molar cause opposite degree of difficulty for maxillary third molar extraction. For example in case of maxillary third molars, vertical and distoangular impactions are easiest to remove, while mesioangular impactions are more difficult, i.e. exactly the opposite of mandibular third molars. Mesioangular impactions in maxillary third molar are more difficult to remove because the bone that is overlying the tooth which must be removed is on the posterior part of the tooth and is comparatively dense than in vertical or distoangular impaction. Moreover, accessibility is also less for a tooth in mesioangular position.
2. Position in buccoangular direction: This also contributes to determining the degree of difficulty of removal. Generally crown of maxillary third molars are directed towards the buccal aspect of the alveolar process. This makes the overlying bone thin and easy to expand. In such cases, a definite bulge can be felt on the buccal aspect. Rarely, the impacted maxillary third molar is positioned towards the palatal aspect of the alveolar process. This necessitates removal of more bone to gain access and thereby increases the difficulty of removal. When the crown is directed palatally, a bony deficit may be palpated on the buccal aspect of alveolar process. Digital palpation followed by radiographic examination will help to determine the buccopalatal position of maxillary third molar.
3. Type of overlying tissues or Degree of eruption: Similar to mandibular molars; tooth which has only soft tissue covering is easier to remove than complete bony impaction.
4. Proximity to maxillary sinus: Frequently the impacted maxillary molar is in close approximation to the floor or posterior wall of the maxillary sinus. Removal of such tooth may result in oro-antral communication or displacement of the tooth into the sinus. Necessary steps should be taken to prevent this.
5. Proximity to maxillary tuberosity: Because of proximity of impacted tooth to tuberosity, it can be fractured during extraction of impacted maxillary third molar. Factors contributing to this hazard are:
   - Dense and non-elastic bone as in old age
   - Multirooted tooth with large bulbous roots
   - Large maxillary sinus expanded to include the roots of third molar
   - Use of excessive force to elevate the tooth which has divergent roots.
   - Mesioangular impactions where the tuberosity is frequently heavier and surrounding bone thinner.
6. Other factors influencing the degree of surgical difficulty : These factors are similar to that of impacted mandibular third molar. Morphology of the tooth especially that of the root plays a vital role in this regard.
   - Tooth with roots which are thin, separated and with curvature are difficult to extract. Fortunately majority of maxillary third molars have fused conical roots.
   - Hypercementosis of roots make removal difficult.
   - Tooth with a wide periodontal space is easier to extract. When periodontal space decreases as in old age, surgical removal is difficult
   - Tooth with a wide follicular space is easier to remove than with no follicular space.
   - Bone when it is less dense and more elastic as in young patients makes extraction easier. While in old age when bone becomes denser and less elastic removal of tooth is more complicated.
   - Close relationship of a deeply impacted tooth to adjacent second molar makes the removal difficult, since more bone should be removed to avoid damage to second molar.
   - Fusion of third molar with roots of second molar makes removal difficult.
   - Presence of large restoration on second molar requires the judicious use of elevator to luxate the impacted tooth.
   - Difficult access due to small oral aperture or trismus complicates the removal.

## Surgical Anatomy

a. *Maxillary tuberosity:* The impacted maxillary third molar is located in the tuberosity. It is surrounded by cancellous bone and a thin buccal cortical plate comparable to an egg shell. The palatal cortical plate is thick and dense. Such an anatomy dictates that the upper third molar should be removed by a buccal approach.

b. *Mucoperiosteum:* The buccal and distal side of the tuberosity is covered by mucoperiosteum of normal thickness in which is found branches of posterior alveolar artery and vein. On the palatal aspect, the tuberosity is covered by thick mucoperiosteum containing greater palatine neurovascular bundle. This is located at the junction between the alveolar process and horizontal part of maxilla.

c. *Maxillary sinus:* Impacted maxillary molar is located close to the floor of the maxillary sinus. Very often there will be only a thin plate of bone separating the floor of the sinus from the third molar root (Fig.10.8). In rare instances, this thin plate of bone may be absent and the root of third molar may protrude into the maxillary sinus. Similarly, the extension of maxillary sinus and its floor into the tuberosity area also varies. The close proximity of third molar root increases the possibility of accidentally pushing the third molar or its root into the maxillary sinus. The extension of sinus into the tuberosity weakens this area leading to accidental fracture of maxillary tuberosity while luxating a firmly fixed upper third molar.

d. *Muscles:* On the buccal side the buccinator muscle is inserted on the lateral aspect of the tuberosity above the molar teeth. The exact position of the attachment of buccinator muscle in relation to molar roots has a surgical implication with regard to spread of infection from the molar either to the buccal vestibule or into the buccal space.

The inferior head of the lateral pterygoid muscle originates from the outer surface of the lateral pterygoid plate, which is located immediately behind the tuberosity area. Damage to this muscle will lead to postoperative trismus.

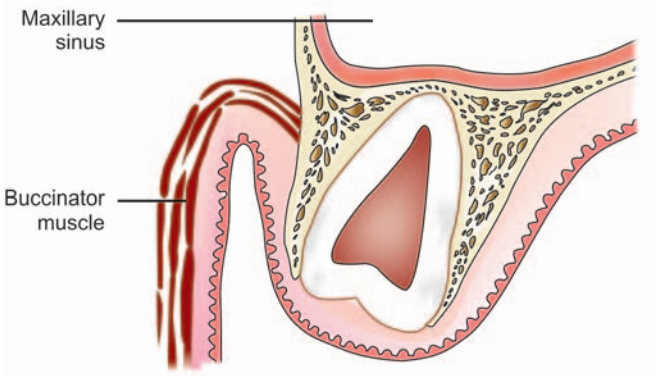



**Fig. 10.8:** Schematic diagram showing the relationship of impacted maxillary third molar to the floor of the maxillary sinus

e. *Buccal pad of fat:* This is present between the buccinator and masseter muscle. During surgery, accidental perforation of the buccinator muscle by surgical blade or retractor may result in prolapse of the buccal fat pad into the operative field. Sudden visualization of a yellowish material will be distressing for the operator. No attempt is made to remove the prolapsed fat by pulling it out. If this is attempted more fat will come out. Instead, that part of fat may be resected or pushed back and a suture given.

f. *Pterygopalatine fossa:* This narrow space is located posterior to the maxillary tuberosity and the pterygoid process forms the posterior boundary. The fossa is limited medially by the vertical plate of palatine bone. Laterally, this fossa communicates with the infratemporal fossa. Excessive pressure exerted in a posterior direction during elevation of an impacted maxillary third molar may cause its displacement into the pterygopalatine fossa.

g. *Infratemporal fossa:* This area is bounded anteriorly by the posterolateral surface of the maxilla, medially by lateral pterygoid plate, and laterally by the ramus of the mandible. Superiorly this fossa reaches up to the inferior orbital fissure. There are a number of important anatomical structures contained in this space. During surgical removal of maxillary third molar it may be displaced through the thin distal bone into the infratemporal fossa.

**Extraction of erupted maxillary third molar:** Use of dental forceps for the extraction of erupted upper wisdom tooth carries the risk of fracture of maxillary tuberosity from excessive force. Similarly extraction of partially erupted upper third molar with conical roots has the hazard of displacing the tooth into the sinus. Hence, for the removal of erupted and partially erupted upper third molar the use of a curved Warwick James elevator is recommended (Fig.10.9). In cases where the tooth is erupted, the curved blade of the instrument is inserted between the second and third molar with the concave side facing posteriorly. Then a gentle force is exerted in a downward and outward direction. If the tooth is resistant and great force is exerted in a backward direction, it can result in fracture of the maxillary tuberosity.

**Steps in the operative procedure for removal of unerupted third molar (Figs 10.10A to D):** One of the difficulties that will be encountered during its surgical removal is the limited access due to the presence of the

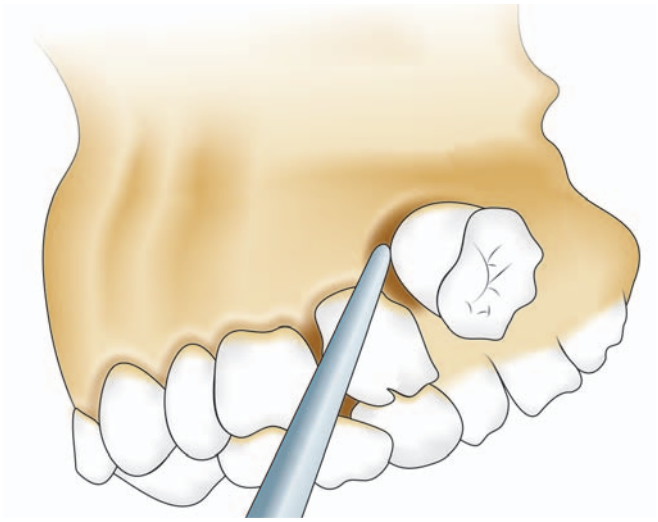
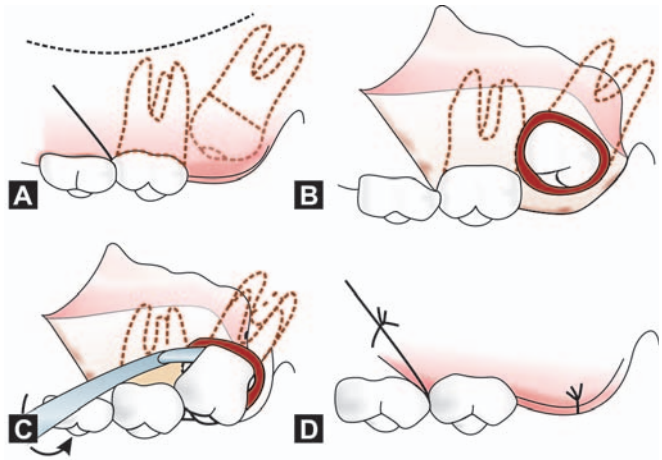


**Fig. 10.9:** Use of a curved Warwick James elevator for removal of maxillary third molar

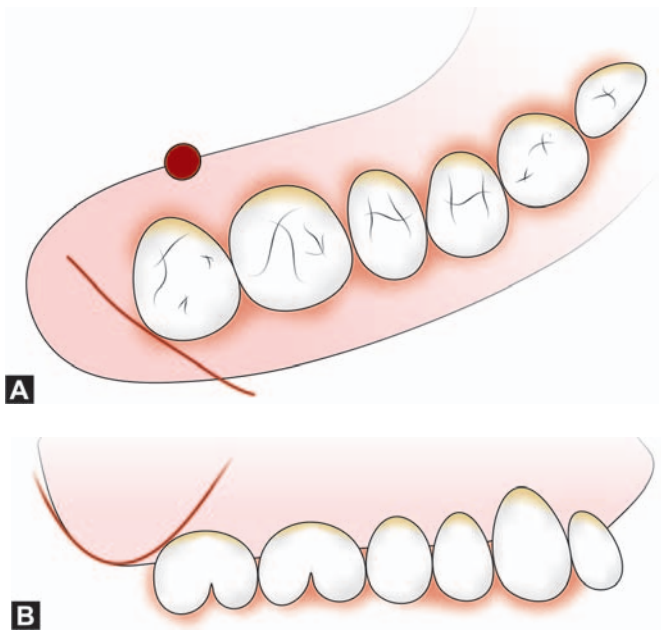



**Figs 10.10A to D:** Steps in the surgical removal of a mesioangularly impacted maxillary third molar. (A) Incision to raise a triangular flap, (B) Mucoperiosteal flap reflected, (C) Overlying bone removed from occlusal and buccal aspect up to the cervical line and elevation of tooth, (D) Suturing completed

coronoid process. This can be overcome by opening the mouth only partially. The basic technique for the surgical removal of maxillary third molar is similar to that of the mandibular third molar.

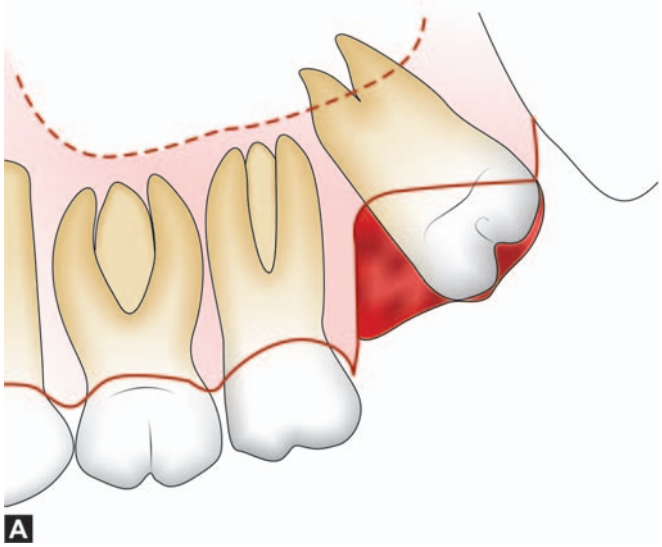
Incision: It starts from the mesial aspect of first molar and extends posteriorly beyond the distobuccal aspect of second molar and then continued into the tuberosity. If greater access is required as in case of a deeply impacted tooth, a release incision can be given in the mesial aspect of second molar to raise a triangular flap.

Using a Howarth's periosteal elevator the mucoperiosteum is reflected. This is a useful instrument for retracting the flap also.

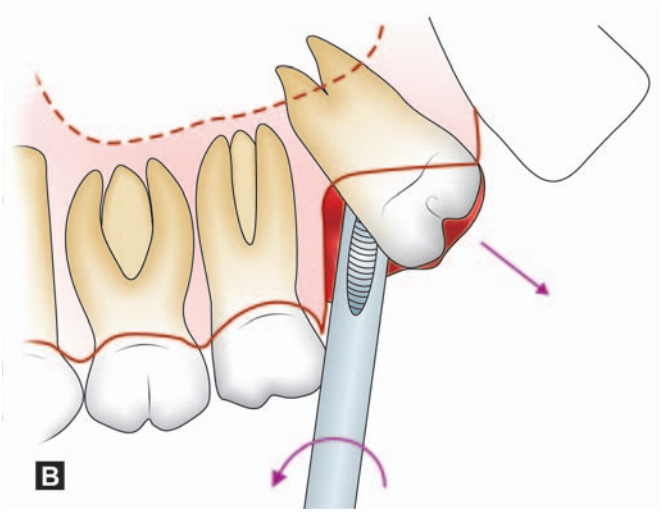



**Figs 10.11A and B:** Incision for palatal diagonal flap described by Darichuk (2005)3 - (A) Occlusal view, (B) Buccal view

A simple yet effective flap design for maxillary third molar surgery, the palatal diagonal flap (Figs 10.11A and B) has been described by Darichuk (2005).[3] This flap provides excellent surgical access to the maxillary third molar region and permits placement of a suitable retractor, preventing displacement of a maxillary third molar during elevation.




**Figs 10.12A**




**Figs 10.12A and B:** (A) Bone removal achieved on the occlusal and the buccal aspect of tooth down to the cervical line to expose the entire crown, (B) Delivery of the tooth using a Potts elevator

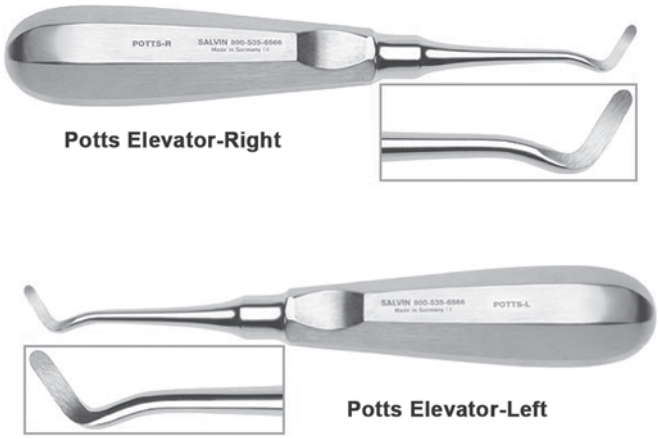



**Fig. 10.13:** Potts elevator; right and left side

**Fig. 10.14:** Martin tooth-grasping forceps

Removal of overlying bone—Bone removal is restricted to the occlusal and the buccal aspect of the tooth down to the cervical line to expose the entire crown (Fig. 10.12 A). This is achieved using chisel or bur; but the latter is preferable. Additional bone is removed on the mesial aspect of the tooth above the height of contour of the crown to create space for the insertion of an elevator and to act as a purchase point. This bone removal can be accomplished using a chisel with hand pressure since the maxillary bone is generally thin. This can also be achieved using a Potts elevator or a periosteal elevator.

Unlike mandibular third molars, maxillary third molars rarely need sectioning. This is because the overlying bone is usually thin and elastic. In cases where the bone is thicker, sclerotic and less elastic as in old patients, tooth removal is facilitated by bone removal rather than tooth sectioning. Chisel is contraindicated to section maxillary teeth due the danger of displacement of the tooth into the maxillary antrum.

Sectioning of maxillary third molar should be avoided and considered only as a last resort because small fragments can be displaced into the sinus or infratemporal fossa.

*Delivery of the tooth:* This is achieved using small straight elevators or a # 301 elevator with force exerted in the distobuccal direction. Some operators prefer angled elevators which easily gains access. Further elevation (Fig. 10.12 B) and delivery can be achieved with a Potts elevator (Fig.10.13). A hemostat and a Martin tooth- grasping forceps (Fig. 10.14) are useful in the removal of tooth or fragments after adequate elevation.

The following points should be borne in mind while elevating the tooth:

1. Due to the proximity of the maxillary sinus and the infratemporal fossa no upward pressure should be exerted during bone removal and delivery of the tooth.
2. This can be avoided by creating sufficient room between the height of contour of the crown (i.e. above the maximum bulge of the tooth) and surrounding bone so that the tip of the elevator can be placed above the height of contour of the tooth. Then pressure is exerted in a distobuccal direction.
3. Moderate pressure is exerted distally, buccally and occlusally (i.e. downward and outward) with the fore finger placed posterior to maxillary tuberosity to detect tuberosity fracture if it occurs.
4. In case of any suspicion regarding the accidental opening into the sinus, every effort should be made to ensure proper closure and the patient instructed appropriately.

**Fig. 10.15:** Laster retractor

Farish and Bouloux (2007)[4] advice the use of the Minnesota retractor or periosteal elevator to be placed distal to impacted maxillary third molar during final elevation so that it will not be displaced under the flap and into the infratemporal fossa. A Laster retractor is an ideal retractor for this purpose because it engages the tuberosity, provides excellent access and prevents displacement of tooth.

Debridement and Closure: The procedure is similar to that of mandibular third molar. A single suture is all that is needed to secure the wound. The suture is passed from the palatal side of the interdental papilla between the first and second molars into the anterior end of the buccal flap. Rapid healing of the wound occurs with minimum postoperative problem.

Frequently, upper third molar sites do not require suturing because the wound is held in proper position by gravity and the surrounding soft tissues.

**Modification of standard technique using chisel:** A technique using chisel has been described by Farish and Bouloux (2007).[4] In this method a small mouth prop is placed between the teeth on the contralateral side. After administration of local anesthesia, an oblique incision is made from the distopalatal aspect extending obliquely over the tuberosity toward the distobuccal aspect of second molar and then extended into the vestibule. This oblique incision permits easy closure of the wound, often without the need for suturing. The buccal flap is then elevated to include the maxillary tuberosity. A Laster retractor (Fig.10.15) can be easily positioned with the small cup- shaped tip firmly engaging the tuberosity. This retractor also protects the cheek and by engaging the tuberosity effectively prevents displacement of the third molar tooth into the infratemporal fossa.

The retractor is held in the left hand while the surgeon stabilizes the chisel with the other hand. The chisel is held parallel to the occlusal plane and the cutting edge positioned adjacent to the distal aspect of the erupted second molar at the occlusal aspect of the alveolar process with the bevel facing towards the cheek. The assistant, using the mallet gives short taps to result in the removal of a thin length of buccal bone from the distal aspect of second molar to the tuberosity. The chisel is then positioned slightly superiorly and the process repeated. When sufficient bone has been removed, a Cryer or Warwick James elevator is positioned to engage the mesial aspect of the crown of the third molar and the tooth is displaced buccally. The soft tissue follicle is removed with a sharp curette and a curved hemostat. Sharp bony edges are then smoothened with a rongeur and bone file. The wound is then copiously irrigated with saline and primarily closed with 3-0 catgut sutures in the vestibular part of the incision.

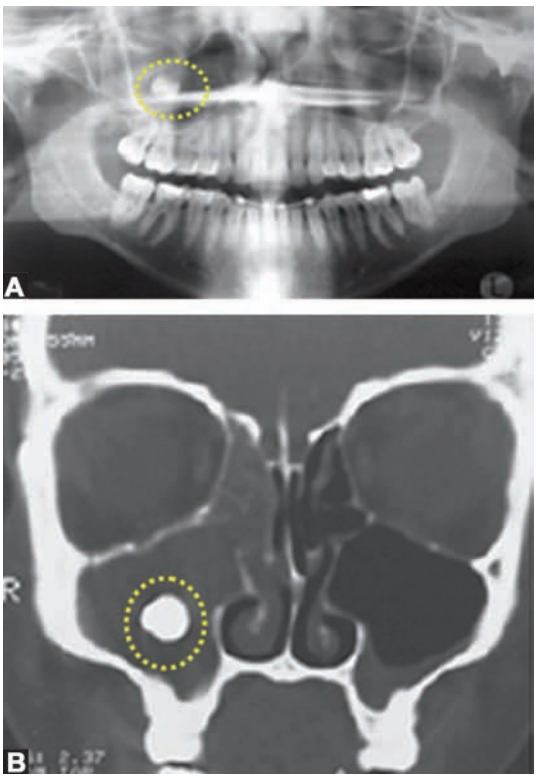
**Endoscopic surgery for removal of ectopic maxillary third molars:** Hasbini et al (2001)[5] reported a rare case of an ectopic third molar at the level of the osteomeatal complex treated by endoscopic surgery. Computed tomography of the paranasal sinuses revealed that an aberrant tooth was obstructing the osteomeatal complex and bulging into the ethmoid infundibulum. Opacity of the entire left maxillary sinus indicated the presence of an associated cyst formation. A transnasal endoscopic sinus technique was employed to create a large middle meatal antrostomy and to remove the tooth as well as the cystic contents and cyst wall. The endoscopic surgical approach used in this case caused less morbidity than do the more common methods (e.g. the Caldwell-Luc procedure) of removing ectopic teeth from the sinus. For lateral or posterior teeth, the authors advised a combined transfacial-transnasal approach, in which a trocar is inserted through the anterior canine fossa; the trocar allows for the introduction of a probe to dislodge the tooth in a medial direction under direct vision. Any related cystic structures can be evacuated at the same time. The dislodged ectopic tooth and associated cyst can then be extracted through a middle meatal antrostomy that was created during the transnasal endoscopic sinus approach.

Di Pasquale et al (2006)[6] reported a case of a 14-year-old girl in which CT of the paranasal sinuses demonstrated a left unilateral maxillary sinus opacification that had been produced by an ectopic molar. The tooth was removed via an endoscopic approach rather than with a traditional Caldwell-Luc procedure. A nasal endoscope was used to create a middle meatal antrostomy and deliver the tooth and its cystic contents.

## Complications During Surgery of Impacted Maxillary Third Molar

**1. Displacement of tooth into maxillary sinus:** This is most likely to occur when the maxillary third molar is partially erupted and has conical roots which are closely related to the floor of the sinus. Attempted extraction of such a tooth using extraction forceps can dislodge the tooth into the maxillary antrum (Figs 10.16A and B). A similar accident can occur when excessive force is exerted for elevating a buried wisdom tooth with poor visibility at the point of application of the elevator. The closer the root tip of the impacted tooth is to the floor of the sinus and higher the initial position of the tooth in the alveolus, the higher the chance for this mishap to occur.

If the entire tooth is dislodged into the maxillary sinus it should be removed as early as possible to prevent infection. Pogrel(1990)[7] stated that the initial attempt at retrieval should be a suction placed at the opening into the sinus. If this procedure does not allow delivery, then the sinus may be irrigated with saline and the suction tip reapplied to the opening. If the second attempt is also unsuccessful, further attempts should be stopped and the patient placed on a course of antibiotics and nasal decongestants. Retrieval can be accomplished via a Caldwell-Luc approach along with the closure of oro-antral fistula.




**Figs 10.16A and B:** (A) Preoperative OPG showing tooth displaced into right maxillary sinus (yellow interrupted line), (B) Coronal CT scan showing the position of the tooth in the maxillary sinus with opacification of maxillary sinus as well as the ethmoid sinus

Sverzut et al (2005)[8] reported a case of an impacted right maxillary third molar that was accidentally displaced into the maxillary sinus during extraction. It was surgically retrieved two years later after maxillary sinus exposure through Caldwell-Luc approach under general anesthesia.

In cases of accidental tooth displacement into the maxillary sinus, the most accepted treatment is the removal of the dislodged tooth to prevent future infections, preferably during the same surgical procedure, if possible. However, delayed treatment does not always precipitate immediate active sinus disease. In the event the professional is not experienced and skilled enough to perform the retrieval surgery and/or the patient is not in physical and/or psychological condition to support the maxillary sinus surgical intervention at the same session, the dentist must be prepared to adequately handle the situation. The case may be either referred to an oral and maxillofacial surgeon or the procedure for retrieval of the displaced tooth must be postponed to a future date when the patient feels more comfortable. In the meantime the patient must be given antibiotic, analgesic and anti-inflammatory medication as indicated.

**2. Dislodgement into soft tisues:** Accidental displacement of upper third molar into the buccal soft tissues (Fig. 10.17) and into the infratemporal fossa may occur. Usually this occurs: (a) when an adequate buccal flap is not raised prior to attempting surgical removal, (b) decreased visibility during surgical extraction, (c) incorrect extraction technique, (d) distolingual angulation of tooth, (e) third molar crown above the level of the adjacent molar root apices.

The tooth will be usually lateral to the lateral pterygoid plate and inferior to the lateral pterygoid muscle (Peterson et al, 2003).[1] Following such an accident, the patient experiences severe pain and trismus. Such displaced tooth should be removed as early as possible to avoid development of infection. If good access and light are available the surgeon should make a single cautious effort to retrieve the tooth with a hemostat or Allis' forceps. Surgical access is gained through an incision along the crest of the alveolus. Often the displaced tooth

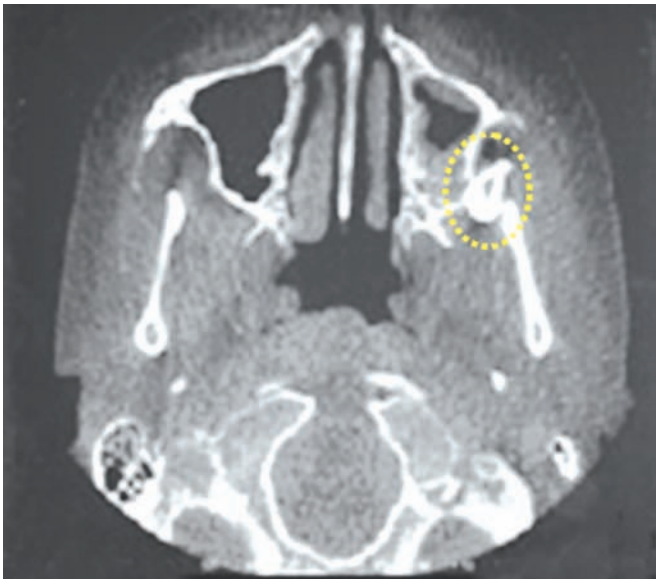


**Fig. 10.17:** Axial CT scan showing tooth displaced into buccal soft tissues

can be found lying deep in the tissues. The tooth is usually not visible and blind probing will result in further displacement. If the tooth could not be removed after a single effort, the incision should be closed. The patient should be informed that the tooth has been displaced and will be removed later. Postoperative antibiotic is administered to prevent infection. During the initial healing phase fibrosis occurs and stabilizes the tooth in a firm position. The tooth should be removed four to six weeks later by an oral and maxillofacial surgeon.

If displaced tooth lies medial to the ramus of mandible (Peterson et al, 2003),[1] it may interfere with opening of the mouth and there is a possibility for infection to occur. In such instances also once the initial fibrosis occurs, the tooth will not migrate. If there is no mandibular restriction, patient can be given the option not to remove the tooth. However, this should be properly documented.

## Prevention and Management

Sufficient removal of buccal bone is necessary before placing an elevator to deliver the maxillary third molar from its socket. With good retraction of soft tissues, the tooth can be observed carefully at all times during elevation. In the general practice setting, once it is established that the tooth has been displaced into the soft tissues, it is sometimes possible to manipulate the third molar towards the socket with finger pressure high in the buccal sulcus. If this technique is unsuccessful, an aspirator tip can be introduced into the socket of the displaced tooth in a posterior direction. If both attempts fail, the tooth should be left *in situ* and the patient referred to an oral surgeon. An explanation of what has happened should be provided.

A radiograph is required to establish the position of the tooth. A periapical radiograph is usually of limited value because of the extent of displacement of the tooth. A panoramic film is preferable, but it may not adequately demonstrate the spatial relation of the displaced tooth to adjacent anatomical structures. Computed tomography (CT) can be helpful to assess the exact location of the displaced tooth in the axial plane. Three-dimensional CT reconstruction may also be desirable (Matthew, 2007).[9]

It is not always necessary to remove a displaced maxillary third molar, unless chronic infection, pain or a malocclusion develops or if trismus restricts jaw movement. However, the patient might request its removal in the absence of symptoms. Once, the decision is made to retrieve the displaced maxillary third molar from the infratemporal fossa, general anesthesia is preferred because the surgical approach might have to be modified intraoperatively. Local anesthetic solution with vasoconstrictor is administered into the soft tissues to reduce bleeding.

An intraoral approach is typically made in the posterior sulcus and a mucoperiosteal flap is raised with a periosteal elevator, which might reveal the tooth. If the tooth cannot be located, image-intensifying cineradiography (Dawson, 1993)[10] might be of value. A Gillies approach can be made via an incision in the hairline; the displaced tooth is palpated and pushed inferiorly using a Howarth periosteal elevator introduced deep into the temporalis fascia (Dawson,1993).[10] Using an 18-gauge spinal needle with stiletto *in situ* instead of a Howarth elevator to push the tooth inferiorly avoids the need for an incision in the temporal region (Orr, 1999).[11]

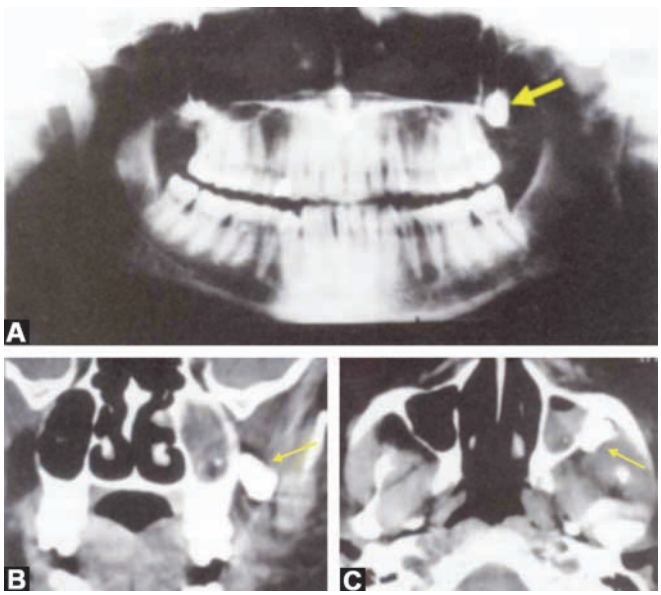
If the displaced tooth still cannot be retrieved or if it is high in the infratemporal fossa, a transantral approach is possible with careful dissection of the posterior wall of the maxillary sinus (Winkler et al, 1977).[12] Alternatively, a hemicoronal incision permits access via elevation of skin from the temporalis fascia. Dissection then proceeds through fascia and muscle to the lateral wall of the orbit (Gulbrandsen,1987).[13] At this point, one expects the tooth to be seen or palpated and retrieved. Once a displaced

maxillary third molar has been retrieved, the soft tissues are debrided and closed in layers with sutures. Antibiotics are indicated to prevent infection in the infratemporal space.

Patel et al (1994)[14] reported that imaging and retrieval of an impacted maxillary third molar displaced into the infratemporal fossa is difficult. The case requires urgent referral and hospitalization for removal under general anesthetic. The use of image intensification equipment in theatre allows removal of such a displaced tooth with minimal morbidity and is recommended. Prevention of displacement with the use of a distal retractor is strongly recommended when surgically removing impacted maxillary third molars.

Dimitrakopoulos and Papadaki (2007)[15] reported a case of a maxillary third molar displaced into the infratemporal fossa, with difficulty in localization due to the synchronous creation of oroantral communication (Figs 10.18A to C).

The patient was referred to the oral and maxillofacial surgery department and underwent successful surgical treatment through an intraoral access. The causes of tooth displacement into the infratemporal fossa, the aid of a computerized tomography (CT) scan in tooth localization, and the difficulty in treating this complication, particularly when the tooth migrates towards the base of the skull, were emphasized by the authors. Prevention of maxillary third molar displacement into the infratemporal fossa predominates over removal and is achieved by adequate flap design, correct extraction technique, and a distal retractor during surgical extraction. In the case of displacement, no effort to retrieve the tooth is recommended because of the risk of hemorrhage, neurologic injury, and further displacement of the tooth. The authors recommended that the patient should be treated with antibiotics and referred to an oral and maxillofacial surgery department for expert management.




**Figs 10.18A to C:** OPG and CT scan of a tooth displaced into the infratemporal fossa. (A) OPG taken immediately after the unsuccessful extraction showed the third molar lying superior and posterior to maxillary tuberosity (yellow arrow), (B) Coronal CT scan and (C) Axial CT scan showed tooth (yellow arrows)out side the maxillary sinus at the lower part of infratemporal space. (Adapted with kind permission from Dimitrakopoulos I., Papadaki, M. Displacement of a maxillary third molar into the infratemporal fossa: Case report. Quintessence Int. 2007; 38 (7): 607-10)

To summarize a tooth displaced into the infratemporal fossa is retrieved through the following approaches (Dimitrakopoulos et al, 2007)[15]:

1. Long incision in the maxillary sulcus to expose the lateral and posterior walls of the maxilla. The tissues are then reflected to locate the tooth.

   In many cases such an incision is inadequate to access the displaced tooth especially when it is located higher up near the skull base. For this reason the following approaches have been suggested to facilitate retrieval of the tooth.
2. Resection of the coronoid process to allow a wider operative field.
3. An extraoral approach with wide exposure of the pterygomaxillary fossa. This method involves considerable morbidity.
4. Removal through an osseous window in the posterior wall of the maxillary sinus in connection with a Caldwell -Luc operation.
5. Using a hemicoronal incision and dissection down to the lateral wall of the orbit.
6. A standard Gilles approach and push the displaced molar in the infratemporal fossa using a Howarth periosteal elevator and deliver the tooth into the mouth through the intraoral incision.
7. Push the tooth from the infratemporal fossa into the mouth through the previously performed buccal incision with an 18-gauge spinal needle introduced at the temporal region deep to zygomatic arch.

**3. Damage to adjacent second molar:** While removing the bone overlying the impacted tooth using bur or chisel, damage to second molar may occur resulting in exposure

of the pulp. Similarly, if the elevator force is not correctly applied it can result in inadvertent subluxation of second molar. Both these contribute to postoperative pain.

**4. Fracture of maxillary tuberosity:** This is a common complication while removing an erupted or an erupting upper third molar tooth and is rarely associated with an unerupted wisdom tooth. This is because in case of an impacted upper third molar tooth, the bone covering the tooth is thin and this fractures easily. Hence, extensive fracture of the tuberosity does not occur as in case of an erupted tooth. Fracture of the tuberosity is more likely to occur if dental forceps alone are used without initially mobilizing it with an elevator like Warwick James elevator.

The anatomic position of the tooth at the end of the dentoalveolar arch is such that the posterior portion has no support and maxillary sinus extends into the tuberosity region or the bone in the tuberosity is soft and osteoporotic. Preoperative radiographic evaluation of the sinus proximity and bone thickness can help to anticipate tuberosity fracture. In a study by Chipasco et al (1993)[16] the extraction of 500 maxillary impacted third molars was accompanied by three cases of fracture of the maxillary tuberosity, indicating an incidence of 0.6%.

In the event that a large area of tuberosity fractures before the tooth become mobile, effort should be taken to conserve the tuberosity. If it is essential that the tooth should be removed (e.g. infected tooth/symptomatic tooth), then the surrounding bone is removed using drill and roots sectioned. The tooth can be thus removed atraumatically and the tuberosity assessed for viability by evaluation of the attached periosteum for vascular supply. Attention should be given to fastidious closure of palatal and buccal mucosal tears. In cases where it is not possible to preserve the tuberosity due to inadequate periosteal attachment, it is then necessary to dissect out the tuberosity along with the tooth and then repair the resulting defect. Removal of large amount of tuberosity can lead to development of an oro-antral fistula or a large defect in the area creating a prosthetic problem.

If there is no urgent need to remove the tooth (e.g. tooth is not infected) and if the bone fragment is large, it is desirable to immobilize the fractured tuberosity using a cap splint or an arch bar extending from the wisdom tooth to the adjacent teeth. When adequate union has occurred, open technique with removal of overlying bone and sectioning of tooth using bur is employed to extract the tooth.

Measures to prevent tuberosity fracture include use of a periosteal elevator to ensure separation of the periodontal ligament from the tooth and palpation with a finger of the non operating hand to evaluate the expansion of the cortical plate upon luxation.

**5. Oro-antral communication/fistula:** Comparatively this is a rare complication to occur. Once detected it should be repaired surgically as soon as possible.

An oro-antral communication (OAC) is any opening between the maxillary sinus and the oral cavity. Unless diagnosed and treated the walls of this communication may epithelialize and become an oro-antral fistula (OAF). OAC occurs most frequently following extraction of first molar teeth, followed by second molar teeth. An incidence of 0.008 to 0.25% OAC has been reported with maxillary third molar removal. It is likely that the incidence of OAC from maxillary third molar removal is underestimated because it may be self-limiting in some cases and in the case of impacted third molars, usually a flap is closed over the extraction site, leading to healing. OACs smaller than 2 mm in diameter closes spontaneously without any treatment.

Various methods for closure of OAC and OAF have been described over the years, including gold foil, buccal flaps, various palatal flaps, tongue flaps, pedicled buccal fat pad (PBFP), cheek flaps and placement of bioabsorbable root analogs. Bouloux and colleagues (2007)[17] prefer the use of the PBFP for closure of OAFs. The use of PBFP for closure of OAF was first described by Egyedi in 1977. The description of this technique included the placement of a split-thickness skin graft over the PBFP. Research has shown that this graft does not need to be covered and epithelializes within a few weeks. The success rate reported for the procedure varies from 92.8 to 100%.

**6. Prolapse of buccal pad of fat:** Even though this is a rare complication to occur, it can cause great embarrassment to the surgeon as well as the patient. This occurs when the buccal fat pad space is inadvertently entered during the procedure when the incision is carried markedly into the cheek. Pushing the prolapsed fat back into the cheek and giving a suture is all that is sufficient. If an attempt is made to pull out the prolapsed fat, more and more of fat will come out. Hence no attempt is made to remove the prolapsed fat; rather it is pushed back into the wound and then closed with a suture.

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CHAPTER

# 11 Postoperative Care and Instructions

## POSTOPERATIVE CARE

Proper written or oral instruction in essential not only for the over all success of the surgical procedure but also for a smooth postoperative period. The patient and the by stander should be informed that unnecessary pain and complications like infection, bleeding and swelling can be minimized if the instructions are followed carefully.

### Immediately Following Surgery

- Bite on the gauze pad placed over the surgical site for an hour. After this time, the gauze pad should be removed and discarded. It may be replaced by another gauze pad if there is bleeding.
- Avoid vigorous mouth rinsing or touching the wound area following surgery. This may initiate bleeding by dislodging the blood clot that has formed.
- To minimize swelling, place ice packs to the side of the face where surgery was performed.
- Take the prescribed pain medications as soon as possible so that it is digested before the local anesthetic effect has worn off. Avoid taking medications in empty stomach to avoid nausea and gastritis.
- Restrict activities on the day of surgery and resume normal activity when one is comfortable. Excessive physical activity may initiate bleeding.
- Do not smoke under any circumstances.

### Bleeding

- A certain amount of bleeding is to be expected following surgery. On the skin where the surface is dry, blood clots within a few minutes. But in the mouth where things are wet, it takes 6-8 hours for the clot to form and the bleeding to subside. Slight bleeding or oozing causing redness in the saliva is very common. For this reason, the gauze will always appear red when it is removed. Saliva washes over the blood clot and dyes the gauze red even after bleeding from the socket has actually stopped.
- Excessive bleeding may be controlled by first gently rinsing with ice cold water or wiping any old clots from the mouth and then placing a gauze pad over the area and biting firmly for sixty minutes. Repeat as necessary.
- If bleeding continues, bite on a moistened tea bag for thirty minutes. The tannic acid in the tea bag helps to form a clot by contracting the bleeding vessels. This can be repeated several times.
- To minimize further bleeding, sit upright, do not become excited, maintain constant pressure on the gauze (no talking or chewing) and avoid exercise.
- If bleeding does not subside after 6-8 hours, inform the doctor.

### Swelling

- The swelling that is normally expected is usually proportional to the surgery involved. Simple tooth extraction generally do not produce much swelling. However, if there was a fair amount of cheek retraction and bone removal involved with the surgical procedure, mild to moderate swelling can be expected on

the affected side. The swelling will not become apparent until the evening or the day following surgery. It will reach its maximum on the second or the third day postoperatively.

- The swelling may be minimized by the immediate application of ice bag following the procedure to the side of the face where surgery was performed. If ice bag is not available sealed plastic bag filled with crushed ice may be used. The bag can be covered with a soft cloth to avoid skin irritation
- The ice bag should be applied for 20 minutes on and five minutes off for the afternoon and evening following the surgery. After 24 hours, ice has no beneficial effect.
- Warm mouth washes and vigorous swishing should be avoided for 12 to 24 hours following surgery since it may interfere with formation of blood clot. This eventually results in postsurgical bleeding. Sometimes this interferes with the formation of blood clot with the ensuing complication of dry socket.
- Once, the initial oozing of blood has stopped (i.e. after 12 to 24 hours) warm saline mouth washes (half teaspoon salt in a glass of water) may be used fourth hourly. The mouth should be filled with normal saline as hot as the patient can tolerate and the head is held to one side in such a way the fluid lies over the area of surgery. When the fluid cools it should be expectorated and the process repeated. Regular use of mouth wash markedly relieves the pain and edema.
- Bright red, hard, hot swelling that does not indent with finger pressure which is getting bigger by the hour would suggest infection. This usually would develop around the third or the fourth day after surgery when normally the swelling should be decreasing in size. If this happen, the doctor should be consulted.

## Temperature

- It is normal to run a low grade temperature (99-100°F) for 2-3 days following oral surgery. This reflects the immune response of the body to surgery. A high temperature (>101°F) might exist for 6-8 hours after surgery but no more than that.
- Antipyretics (e.g. paracetamol 500 mg) every 4-6 hours will help to reduce the temperature.
- A temperature >101°F several days after surgery, especially if accompanied by hard swelling and increased pain, is usually indicative of infection. The doctor should be intimated should this occur.

## Pain

- Postoperative pain is only mild or moderate and is controlled easily by the use of mild analgesics like aspirin, paracetamol, ibuprofen or combinations of aspirin, phenacetin and codeine.
- Pain or discomfort following surgery is expected to last 4 to 5 days. For many patients, on the third and fourth day require more pain medicine than on the first and second days. Following the fourth day pain should subside more and more everyday.
- Many medications for pain can cause nausea or vomiting. It is wise to have something in the stomach (yogurt, ice cream, pudding or apple sauce) before taking pain medicines (especially aspirin or ibuprofen). Antacids or milk of magnesia can help to prevent or reduce nausea.
- If the pain is very severe it indicates the possibility of something going wrong and the most likely cause is the development of infection. In such an instance the doctor should be contacted.
- Use of powerful analgesics is best avoided since the use of such analgesics may mask the onset of post-operative complication.
- While taking analgesics do not drive an automobile or work around or operate heavy machinery. Similarly alcohol should be avoided along with analgesics.

## Antibiotics

- Antibiotics are not given as a routine procedure after oral surgery. The over use of antibiotics leading to the development of resistant bacteria is well documented. So careful consideration is given to each circumstance when deciding whether antibiotics are necessary. In specific circumstances, antibiotics will be given to help prevent infection or treat an existing infection.
- When antibiotics are prescribed it should be taken on schedule in the correct dosage as directed by the doctor until they are finished.
- Discontinue antibiotic use in the event of a rash or other unfavorable reaction. Contact the doctor immediately if any allergy develops.

## Diet

- Drink plenty of fluids. Try to drink 5 to 6 glasses on the first day.
- Drink from a glass or a cup and do not use a straw. The sucking motion will suck out the healing blood clot and start the bleeding again.
- Avoid hot liquids or food till the anesthesia effect wears off. Otherwise, it can result in burning/scalding of lips and tongue.
- Soft food and liquids can be eaten on the day of surgery. The act of chewing does not damage anything, but should avoid chewing sharp or hard objects at the surgical site for a week.
- Return to a normal diet as soon as possible unless otherwise directed. Eating multiple small meals is easier than three regular meals for the first few days.

## Oral Hygiene

- Good oral hygiene is essential to proper healing of any oral surgery site.
- Brushing of teeth can be resumed from the night of surgery onwards. Avoid disturbing the surgical site so as not to loosen or remove the blood clot.
- Mouthwashes have an alcohol base and it may irritate fresh oral wounds. After a few days, dilute the mouthwash with water and rinse the mouth.

## Stiffness of Jaw (Trismus)

- Perform active jaw opening from the next day of surgery to prevent development of jaw stiffness. This will not cause tearing of the suture.
- If the muscles of the jaw become stiff, chewing gum at intervals will help to relax the muscles. Use of warm, moist heat to the outside of the face over these muscles also will help to relieve this.

## Smoking

- Smoking retards healing dramatically. Nicotine constricts the blood vessels which slows the formation of blood clot in the socket. Smoking contributes to the development of the painful complication 'Dry Socket'.

## Activity

- Keep physical activities to a minimum for 6-12 hours following surgery.

## Suture Removal

- Sutures should be left in place for about seven days. Report to the doctor after seven days for suture removal. In the event absorbable sutures are placed, they need not be removed.

## Summary of Instructions to Patient Following Surgical Removal of Impacted Tooth

1. Remove the gauze pack after 30 mts to one hour.
2. Apply ice (ice cubes taken in a polythene bag) on the face for the first 24 hours.
3. For the first day take cold liquids or semisolids.
4. Avoid warm saline gargle in the first 24 hours.
5. There may be mild to moderate swelling on the side of the face for three to four days.
6. Mild bleeding/oozing of blood can be there from the surgical site for one to two days. In the event of excessive bleeding bite on a fresh piece of sterile gauze and inform the doctor.
7. In the first few days difficulty may be experienced in opening the mouth. To avoid this, from the next day of surgery onwards try to open the mouth forcefully.
8. From the next day onwards after surgery or once the oozing of blood has completely stopped, warm saline mouth-baths can be used at fourth hourly intervals. Avoid application of dry heat on the face.
9. Tooth brushing have to be done from the next day on wards.
10. Take the drugs prescribed by the doctor at regular intervals.
11. Avoid alcohol, smoking, physical exercise and long journey for the next few days.
12. Report for review to the doctor as suggested for suture removal.

CHAPTER

# 12 Drug Therapy

The sequelae of third molar surgery include pain, edema, trismus, infection, dry socket etc. Various drugs are used to minimize or eliminate these outcomes. The objective is to make the surgical procedure as pleasant as possible to the patient without causing serious side effects.

Drugs can be administered prophylactically or empirically. A drug that is administered before a surgical procedure is referred to as prophylactic therapy, while that is administered after the procedure is referred to as empirical therapy.

## Use of Antibiotics

One of the primary goals of the surgeon in performing any surgical procedure is to prevent postoperative infection as a result of surgery. To achieve this goal, prophylactic antibiotics are necessary in some surgical procedures.

In general the rationale for the use of antibiotic is based on wound classification. The following table on the next pages hows the classification of various types of wounds and the indication for antibiotic prophylaxis.

Surgery for the removal of the impacted third molars fits into the category of clean/contaminated surgery. The incidence of infection is usually between 2% and 3%. It is difficult and probably impossible to reduce infection rates below 3% with the use of prophylactic antibiotics. Therefore, it is unnecessary to use prophylactic antibiotics in third molar surgery to prevent postoperative infections in the normal healthy patient. Although the literature contains many papers that discuss the use of prophylactic perioperative antibiotics, there is essentially no report of their usefulness in prevention of infection following third molar surgery.

Based on various reports it seems that the risk of postoperative infection after third molar surgery increases in the presence of following factors:

1. Increased time of surgery
2. Decreased operator experience
3. Increased surgical complexity
4. Higher incidence following mandibular third molar removal
5. Age-patients older than 34 years

The use of prophylactic antibiotics in third molar surgery does, in fact, reduce the incidence of dry socket. Although systemic antibiotics are effective in the reduction of postoperative dry socket, they are no more effective than local non systemic measures like copious irrigation, preoperative rinses with chlorhexidine, and placement of antibiotics in the extraction socket. The incidence of antibiotic related complications such as allergy, bacterial resistance, gastrointestinal (GI) side effects and secondary infections are not outweighed by the benefits. Therefore the routine use of perioperative systemic antibiotic administration does not seem to be valid.

The results of study by Poeschl et al (2004)[1] showed that specific postoperative oral prophylactic antibiotic treatment after the removal of lower third molars does not contribute to a better wound healing, less pain, or increased mouth opening and could not prevent inflammatory problems after surgery. And therefore is not recommended for routine use. This finding is supported by the findings of Hill (2005).[2]

| *Type of wound* | *Features of wound* | *Example of maxillofacial/ oral wound* | *Risk of infection* | *Indication for antibiotic prophylaxis* |
|---|---|---|---|---|
| Clean wound | Free of infection or inflammation. Wound does not involve alimentary, biliary, respiratory or genitourinary tract. | Surgery of TM joint, facial cosmetic surgery | Less than 2% | Optional |
| Clean contaminated wound | Associated with elective procedures involving alimentary, biliary, respiratory or genitourinary tract. | Orthognathic surgery Surgical removal of impacted tooth, dental extraction | 3% to10% | Recommended Optional/ Recommended |
| Contaminated wound | Inflamed tissue such as cellulitis | Maxillary fracture in a patient with active maxillary sinusitis | 20% | Recommended |
| Dirty wound | Spillage of pus into surgical site | Mandibular fracture through an impacted third molar that is draining pus | 40% | Recommended |

However, in a recent study by Halpern et al (2007)[3] has shown that following third molar removal the use of intravenous antibiotics (penicillin and clindamycin in those allergic to penicillin) administered prophylactically decreased the frequency of surgical site infection. The authors cannot comment on the efficacy of intravenous antibiotics in comparison to other antibacterial treatment regimens, e.g. chlorhexidine mouth rinse or intra socket antibiotics.

The comparison of various studies poses a tremendous challenge because of the variability in parameters and the methods used for each study.

Even though surgery of impacted third molar do not commonly result in serious nosocomial infections, efforts to prevent prolonged recovery periods caused by delayed wound healing and wound infection are beneficial economically. Considering the cost of antibiotic therapy compared to hospital stay/absenting from work, antibiotics should be administered to all patients who have increased susceptibility to infection.

Patients who undergo surgical removal of third molar are generally healthy and are not likely to develop postoperative infection. Factors that increase the risk of postoperative infection in any surgical patients include diabetes, cirrhosis, end-stage renal disease, corticosteroid therapy, old age, obesity, malnutrition, massive transfusion, preoperative comorbid disease and American Society of Anesthesiologists (ASA) patient classification III, IV and V.

Use of prophylactic or empiric antibiotic therapy is recommended for patients with comorbid diseases. It is also well accepted that patients who are afflicted with any systemic disease that compromises the immune defense system against bacterial infection (e.g. neutropenia, leukopenia, splenectomy, leukemia, myeloproliferative diseases) are candidates for antibiotic therapy before and after third molar surgery. There is also no controversy regarding administration of preoperative antibiotic therapy in the management of fascial space infection or dentoalveolar abscess associated with impacted third molars. Similarly antibiotics are indicated for patients susceptible to subacute bacterial endocarditis and also for prosthetic joint replacement cases.

Early in the antibiotic era, prophylactic antibiotic therapy was thought to be associated with higher rates of infection and resistance. This belief was disproved in a study conducted by Bruke in 1961. This study also showed that the timing of administration of prophylactic antibiotics has great significance. The timing of a surgical incision should correspond with the peak systemic concentration of the antibiotic administered. It has been determined that the ideal timing for prophylactic antibiotic therapy is 30 minutes to two hours before surgery. This is followed by additional coverage extending for one to two half-lives of the prescribed antibiotic for the length of the operation. Moreover, the dose of the antibiotic should be twice the therapeutic dose. In the absence of infection antibiotics should not be continued beyond the operative day.

- The timing of a surgical incision should correspond with the peak systemic concentration of the antibiotic administered.
- The ideal timing for prophylactic antibiotic therapy is 30 minutes to two hours before surgery.
- The dose of the antibiotic should be twice the therapeutic dose.

Proper administration of antibiotic prophylaxis requires evaluation of various factors such as the type of surgery performed, organisms involved, choice of antibiotic, its dosage and administration. Identification of the organism involved in infection at third molar sites has been difficult. Studies have shown a higher prevalence of anaerobic organisms even when the periodontal probing depths were normal. However studies have shown that aerobic streptococci were the most commonly found organism present in infected third molar wounds. This variety in the microbial population causes difficulty in selecting the appropriate antibiotic.

In the event that the operator is planning to give an antibiotic the following principles should be considered before prescribing antibiotics:

1. The surgical procedure should harbor a significant risk for infection, for example:
   - Long procedure (> 30 minutes) or difficult surgery involving significant tissue trauma.
   - Where there is existing infection in and around the surgical site.
2. Administration of the antibiotic must be immediately prior to or within 3 hours after the start of surgery:
   - The ability of systemic antibiotics to prevent the development of a primary bacterial lesion is confined to the first 3 hours after inoculation of the wound.
   - Commencing prophylactic antibiotic cover the day before surgery only leads to the development of resistant organisms.
   - Continuing antibiotics for days after surgery has not been shown to decrease the incidence of wound infection.
3. Prophylactic antibiotics should be given at twice the usual dose over the shortest effective time so as to minimize the potential side-effects of long term use (e.g. diarrhea) and to prevent the growth of resistant strains of bacteria.
4. There are many antibiotic prophylactic regimens currently used. The following are just a few that may be considered.
   - Amoxicillin 3 gm orally, 45 minutes before surgery under local anesthesia.
   - Clindamycin 600 mg orally, 30 minutes before surgery under local anesthesia for patients allergic to penicillin.
   - Benzyl Penicillin 600 mg IV/IM on induction for procedures under general anesthesia.
   - Erythromycin lactobionate 500 mg IV on induction for surgery under general anesthesia for patients allergic to penicillin

The above dose may be followed with an additional oral dose 6 hours after the initial dose.

To conclude, an analysis of the current literature on the topic supports routinely prescribing and not prescribing antibiotics as part of the removal of asymptomatic impacted third molars, thus making it surgeon's preference. For patients with active infection and medically compromised patient who is more susceptible to infection, prophylactic antibiotics are indicated and should be administered one to two hours before the surgical procedure. The presence of anaerobic bacteria at the third molar area without the evidence of periodontal disease supports the use of prophylactic antibiotics in all cases of impacted mandibular third molar removal. A strong argument against the routine use of prophylactic antibiotics in third molar removal is the possibility of emergence of antibiotic resistant strains. However, till date this occurrence has not been documented in cases of third molar removal (Mehrabi et al, 2007).[4]

## Use of Anti-inflammatory Drugs and Steroids

As a result of the trauma occurring during surgical extraction of third molars inflammatory response occurs resulting in edema, pain and trismus after the operation. Maximum edema after surgical extraction of third molars was found to occur between 48 to 72 hours (Peterson, 1998)[5]. This occurs because of the release of cytokines, prostaglandins, and histamine from leukocytes, endothelial cells and mast cells. The increase in osmotic pressure within injured tissues and leakage from capillaries are responsible for the expansion of tissues that occurs with edema. Corticosteroids have been shown to reduce edema following third molar surgery (Messer et al, 1975).[6] Steroids act by interfering with capillary vasodilation, leukocyte migration, phagocytosis, cytokine production and prostaglandin inhibition. The inhibition

of capillary vasodilation prevents entry of intravascular fluid into interstitial space. The leakage of fluid and leukocytes results in irritation of free nerve endings and this in turn cause release of pain mediators, including prostaglandin and substance perioperative corticosteroids act to prevent inflammation and reduce pain at the site of insult. The anti-inflammatory action of steroids is dependent on the dose and increases as the plasma concentration in proximity to the surgical site reaches the therapeutic range.

The use of perioperative corticosteroids to minimize swelling, trismus and pain has gained wide acceptance in the practice of oral and maxillofacial surgery. However, the method of usage is extremely variable. The one which is most effective has yet to be clearly delineated.

The body's daily production of cortisol is 15 to 30 mg, which may increase up to 300 mg during a stressful event. The normal concentration of cortisol in a healthy patient is 13 µg/ dL. This may increase up to 50 - 73 µg/ dL in septic shock.

The most widely used steroids are dexamethasone and methylprednisolone. Both of these are almost pure glucocorticoids with little mineralocorticoid effect. Also, these two appear to have the least depressing effect on leukocyte chemotaxis. Common dosages of dexamethasone are 4 to 12 mg given IV at the time of surgery. Additional oral dosages of 4 to 8 mg. twice a day for the day of surgery and 2 days afterwards leads to the maximum relief of swelling, trismus and pain. Methylprednisolone is most commonly given IV 125 mg at the time of surgery followed by significantly lower doses, usually 40 mg 3 or 4 times daily taken orally for the day of surgery and for 2 days after surgery. It is important to note that a tapered dose of steroids after third molar surgery is prescribed not to compensate for adrenal suppression; but rather to correlate with the decline in surgical stress in the 72 hour postoperative period. The bioavailability of glucocorticoids after oral administration is remarkably high and may provide effects that parallel intravenous administration. Gastrointestinal side effects, however, are known to occur from oral intake. Steroids given orally three to four hours before surgery lessen gastrointestinal upset. In an outpatient environment, patient compliance may not always be optimal with regards to timing of intake. High dose, short-term steroid use is associated with minimal side effects. They are contraindicated in patients with gastric ulcer disease, active infection, active tuberculosis, acute glaucoma and certain type of psychosis. Relative contraindications include diabetes mellitus, hypertension, osteoporosis, peptic ulcer disease, infection, renal disease, Cushing's syndrome and diverticulitis. The administration of perioperative steroids may increase the incidence of dry socket after third molar surgery, but the data is lacking as to the precise degree of increase.

Recent work on the use of corticosteroids would suggest that these drugs are of great value in reducing postoperative sequelae after third molar surgery. Short-term steroid therapy is not associated with the development of adrenal crisis. However, there is no consensus of opinion regarding the ideal preparation and dosage to be used following surgery of impacted molar.

**Patients on long-term steroid therapy:** Continuous daily administration of corticosteroids for a month results in suppression of adrenal glands and internal corticosteroid production. Such patients require a doubling of the steroid dose on the day of the surgery, followed by gradual tapering postoperatively back to the original daily dose. Adrenal insufficiency may occur up to one year after cessation of steroid therapy. Even if these patients have discontinued their steroid therapy for up to one year, a tapering dose of steroids may be required for surgery. Intraoperative adrenal insufficiency most commonly presents as hypotension that is resistant to fluid treatment but responds to steroid therapy. When adrenal insufficiency is suspected preoperatively, cortisol stimulation test can be performed. An initial cortisol level is obtained first. Adrenocorticotropic hormone is then injected and the cortisol level estimated in one hour. If the cortisol level does not increase, a diagnosis of primary adrenal insufficiency can be made.

The adverse effects of prolonged steroid administration are extensive. They include poor wound healing, hypertension, electrolyte abnormality, psychosis, euphoria, osteoporosis, hyperglycemia, central obesity, abdominal striae, thin skin, glaucoma, myopathy, amenorrhea, hirsutism, acne and adrenal insufficiency. Short term steroid therapy like that used following third molar surgery is not associated with the above side effects.

## Use of Non-steroidal Anti-inflammatory Drugs (NSAIDs)

Post-operative pain and inflammation following surgical removal of impacted third molars are also managed with non-steroidal anti-inflammatory drugs (NSAIDs). The edema occurring after the surgical extraction of third

molars may cause pain because of the pressure it exerts on the masticatory muscles. Moreover, since the edema fluid creates an environment prone to infection, in order to relieve the post-operative swelling, anti-inflammatory drugs may be administered. During the primary phase of cellular healing, called the inflammatory reaction, non-steroidal anti-inflammatory drugs act by inhibiting the prostaglandin synthesis. Therefore, they are frequently used after surgical procedures in order to reduce the soft tissue edema and pain by suppressing inflammation.

## Combining Steroids and NSAIDs

Buyukkurt et al (2006)[7] reported that the combination of a single dose of prednisolone and diclofenac is well-suited to the treatment of postoperative pain, trismus, and swelling after dental surgical procedures and should be used when extensive postoperative swelling of soft tissue is anticipated.

Schultze-Mosgau et al (1995)[8] conducted a study to assess the efficacy of ibuprofen and methylprednisolone in the treatment of pain, swelling and trismus following the surgical extraction of impacted third molars. This regimen included 32 mg of methylprednisolone 12 hours before and after the procedure and 400 mg of ibuprofen three times per day on the day of the operation and for the first two postoperative days. It was concluded that this perioperative regimen of methylprednisolone and ibuprofen significantly reduced pain, swelling, and trismus following the unilateral extraction of impacted maxillary and mandibular third molars.

Antihistamines and enzymes chymotrypsin, hyaluronidase has been shown to be of little value in controlling postoperative edema and pain.

## Use of Analgesics

Postoperative analgesics can affect either central or peripheral pain receptors. Common centrally acting analgesics include opioid narcotics. Peripherally acting analgesics primarily inhibit prostaglandins. Examples include acetaminophen, aspirin, and cyclo-oxygenase (COX-1 and COX-2) nonsteroidal anti-inflammatory drugs (NSAIDs).

Perioperative administration of opioids decreases pain, increases tolerance to pain, and a pleasing sedating effect. However, opioids can produce several untoward effects such as respiratory depression, nausea, vomiting, constipation and tolerance. The most common opioid preparations include oxycodone, hydrocodone and codeine. Ibuprofen and diclofenac sodium are NSAIDs with high analgesic efficacy and are commonly prescribed. Adverse effects of NSAIDs include gastro-intestinal bleeding and pain, tinnitus, and renal failure. When comparing the analgesic efficacy of opioids, NSAIDs and combinations of these medications, the combined formulations provided the highest efficacy. Surprisingly, opioids when used alone are less effective than NSAIDs in relieving pain after third molar removal and these drugs alone cannot be recommended for this purpose. Dependency is rare with the short term use of opioids.

NSAIDs act by reducing the production of peripheral prostaglandins, thromboxane $A_2$ and prostacycline production by inhibiting COX enzyme. COX-1 receptors are found within all tissues while COX-2 receptors are present only in inflammatory and neoplastic tissues. The use of COX-2 inhibitors was initially favored over classical NSAIDs because of nearly 50% reduction in the side effects associated with NSAID administration such as peptic ulcer disease and renal failure. However, recent studies have shown that COX-2 inhibitors induce thrombosis in patients with a history of coronary artery disease or cerebrovascular accident.

The ideal agent for use after third molar surgery should alleviate pain, reduce swelling and trismus to a minimum, promote healing and have no unwanted effects. Of course, such an agent does not exist. For relief of pain, analgesics are the obvious choice. Where possible, an analgesic with additional anti-inflammatory properties should be used. Seymour et al (2003)[9] reported that soluble aspirin 900 mg provides significant and more rapid analgesia than paracetamol 1,000 mg in the early postoperative period after third molar surgery.

Patients should be encouraged to take analgesics either before the onset or at the time of onset of pain or discomfort rather than waiting till the pain becomes unbearable.

Long-acting local anesthetic solutions may be of value in some situations where extreme pain is likely to be a feature in the immediate post-operative period. However, there are no strict criteria for identifying such cases pre-operatively.

Studies have shown that administering a dose of analgesic preoperatively markedly reduces postoperative pain.

## SUMMARY OF PERIOPERATIVE DRUG THERAPY

### Use of Antibiotics

The routine use of antibiotics in third molar removal is not recommended. However, antibiotics may be considered in the following situations-

- Presence of acute infection at the time of operation
- Significant bone removal
- Prolonged operation time
- Patient is at increased risk of infection

### Use of Steroids

Where there is a risk of significant postoperative swelling, pre- or perioperative administration of dexamethasone or methylprednisolone has been shown to reduce swelling and discomfort

### Use of Analgesics

Oral analgesics such as paracetamol or ibuprofen are commonly advised for outpatients. The new COX-2 selective inhibitors such as rofecoxib have superior analgesic effects without the common gastrointestinal side-effects. NSAIDs may also be helpful in reducing postoperative swelling.

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CHAPTER

# 13 Complications of Impaction Surgery

Studies have shown that surgical removal of impacted third molars is associated with an incidence of complications around 10%. These complications can be classified as the expected and the predictable ones, such as swelling and pain, and more severe complications such as fracture of the mandible. The overall incidence and severity of the complications are directly related to the depth of impaction, age of the patient, the relative experience and training of the surgeon and the time taken for the procedure.

In a study conducted by Haug RH (2005)[1], the sample was provided by 63 Oral and Maxillofacial Surgeons and was composed of 3,760 patients with 9,845 third molars who were 25 years of age or older. Alveolar osteitis was the most frequently encountered postoperative problem (0.2% to 12.7%). Postoperative inferior alveolar nerve anesthesia/paresthesia occurred with a frequency of 1.1% to 1.7%, while lingual nerve anesthesia/paresthesia was calculated as 0.3%. All other complications also occurred with a frequency of less than 1%.

In a recent study by Waseem Jerjes et al (2006)[2], 1087 patients who underwent surgical removal of third molar teeth were prospectively examined to analyze the possible relationship between postoperative complications and the surgeon's experience parameter. Seven surgeons; three specialists in surgical dentistry and four oral and maxillofacial Senior House Officers (OMFS residents) carried out the surgical procedures. The study concluded that the higher rate of postoperative complications in the residents group suggests that at least some of the complications might be related to surgical experience. This raises a number of important issues related to training. Ideally, third molar removal should only be carried out by experienced practitioners and not by occasional surgeons. However, surgeons are not created by divine right and need training to gain the requisite level of experience. This will unfortunately result in a higher level of complications even when residents are closely supervised.

**Complications may occur:**

A. During the surgical procedure
B. Immediate postoperative period
C. Late postoperative period.

## A. Complications during the Surgical Procedure

These are a found to occur during each major step of the surgical procedure viz.

1. Incision
2. Bone removal
3. Tooth sectioning
4. Elevation of the tooth.

Possible complication which can occur during each of the above step and appropriate preventive steps that can be taken to avoid these will be explained.

***1. Complications during incision***

Following the standard incision for the reflection of flap that is described above only a mild bleeding will occur which can be easily controlled. Excessive bleeding may occur in the following situations:

*a. Pre-existing local inflammation* which is inadequately controlled. Hence attention should be paid for adequate control of local infections like pericoronitis before contemplating the surgery.

b. *Bleeding from retromolar vessels:* If the incision is carried upwards towards the coronoid process instead of directing it out wards towards the cheek, retromolar vessels may be cut. These small vessels emerge from a small foramen; retromolar foramen located at the apex of the retromolar triangle or in the retromolar fossa. If these vessels are injured, the ensuing bleeding can be troublesome interfering with further reflection of the flap. The bleeding can be easily controlled with pressure pack.

c. *Bleeding from facial vessels:* This is an unusual complication to occur; and if it happens a torrential hemorrhage can result. The facial vessels (artery and vein) cross the inferior border of mandible at the level of the anterior border of masseter. These vessels can be injured if the anterior incision is carried too vertically down into the buccal sulcus and at the same time pierces the periosteal envelope and reaches the muscle. This mishap can be avoided by holding the sharp edge of the blade directed superiorly and making the incision from down towards the teeth. Should this misfortune occur, the bleeding can be arrested temporarily by external digital compression of the vessels where they lie over the bone. For permanent hemostasis, the artery or vein has to be clamped with a hemostat and ligated.

d. *Damage to lingual nerve:* Utmost care should be taken while making incision on the lingual aspect in the third molar region due to the possibility of injuring the lingual nerve which lies superficially and in close proximity to the tooth. A vertical incision should never be given on the lingual aspect of the mandible in this region for the same reason.

**2. *Complications during bone removal***

a. *Use of bur:* Provided reasonable precautions are taken, use of bur will not cause problem during use. But the possibility of following complications should be borne in mind while using hand piece and bur.

- Accidental burns: An improperly maintained hand piece with a damaged bearing can get heated up during usage. If this is not detected by the gloved fingers of the operator, accidental burning of the cheek and lip of the patient will occur. This will not be felt by the patient since the above regions will be anesthetized. Burns can be very painful during the healing period and will be associated with delay in healing.
- Laceration of soft tissues: During use the bur may slip and get driven into the buccal or lingual soft tissue. This will cause laceration of the tissue and on the lingual side it may injure the lingual nerve. If the bur is revolving while the hand piece is being taken in and out of the mouth, the soft tissues of the cheek and the lips can get abraded or lacerated. Hence make sure that the micromotor has stopped completely before these acts.
- Injury to inferior alveolar neurovascular bundle: While 'guttering' bone on the buccal side of the impacted tooth, as the bur reaches the apex of the tooth, the mandibular canal may be inadvertently opened. This will result in brisk hemorrhage from inferior alveolar vessels, which can be controlled with pressure pack or bone wax. But sometimes damage to nerve can also occur resulting in anesthesia in the distribution of mental nerve. In rare instances the mandibular canal may be buccally placed and at a more superior level than the normal. In such cases injury to contents of the canal will occur more easily during 'guttering'.
- Injury to adjacent tooth: Drilling in the region of the mesial surface of impacted tooth should be kept to the minimum to avoid damage to the distal aspect of the adjacent second molar.
- Injury to lingual nerve: While removing bone on the distolingual aspect extreme care is taken to protect the lingual nerve from bur by way of proper retraction. It is advisable not to remove any bone on the lingual aspect due to the possibility of causing damage to lingual nerve.
- Necrosis of bone: Even though this is a late complication, it occurs due to inadequate cooling of the rapidly revolving bur which in turn causes overheating of bone and its subsequent necrosis followed by sequestration. Profuse irrigation of the surgical site using sterile saline can avoid this mishap.
- Emphysema: Air driven handpiece has the disadvantage of causing surgical emphysema as well as driving the tooth and bone particles into the soft tissues. Retention of such debris in the soft tissues can result in postoperative infection also. Using micromotor and handpiece can avoid this complication

b. *Use of chisel*: Chiseling is a relatively safe, speedy, and efficient means of bone removal when used correctly. When used improperly it can also cause the following substantial damages.

- Splintering of bone: When chisel is used to remove the buccal cortical plate covering the impacted tooth, the split can sometimes extend forwards along the buccal aspect of the teeth and denude the teeth of external cortical plate. This happens because on the buccal and lingual side in the posterior aspect of mandible the 'grains' runs antero- posteriorly. Hence, a vertical stop cut is made first at the mesial end of the portion of the bone to be removed to avoid accidental splintering of the buccal cortical plate.

Similarly when splitting the lingual plate, if the cutting edge of the chisel is held parallel to the internal oblique ridge, a splintering of lingual plate will occur, with the split extending up to the coronoid process. To avoid this, the bevel of the chisel should be held at an angle of 45° to the bone surface and pointing in the direction of the lower second premolar of the opposite side. In its correct position the cutting edge of the chisel will be parallel to the external oblique ridge.

- Fracture of mandible: If the chisel is carelessly placed and if a blow with considerable force is delivered it can lead to fracture of mandible.
- Displacement of tooth into lingual pouch: A hard chisel blow directed on the buccal side of the wisdom tooth may fracture the lingual wall of the socket, displacing both the tooth and the fractured lingual plate into the lingual pouch.
- Injury to lingual nerve: While working on the distal aspect of the impacted third molar, slippage of the chisel can severe the lingual nerve unless it is adequately protected with a retractor.
- Injury to second molar tooth and soft tissues: Wrong positioning of the chisel blade or slippage of the instrument can injure the second molar or the adjacent soft tissue.

***3. Complications during sectioning of tooth***

Tooth can be sectioned using bur or osteotome: Unless this is carefully performed it can lead to the following complications:

*Use of bur*

- Incorrect line of sectioning of crown: The ideal site for sectioning of the crown is the cervical portion of tooth i.e. apical to the cemento -enamel junction with bur held at right angles to the long axis of the tooth. If the bur cut is not correctly angulated or bur cut is done at different sites, it will be difficult to separate the crown and remove it.
- Injury to mandibular canal: During tooth sectioning if the bur is carried to the full width of the tooth in the superior inferior direction, to reach its 'bed' there is a possibility of damaging the contents of the canal. This can lead to severe bleeding from the vessels during the surgery and later on numbness of the lower lip. Hence the entry of the bur is limited to three-fourths of the width of the tooth. The rest of the tooth is separated with leverage using an instrument like curved Warwick James elevator. But this has the disadvantage of sometimes leaving a thin shelving edge of root extending forwards along the floor of the socket. This will make the subsequent root removal more difficult.
- Breakage of bur: This can occur either due to the application of a heavy pressure or due to the repeated use of the same bur. Used burs should be discarded and a fresh bur used in each case. Binding of the bur in the tooth structure is another reason for fracture. Tapering fissure burs are less likely to bind than flat fissure burs and hence the former is preferred for tooth sectioning. Recovery of a fractured bur tip from the bone or tooth structure is a difficult endeavor.

*Use of osteotome*

- Compared to osteotome, chisels are ineffective to achieve a clean section of the tooth. Hence the former one is used. However, osteotome can not create a space into which the sectioned crown could be moved. Hence more than one section is necessary. Conversely if a wide bur is used then sufficient space will be created into which the sectioned crown can be moved enabling its removal.
- Fracture of mandible, injury to lingual nerve, second molar or soft tissues and displacement of tooth into lingual pouch are other possible complications associated with the use of an osteotome.

***4. Complications during elevation of tooth***

A number of complications which are listed below may occur during this stage of surgery:

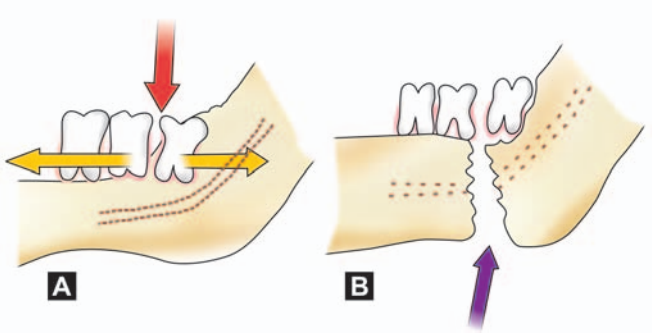
- Fracture of impacted tooth/ root: This is considered to be the most common complication to occur during this stage and is most often due to inadequate removal

of bone. It may also be due to already weakened tooth structure due to caries, resorption or restoration. Adequate bone removal and proper assessment of the tooth preoperatively can prevent this. Facture of the root also can occur. All efforts should be made to remove the root tip. It must be remembered that aggressive and destructive attempts to remove roots may cause more damage than benefit.

- Injury to second molar: Injudicious elevation of impacted tooth using second molar as the fulcrum can result in the subluxation or expulsion of the latter. This risk is more if the second molar has conical roots or when first molar is missing. Similarly fracture of the crown or dislodgement of filling / artificial crown of second molar can also occur during elevation of wisdom tooth. The incidence of damage to restorations of the second molar has been reported to be 0.3 % to 0.4%. Teeth with large restorations or carious lesions are always at risk of fracture or damage upon elevation. Correct use of surgical elevators and adequate bone removal can help prevent this. Possibility of such a mishap has to be informed to the patient pre-operatively and all precautions taken to avoid it.
- Fracture of mandible: Mandibular fracture as a result of third molar removal is a recognized complication and has significant medico legal and patient care implications. It should be included in all third molar extraction consent forms (Bouloux et al 2007).[3] Mandibular fracture during or after surgical third molar removal is however a rare one. The incidence has been reported to be 0.0049% (Libersa et al, 2002).[4]

Possible predisposing conditions, such as increased age, mandibular atrophy, concurrent presence of a cyst or tumor and osteoporosis have been implicated in increasing the risk of mandibular fracture. The preangular region of mandible is an area of lowered resistance to fracture because of its thin cross-sectional dimension and an impacted tooth occupies a relatively significant space of this weak area. The concurrent presence of a dentigerous cyst around the third molar or a radicular cyst around the second molar and the removal of the tooth and any surrounding bone to mobilize it will further weaken this area.

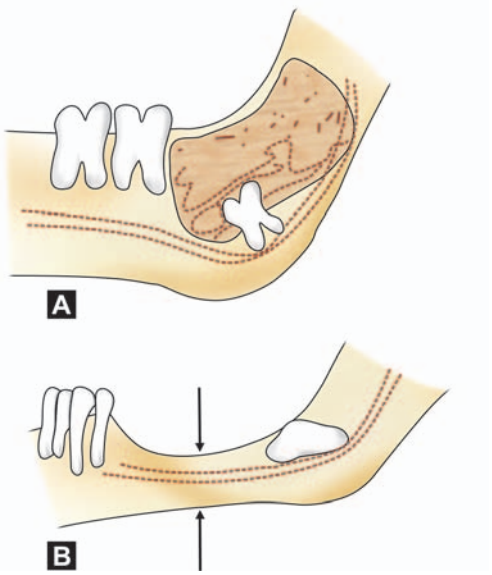
Fracture is almost always caused by the application of excessive tensile or shear forces across the superior border of the mandible in the third molar area (Fig.13.1). This results in the initiation of a fracture and its propagation along the line of weakness caused by the third molar in its socket. The instrument in use is almost always the large straight elevator and the operator tries to elevate the wisdom tooth distally and occlusally using excessive force.




**Figs 13.1A and B:** (A) Application of excessive force (red arrow) using an elevator mesial to impacted third molar without adequate removal of overlying bone, forces the adjacent teeth in opposite directions (yellow arrows) resulting in extensive shear force. This result in fracture of mandible (B) shown as blue arrow

Weakening of mandible due to excessive removal of bone or a thin and atrophic mandible due to resorption as in old age or bone weakened by local pathological conditions are contributory factors (Figs 13.2 to 13.5).

An intra-operative fracture must be suspected when a loud crack accompanies sudden loosening of a tooth that was very resistant to elevation. Inspection of the




**Figs 13.2A and B:** Conditions causing weakening of mandible predisposing to fracture during surgical removal of impacted tooth. (A) Dentigerous cyst involving angle of mandible, (B) Atrophy of mandible in old age. Sclerosis of bone / osteoporosis is also a contributory factor

**Fig. 13.3:** Extensive dentigerous cyst associated with impacted 38

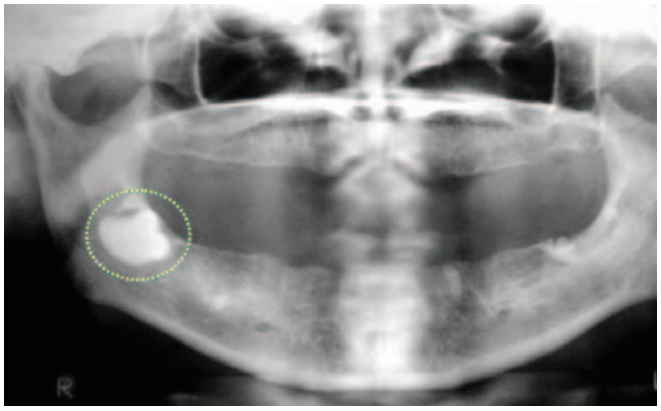


**Fig. 13.4:** Impacted 48 (complete bony impaction) in edentulous mandible. The angle of mandible is weakened by the presence of impacted tooth. Extensive removal of bone for extracting the tooth will further weaken the mandible predisposing to fracture

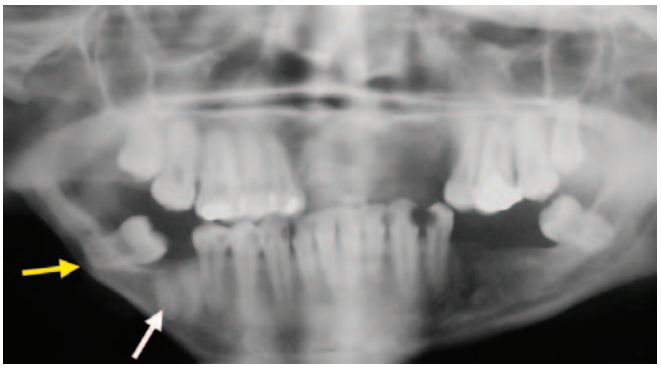


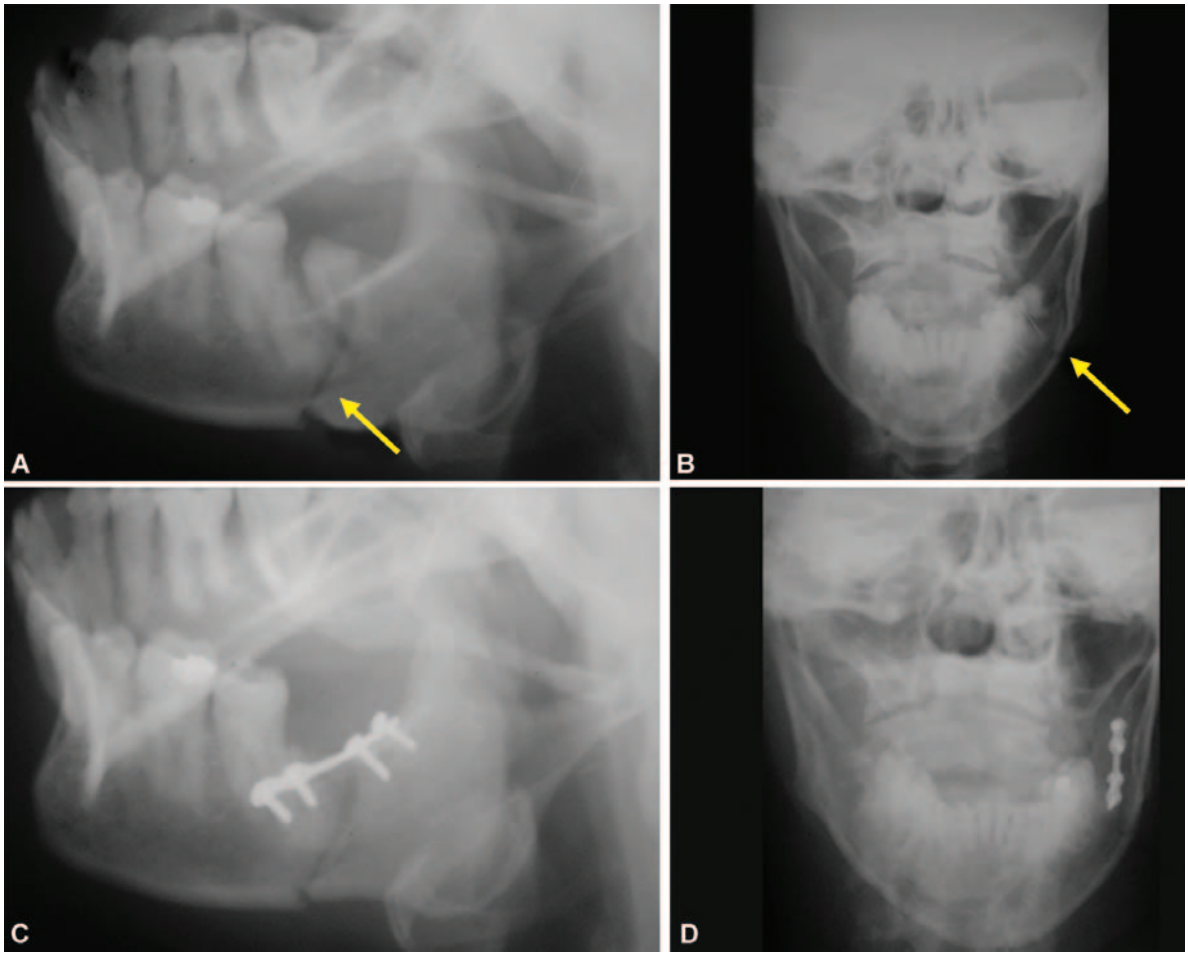
**Fig. 13.5:** OPG showing impacted 48 in a congenitally atrophic mandible. Note the thin amount of basal bone beneath 48 (yellow arrow), which is likely to get fractured during surgical removal of impacted 48. Note the root stumps of 46 (white arrow)

operative site will demonstrate a fracture through the tooth socket. Displacement of the fracture will be accompanied by a change in the patient's occlusion. The diagnosis must be confirmed radiographically (Fig. 13.6).

Alternatively, a patient may present in the post surgical period with a fractured jaw secondary to trauma. This happens because removal of tooth leaves a defect in the jaw and temporarily renders the jaw more susceptible to fracture from minor trauma especially when unwarranted bone removal has been done. Studies have shown that the fractures occurred 5 to 28 days after the tooth removal. It has been concluded that the major risk factor for this complication seemed to be advanced age in combination with a full dentition.

Regardless of the mechanism, mandibular fractures that occur during or soon after the extraction of the mandibular third molars are usually non displaced or minimally displaced. Such hairline fractures that extent from an extraction site are not easily identified and clinical suspicion may require CT if the initial panoramic film gives negative results. The practitioner should treat the fracture definitively just as if the patient were a trauma patient. Failure to do so may result in further complications. If this mishap occurs, the case has to be referred to a specialist for expert management. The patient should be informed of this disaster and all records relevant to the case like radiographs and clinical notes preserved. The line of management includes removal of the remaining portion of the impacted tooth followed by fixation of fracture by eyelet wiring and maxillary mandibular fixation or upper border wiring or bone plating or other methods of fixation. The line of management is dictated by the amount of bone loss, degree of displacement and the accessibility.

- Dislodgement of tooth/crown into the lingual pouch or lateral pharyngeal space: Mandibular third molars can be iatrogenically displaced into the sublingual, submandibular, pterygomandibular and lateral pharyngeal spaces. Weakened or thin lingual plate, lingual obliquity of impacted tooth, insufficient reflection of overlying mucoperiosteum, inadequate bone removal, excessive or uncontrolled force during elevation are considered the main causes for this accident. Adequate reflection of overlying gingiva and placing a finger over the wisdom tooth to assess its movement during elevation can help to a great extent to prevent this complication. Lower third molars that




**Figs13.6 A to D**: (A and B) Radiographs of mandible showing fracture of left angle of mandible (yellow arrows) in a 54-year-old female which happened during attempted removal of impacted 38 by a general dental practitioner, (C and D) Postoperative radiographs following open reduction and internal fixation using mini plates alongwith surgical removal of impacted 38

are pushed through a perforation in the thin lingual alveolar bone normally pass inferiorly into the mylohyoid muscle.

A fractured root also can be displaced into the lingual pouch during its attempted removal from the socket. See Figure 5.9 in Chapter 5.

To retrieve a tooth or root displaced into the lingual space, pressure is exerted beneath the mandible externally to prevent its further displacement downwards and at the same time using the index finger of the other hand to milk the tooth / root back into the socket through the breach in the lingual plate. If required the lingual gingiva may be reflected as far as the premolar region and the mylohyoid muscle incised to gain access to the submandibular space and deliver the tooth. It is then grasped using a hemostat and removed. Good light and suction are mandatory for success. Also care should be taken to protect the lingual nerve. Locating the displaced tooth is challenging due to the limited working area and hemorrhage with resultant compromised visualization and blind probing that may result in further displacement. A combination of intraoral and extraoral approach may be required in certain instances to remove the tooth.

Gay-Escoda and associates (1993)[5] reported a case in which a patient underwent extraction of a displaced mandibular third molar that was found between the platysma and sternocleidomastoid muscle. It was removed via transcutaneous approach. The authors opined that the tooth might have undergone progressive migration as a result of inflammatory reaction.

Esen and colleagues (2000)[6] described a case in which a patient presented months after attempted extraction of

a mandibular third molar with progressive limitation in mouth opening, edema of left neck and dysphagia. A panoramic film revealed a tooth in the pterygomandibular region. CT scans showed the precise location of the tooth at the anterior border of the lateral pharyngeal space beneath the left tonsillar region. The tooth was removed transorally from the tonsillar fossa (after completion of a tonsillectomy) through a vertical incision from the tonsillar fossa to the retromolar trigone.

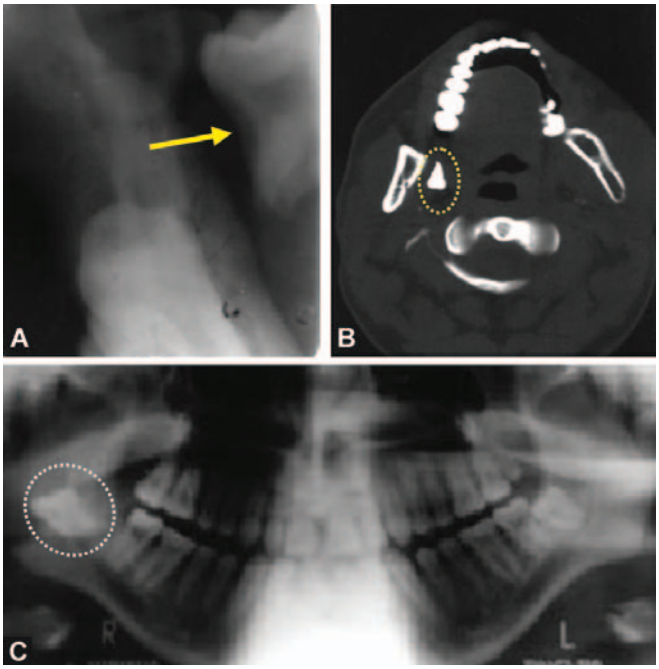
In cases where the tooth / root have been further migrated downwards and backwards into the lateral pharyngeal space, the patient will be complaining of severe pain on swallowing. An extra oral approach will be necessary to reclaim the tooth and to avoid the development of an infection.

Ortakoglu et al (2002)[7] reported a case of displacement of lower third molar into the lateral pharyngeal space during surgical removal. The radiological examination included panoramic, occlusal and computerized tomographic (CT) views to localize the tooth correctly. The radiological findings showed that the tooth was displaced into the pterygomandibular region. Removal of the tooth under local anesthesia via lingual approach was performed. The incision was made on the alveolar crest between the anterior edge of the ramus and lingual mucoperiosteum of the second molar. After reflection of the mucoperiosteal flap, the lateral pharyngeal space was reached by blunt dissection. In this area the tooth was located in a horizontal position and removed carefully.

Figure 13.7 shows the various radiographic views of a tooth displaced into the pterygomandibular space.

Some authors suggest that the displaced tooth must be removed at the initial surgical attempt to avoid development of infection. However, others propose a 3-4 week waiting period to allow the development of fibrous tissue around the tooth thereby immobilizing it. This will enable its removal in the second attempt. Such a line of management has the possibility of development of infection unless antibiotics are administered. Delayed intervention in the event of a displaced tooth into the lateral pharyngeal space carries the risk of infection, thrombosis of the internal jugular vein, erosion of the carotid artery or one of its branches and interference with cranial nerves IX to XII (Bouloux et al, 2007).[3]

- Injury to mandibular canal: While elevating the tooth as the crown moves upwards, the roots may be forced downwards (Fig.13.8) with the apices piercing the mandibular canal and injuring the neurovascular bundle. This happens more commonly in cases of mesioangular and horizontal impactions. Injury to vessels can result in brisk hemorrhage. Bleeding can be controlled by immediately packing the socket with gauze. Once the initial severe bleeding is controlled, bone wax can be applied or placing a pack of




**Figs 13.7A to C:** Radiographic views of a tooth displaced into pterygomandibular space. (A) Periapical X-ray (note the yellow arrow pointing towards the tooth), (B) Axial CT scan showing the displaced tooth (yellow interrupted oval), (C) OPG shows the displaced tooth (white interrupted circle). [*Courtesy:* Ortakoglu et al]

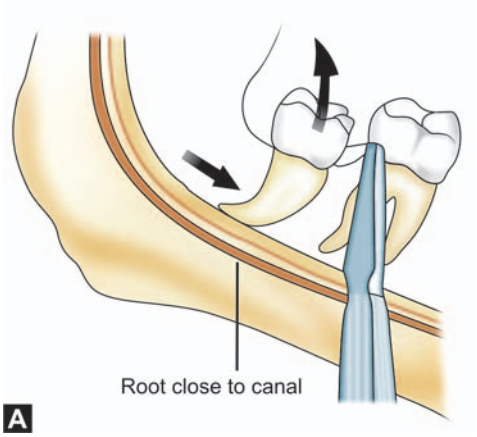
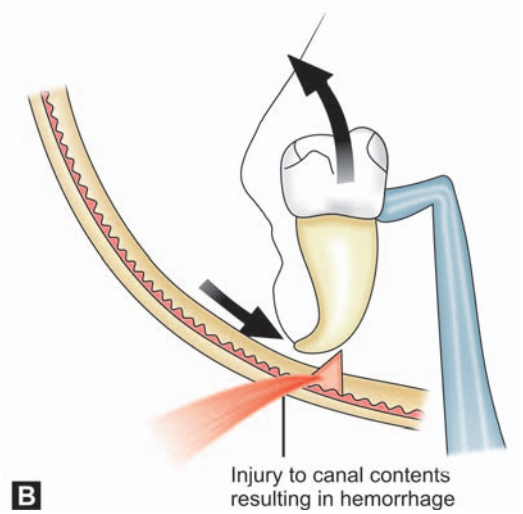



**Fig 13.8A**




**Figs 13.8A and B:** (A) While elevating the tooth; as the crown moves upwards, the roots may be forced downwards with the apices piercing the mandibular canal, (B) Injury to the neurovascular bundle and resulting hemorrhage. Damage to inferior alveolar nerve also can occur resulting in anesthesia in the distribution of mental verve

Whitehead's Varnish or antibiotic cream on gauze and leaving it in position for one or two days. Other alternatives are gelatin sponge (Gelform) or oxidized cellulose (Oxycel) to control the bleeding. Unlike the gelatin sponge, oxidized cellulose can be packed into the socket under pressure. Damage to inferior alveolar nerve also can occur in a similar situation resulting in anesthesia in the distribution of mental verve.

While working in the depth of the socket to retrieve a fractured root, the root piece can be inadvertently pushed into the canal resulting in injury to the contents. If bleeding occurs it has to be controlled by the methods described above. Any further attempt to remove the fragment through the socket is futile and buccal cortical plate in the region has to be removed to expose the root to effect its removal.

## Post Surgical Sequelae and Complications

Following the surgical removal of an impacted third molar, certain normal physiological responses will occur as sequelae. These range from mild bleeding and swelling to trismus. Even though the patient has been for warned, all these are disagreeable to the patient and hence, they should be kept to the minimum.

**1. Hemorrhage:** If adequate hemostasis is achieved at the time of surgery, it is unlikely for postoperative hemorrhage to occur. The incidence of clinically significant bleeding following third molar extraction ranges from 0.2 to 5.8%. Excessive hemorrhage resulting from extraction of mandibular molars is more common than bleeding from maxillary molars. In a study conducted by Chiapasco et al (1993)[8] the rate of postoperative bleeding for mandibular and maxillary third molar extraction was 0.6% and 0.4%, respectively. These complications occurred mostly in cases of deep distoangular and horizontal impaction in the mandible. In the maxilla, high vertically positioned molars were most often implicated.

Jensen (1974)[9] reviewed 103 cases of postoperative hemorrhage after oral surgery and made several important observations. He found that the male to female ratio was 2:1, and the age range was 21 to 45 years. There was a personal or family history of bleeding in 25% of cases. Postoperative bleeding occurred within 8 hours of the surgery in 75% of cases. The general physical condition of the patient was not affected in 84% of cases. Among cases in which the location of the bleeding was identified, 7% had an arterial source and 72% involved hemorrhage from the soft tissue. A single site of bleeding was found in 43% of cases. 10% had inadequate postoperative instructions. Local control was successful in 84% of patients. Hematological investigations revealed no diagnosable bleeding abnormalities, except in 4 patients with previously known coagulation deficiencies.

The hemorrhage can be either intraoperative or postoperative and its etiology being either local or systemic in nature. Systemic conditions such as hemophilia A or B and von Willebrand's disease are often diagnosed early in patient's life. Management of these patients include close coordination with the hematologist and maximum use of local measures, including the fabrication of a customized dressing plate before surgery. Anticoagulant drugs such as warfarin sodium and antiplatelet medications such as aspirin should be discontinued/switched to other drugs in the preoperative period.

Local factors that result from soft tissue damage and injury to blood vessels represent the most common cause of postoperative hemorrhage. Intraoperative and postoperative bleeding can be minimized by using good surgical technique, minimum trauma to the hard and soft tissues and avoiding damage to inferior alveolar neurovascular bundle. Nevertheless as a result of physical exertion or raise in blood pressure or due to any of the

local or systemic causes (bleeding diathesis) post operative bleeding can occur.

The most effective way to achieve hemostasis following surgical removal of impacted tooth is the application of a moist gauze pack over the site of the surgery and bite with adequate pressure for 45 minutes. Preparations of zinc sulphate (Zingisol) or glycerine tannic acid (Sensoform Gum Paint, Stolin Gum Astringent) can be used to wet the pack as these will act as styptics and stop bleeding (Table 13.1).

Rarely bleeding from inferior alveolar vessels or facial vessels may occur. After locating the source of bleeding, packing the site or clamping and ligature of the vessel is done. When bleeding occurs from the socket, attempting to control it by tight suturing across the socket is futile and hazardous. This is because bleeding may still continue with blood not collecting in the oral cavity but rather spreading into the tissue spaces beneath the sutures. This may lead to hematoma formation in the base of the tongue or parapharyngeal space ultimately resulting in respiratory obstruction.

Treatment of post extraction bleeding starts with a review of the patient's medical and surgical history. Vital signs and clinical status should be monitored continuously. An attempt to quantify the amount of blood loss is helpful. Hypotension due to loss of blood volume can be measured by blood pressure and heart rate. An increase in the heart rate of more than 15 beats/minute, a decrease in the systolic blood pressure of more than 15 mm Hg or any drop in the diastolic blood pressure indicates significant hypovolemia (defined as more than 30% of total blood volume lost). Intraoral examination with adequate lighting of the oral cavity and oropharynx will allow identification of the bleeding area. Direct pressure with gauze is then applied for 20 to 30 minutes. This measure is usually sufficient to control bleeding, since the reason for bleeding is some secondary trauma associated with the patient sucking the socket. If the bleeding continues, infiltration of local anesthetic (with 1:100,000 epinephrine) should be done. In contrast to the common misconception that any clot that has formed should be left in place, all clot and debris must be removed to allow examination of the socket. The socket should be curetted and suctioned to identify the source of bleeding. If the source is not arterial, then any of a variety of local hemostatic agents can be used. If an arterial source is identified (indicated by pumping of bright red blood), the vessel must be ligated. If the bleeding is from soft tissue and is arterial in nature but does not involve the neurovascular bundle, it is usually amenable to cautery. Bleeding from bone can be managed with bone wax or various other hemostatic agents described below. If the source is intra-alveolar, then absorbable packing may be placed into the socket, and maintained thereby sutures. Oral fibrinolysis from salivary enzymes may be a cause for postoperative bleeding. The use of fibrin stabilizing agents such as epsilon aminocaproic acid or tranexamic acid may be helpful in such cases.

**Table 13.1:** Styptics and local agents for the control of hemorrhage.

| *Name* | *Action* | *Application* |
|---|---|---|
| Monsel's solution-contains ferric sulphate | Precipitates protein and aids clot formation | Wet a gauze pack with the drug and then bite on the gauze pack |
| Sensoform Gum Paint-contains glycerine tannic acid | Precipitates protein and aids clot formation | Wet a gauze pack with the drug and then bite on the gauze pack |
| Mann hemostatic-mixture of tannic acid, alum and chlorobutamol | Precipitates protein | Wet a gauze pack with the drug and then bite on the gauze pack |
| Silver nitrate, ferric chloride | Precipitates protein | Wet a gauze pack with the drug and then bite on the gauze pack |
| Folded tea bag | Precipitates protein | Bite over a folded tea bag |
| Adrenalin | Induces vasoconstriction. Should not be used in patients with hypertension or cardiac diseases. | Applied with a gauze pack in a concentration of 1:1000. Vasoconstrictor effect is reversible and hence watch for recurrence of bleeding. |

The following materials can be placed in the socket to achieve hemostasis. (Table 13.2).

*Absorbable gelatin sponge:* The most commonly used and the least expensive is the absorbable gelatin sponge (Gelfoam). This material is placed in the socket and held in place with a figure - of -eight suture placed over the socket. The absorbable gelatin sponge forms a scaffold for the formation of blood clot and the suture helps to keep the sponge in position during the coagulation process. A gauze pack is then placed over the socket and is held with firm pressure.

*Oxidized cellulose:* Another material that can be used to control bleeding is oxidized regenerated cellulose (Surgicel and Oxycel). The material promotes coagulation better than the absorbable gelatin sponge, because it can be packed into the socket under pressure. The gelatin sponge on the other hand becomes very friable when wet and can not be packed into a bleeding socket. However, since the packing of the socket with oxidized cellulose causes a delay in the healing of the socket, this is reserved for more persistent bleeding.

Surgicel comes in knit form whereas Oxycel comes in a microfibrillar form. Surgicel has the fibers which are knit together and they are solid fibers whereas Oxycel has hollow fibers but they essentially work the same way. Surgicel is relatively acidic and is thought to cause some small vessel contraction. Like gelfoam, it works at the same point in the intrinsic pathway of clotting causing contact activation. Hence, functional clotting factors are needed in order for this to work. It is thought to be relatively bacteriostatic when compared to other hemostatic agents. The theory behind this is that because of its relatively low pH, it deactivates and denatures some of the bacterial proteins especially those related to antibiotic resistance, thus making them more susceptible to antibiotics. It needs to be applied dry and absorbs within four to eight weeks.

*Topical thrombin*: If there is some doubt regarding patient's ability to form clot, a liquid preparation of topical

**Table 13.2:** Local hemostatic agents useful for controlling bleeding from extraction socket

| *Name* | *Source* | *Action* | *Application* |
|---|---|---|---|
| Gelfoam | Absorbable gelatin sponge | Scaffold for blood clot formation | Place into the socket and retain in place with suture |
| Surgicel | Oxidized regenerated methyl cellulose | Binds platelets and chemically precipitates fibrin through low pH | Place into socket (It cannot be mixed with thrombin) |
| Avitene | Microfibrillar collagen | Stimulates platelet adherence and stabilizes clot; dissolves in 4 to 6 weeks | Mix fine powder with saline to desired consistency |
| Collaplug | Preshaped, highly cross-linked collagen plugs | Stimulates platelet adherence and stabilizes clot; dissolves in 4 to 6 weeks | Place into extraction site |
| Collatape | Highly cross-linked collagen | Stimulates platelet adherence and stabilizes clot; dissolves in 4 to 6 weeks | Place into extraction site |
| Thrombin | Bovine thrombin (5,000 or 10,000 U) | Causes cleavage of fibrinogen to fibrin and positive feed back to coagulation | Mix fine powder with calcium chloride and spray into desired area. Alternatively mix cascade with gelfoam before application |
| Fibrin glue (Tiseel) | Bovine thrombin, human fibrin, calcium chloride and aprotinin | Antifibrinolytic action of aprotinin | Requires specialized heating, mixing and delivery system; inject into extraction site |
| Horsley's Bone wax | Bee's wax - 7 parts<br>Olive oil - 2 parts<br>Phenol - 1 part | Acts by mechanical occlusion | Large quantity can cause foreign body granuloma and infection. Hence, to be used judiciously. |

thrombin (prepared from bovine thrombin) can be saturated onto a gelatin sponge and inserted into the socket. The thrombin bypasses all the steps in the coagulation cascade and helps to convert fibrinogen to fibrin enzymatically, which forms a clot. The sponge with topical thrombin is secured in place with a figure - of - eight suture. A gauze pack is then placed over the socket.

*Collagen:* This is another material that can be used to control bleeding from a socket. Collagen promotes platelet aggregation and thereby accelerates coagulation. Collagen is currently available in several different forms. Microfibrillar collagen (Avitene) is available as a loose and fluffy material that can be packed into the extraction socket. This is then held in place using suture and gauze pack. A more highly cross-linked collagen is supplied as a plug (Collaplug) or as a tape (Collatape). These materials can be more easily packed into the socket. However, they are more expensive.

If local measures are not successful then the situation needs to be managed urgently, especially if the patient becomes symptomatic. The surgeon should consider performing additional laboratory screening tests to determine whether the patient has a profound hemostatic defect. Consultation with the hematologist is advisable in such instances for the further management of the case. Figure 13.9 shows the general management protocol and algorithm for the treatment of post extraction bleeding.

Airway, breathing and circulation must be assessed. As in all emergencies, airway management is the first step in stabilizing the patient. Uncontrollable intraoral hemorrhage can quickly lead to airway compromise either because of an expanding hematoma in the neck or from blood pooling in the airway. The size and spread of a hematoma depends on its vascular origin (capillary, venous or arterial) and the tissue into which it is bleeding (muscle, fat or interstitia). The location of the hematoma can be delineated using CT scan with contrast. Hematomas stop expanding when the pressure of the pooling blood exceeds the vascular pressure of the bleeding site. If the hematoma continues to expand obstructing the airway surgical exploration of the site, evacuation of hematoma and ligation of the vessel has to be done.

In the event of considerable blood loss, replacement therapy in the form of whole blood or blood substitutes should be considered in a hospital setting after hematological examination and medical consultation. This is essential to avoid the patient going into hemorrhagic shock and its attended complications.

Moghadam (2002)[10] reported a case of life-threatening hemorrhage occurring immediately after extraction of third molars and resulting in airway compromise.

Massive intraoperative bleeding is a rare occurrence and can be secondary to a mandibular / maxillary arterio-venous malformation (AVM), which can be either low flow (venous) or high flow (arterial). The presence of such a malformation in the mandible or maxilla is potentially life-threatening secondary to torrential hemorrhage if tooth extraction is attempted. In a series reported by Guibert-Trainer et al (1982)[11] eight percent of patients died as a result of massive hemorrhage during tooth extraction. AVMs are comparatively rare in the orofacial region compared to other pars of the body. In the maxillofacial region AVMs are often apparent on physical examination and panoramic radiography (Bouloux et al, 2007).[3] A history of recurrent or spontaneous bleeding from the gingiva is the most frequent sign. Other physical findings include gingival discoloration, hyperthermia over the lesion, a subjective feeling of pulsation and the presence of a palpable bruit. Mandibular AVMs usually appear as multilocular radiolucencies on radiographic studies, although significant lesions may be nonapparent. Angiography is essential to confirm the diagnosis and assess the extent and vascular architecture of the lesion. Treatment of AVMs involves either surgical excision or embolization.

**2. Edema (Table 13.2)**: This is an expected sequelae of third molar surgery. Patients with round puffy face frequently develop more swelling than those with a lean face. Postoperative swelling usually subsides rapidly in two or three days. If it persists, it is suggestive of infection or hematoma formation and it has to be managed accordingly. Parenteral administration of corticosteroids is found to be extremely useful to minimize postoperative edema. The role of application of ice packs to the face to reduce the swelling is controversial. Ice pack applied intermittently for the first 24 hours definitely makes the patient more comfortable and reduces the pain. However, opinion among investigators is divided regarding the effectiveness of ice application.

Mac Auley DC (2001)[12] stated that ice, compression and elevation are the basic principles of acute soft tissue injury. After a thorough literature review he found that

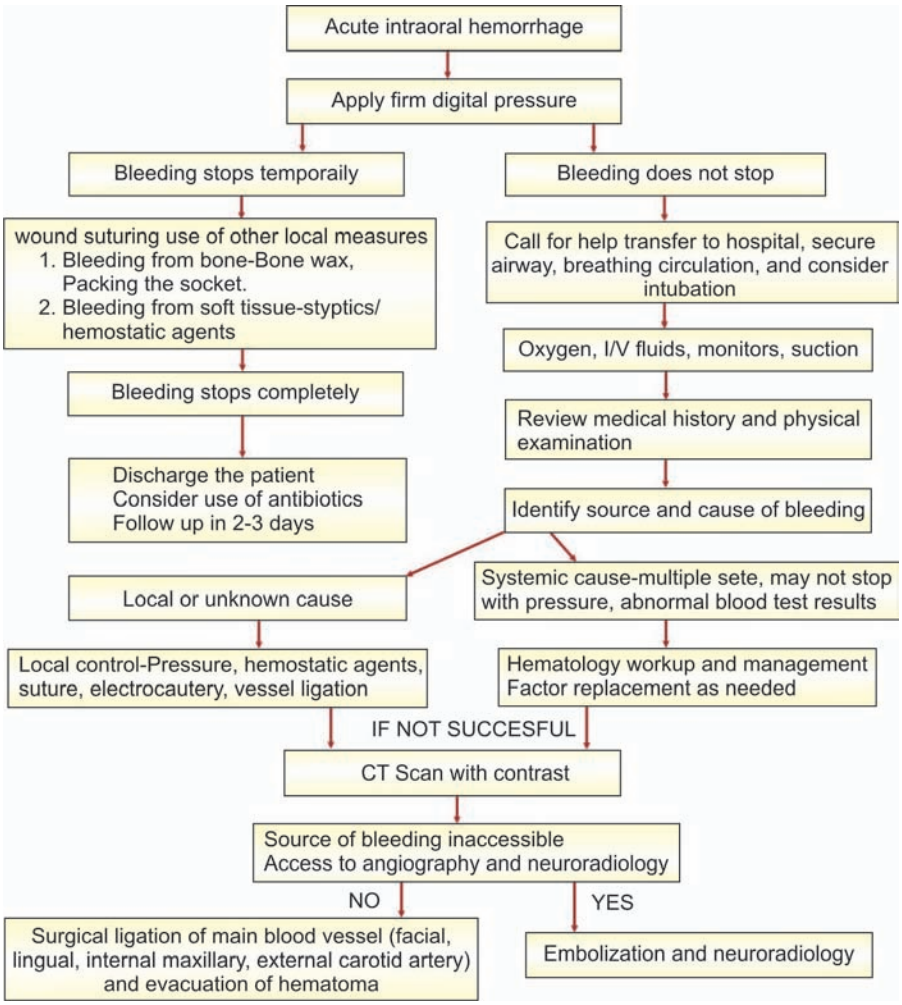



**Fig 13.9:** Algorithm showing the general management protocol and treatment of post extraction bleeding

temperature change within the muscle depends on the method of application, duration of application, initial temperature, and depth of subcutaneous fat. The evidence from this systematic review suggests that melting iced water applied through a wet towel for repeated periods of 10 minutes is most effective. The target temperature is reduction of 10-15 degrees C. Using repeated, rather than continuous, ice applications help to sustain reduced muscle temperature without compromising the skin and allows the superficial skin temperature to return to normal while deeper muscle temperature remains low. It was concluded that ice is effective, but should be applied in repeated application of 10 minutes to be most effective.

Studies by Sortino et al (2003)[13] indicate that application of an ice pack controls the temperature of the mucosa post-surgery more effectively and that the duration of surgery appears not to influence temperature variations. In the postoperative phase they recommend a rational application of ice packs appropriate to the constitution of each patient.

Filho et al (2005)[14] reported that cryotherapy (ice application) was effective in reducing swelling and pain in their sample. Despite playing no role in the reduction of trismus, the authors recommend its use.

The effect of external application of local cold on swelling, trismus, temperature and pain postoperatively in surgical removal of impacted mandibular third molars was studied in a cross-over study comprising 45 patients by Forsgren et al (1985).[15] They concluded that the external application of cold after the surgical removal of impacted mandibular third molars does not appear to

**Table 13.3:** Differential diagnosis of postoperative swelling

| *Condition* | *Cause* | *Time of onset* | *Clinical features* | *Management* |
|---|---|---|---|---|
| Emphysema | Entry of air into tissues | During the procedure | Feeling of crepitus/air in the tissue | Minimum emphysema-may be left as such or a pressure dressing given. Massive spreading emphysema-emergency management to maintain airway, antibiotics to prevent infection |
| Normal post operative oedema | Normal inflammatory reaction of body | 3 to 4 hours after the procedure | Pain not marked, non tender, soft swelling, subsides rapidly | Ice application, drug therapy, pressure bandage |
| Hematoma | Bleeding into tissue planes primary or reactionary | Immediately following surgery or a few hours later | Persists longer, tense and tender, change in colour of the skin or mucosa | Removal of sutures, drainage of hematoma, hot saline mouth wash, antibiotic therapy if infected |
| Abscess formation/ Infection | Infection of the surgical site | 2 to 3 days later | Severe pain and tender-ness, raise of temperature, fluctuation if abscess has formed | Incision and drainage if pus has formed, culture and sensitivity of pus, antibiotics and supportive therapy |

improve the postoperative course, either on a short or long-term basis.

A recent animal study was conducted by Nusair (2007)[16] to note the effect of local application of ice bags on facial swelling after oral operations in rabbit. It was observed that there was no significant difference between the test and control sides 24 or 48 hours postoperatively.

Pressure bandages also have a role in minimizing the edema. Oral preparations of chymotrypsin or serratiopeptidase have been advocated by various authors to control postoperative swelling. The swelling usually reaches its maximum by the end of the second postoperative day and is usually resolved in a week's time.

Another adjuvant measure suggested in reducing post operative oedema and pain is the use of a small surgical tube drain. In a study conducted by Rakprasitkul et al (1997)[17], the insertion of a small surgical tube drain with primary wound closure (drain group) was compared to a simple primary wound closure (no drain group) after removal of impacted third molars. The operation time was found to be significantly longer and mouth opening significantly wider in the immediate postoperative period in the drain group subjects as compared to the other. There was no significant difference in the severity of pain between the two groups. Facial swelling was found to be significantly less in the drain group subjects. The number of patients with wound breakdown, edema, and bleeding was found to be less in the drain group than in the no drain group. Thus, the postoperative problems, in general, were less in the surgical drain group as compared to the no drain group.

**3. Trismus:** Mild difficulty in opening the mouth is also an expected sequelae of third molar surgery. It has been noted that those patients who have been given steroids for the control of edema, also tend to have less trismus. Some patients have a misconception, that it is the suture that is preventing normal opening and hence avoids mouth opening lest the suture may break. Such patients should be identified and properly instructed to perform jaw exercise. Active jaw exercise started the day after surgery and continued till the suture removal will ensure adequate mouth opening. The earlier the patient starts on normal diet and regular oral hygiene habits the

better will be mouth opening at the time of suture removal.

When severe trismus occur the possibility of hematoma formation, excessive stripping of muscle insertion and infection especially in the submasseteric space should be considered.

Protracted trismus is unusual following third molar surgery. If this happens, active jaw exercise, hot fomentation, short wave diathermy and massage have to be considered.

**4. Pain:** Pain following atraumatic and expeditious surgery is usually minimal and this can be controlled with mild analgesics. Unduly prolonged surgery, excessive cutting of dense bone, improper handling of soft tissues and low pain threshold of the patient; all contributes to postoperative pain. Dry socket, hematoma formation and infection are the usual causes of severe pain.

The post surgical pain begins when the effect of the local anesthesia subsides and reaches its maximum intensity during the first 4 to 8 hours. Lago-Méndez et al (2007)[18] observed that there is a statistically significant relationship between the surgical difficulty and postoperative pain. Pain after extraction of mandibular third molar is directly proportional to the surgical difficulty and duration of the procedure.

Maintenance of good oral hygiene preoperatively has been found to be related to postoperative pain. Studies by Peñarrocha et al (2001)[19] reported that poor oral hygiene before the surgical removal of impacted lower third molars is correlated with greater postoperative pain. Maximum postoperative pain was recorded 6 hours after extraction, with peak inflammation after 24 hours. Patients with poor oral hygiene reported higher pain levels throughout the postoperative period and more analgesic consumption in the first 48 hours. In contrast, oral hygiene appeared to exert no influence on either trismus or inflammation.

A plethora of analgesics is available for the management of post surgical pain. Analgesics should be given before the effect of local anesthesia subsides. That way the pain is easier to control, requires fewer drugs, and may require a less potent analgesic. Certain authors advice that administration of analgesics before surgery may be beneficial in the control of postoperative pain. There is a strong correlation between postoperative pain and trismus, indicating that pain may be one of the principle reasons for limitation of mouth opening after the removal of impacted third molars. Hence, it has been noted that patients who have received steroids for control of oedema usually complaints of less pain.

Usually, postoperative pain lasts up to the third post operative day. Should it persist after that period, patients should be recalled for evaluation.

**5. Infection:** The incidence of infection following the removal of third molars is very low when strict aseptic technique has been followed. Infection after third molar surgery have been reported to vary from 0.8 to 4.2%. It may develop either in the early or in the late postoperative period. Mandibular sites are more commonly affected. It has been suggested that the risk factors for postoperative infection include age, degree of impaction, need for bone removal, or tooth sectioning, presence of pericoronitis, surgeons experience, use of antibiotics and clinical setting (hospital versus office procedure). The benefit of perioperative or postoperative systemic antibiotics on the incidence of infection is debated and cannot be recommended routinely. The use of antibiotics is discussed in detail in appropriate sections (Chapter on Drug Therapy).

Nearly half of the infections are the localized, subperiosteal abscess which occurs two to four weeks postoperatively. This usually happens due to debris left under the mucoperiosteal flap. It is treated by surgical drainage and antibiotic therapy.

The strategic position of the mandibular third molar at the junction of a number of different fascial spaces (Fig.13.10) requires that any infection in this area must be taken seriously because of the ability of such an infection to spread along the fascial planes and compromise the airway.

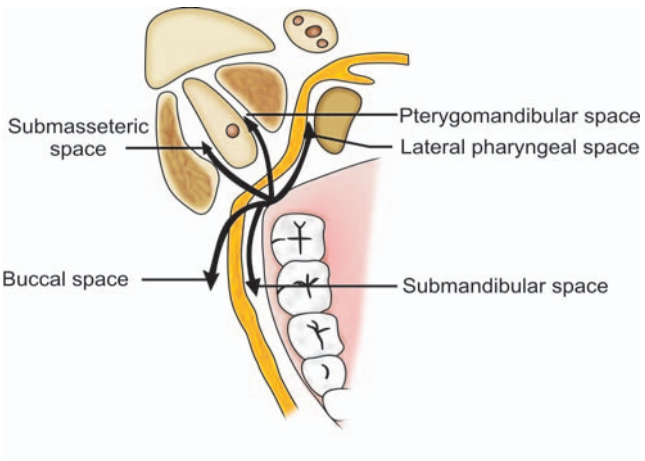



**Fig. 13.10:** Spread of infection from mandibular third molar area to various fascial spaces (marked with black arrows)

Infections in the buccal space and buccinator space are usually localized on the lateral side of the mandible. Submasseteric infections occupy the potential space between the lateral side of the mandible and the masseter muscle. This space is not lined by fascia. However, infection in this area is in direct contact with the masseter muscle and usually induces intense spasm in the muscle resulting in profound trismus.

Pterygomandibular space infections (Fig.13.11) occupy the fascia- lined space between the medial pterygoid muscle and the medial aspect of the mandible. Infections in this area cause trismus and sometimes airway embarrassment also.

The submandibular space is formed by the splitting of the investing layer of fascia of the neck to enclose the submandibular salivary gland and is in continuity with the pterygomandibular and parapharyngeal spaces. Infections in this region can cause airway embarrassment.

Parapharyngeal space infections occur between the pharyngeal mucosa and superior constrictor muscle. Infections in this region are potentially life-threatening and may produce significant airway embarrassment requiring urgent attention. Infections may also involve the retropharyngeal tissues and subsequently the mediastinum with disastrous results.

Infections from maxillary third molar may spread to the maxillary vestibule, buccal space, deep temporal space or infratemporal fossa.

Following surgical removal of third molar when infection spreads to soft tissues, the initial edema does not subside; rather it increases in size. Sometimes infection can be of late onset developing after the initial edema has subsided. In either case the significant features are severe pain, marked tenderness and a raise in temperature. If pus forms there will be flactuation. If the onset of infection is detected sufficiently early, its further progress can be terminated by administration of antibiotic. Antibiotic therapy will also prevent the spread of infection into adjacent facial spaces.

**Fig. 13.11:** Pterygomandibular space infection following surgical removal of 48. Note the swelling and erythema (yellow circle) and the associated trismus

Once abscess has formed, it should be drained first, followed by antibiotic therapy. Culture and sensitivity of pus will help to identify the organism as well to select the antibiotic which the organism is sensitive to. Penicillin is the antibiotic of first choice considering the mixed nature of the organism involved. Metronidazole can also be added to increase coverage against anaerobic organisms. The use of clindamycin as an alternative drug has become popular because it provides aerobic and anaerobic coverage. The selection of antibiotic should be carefully done considering the most likely microorganism involved, the possibility for allergic reactions, side effects and complications.

## Infections of Delayed Onset

Hematomas or food trapped under the flap have been cited by some authors as possible causes of delayed-onset infections. However, the most possible cause of this complication is the dead space created beneath the soft tissue lying behind the second molar. A possible source for the bacteria could be the gingival sulcus of the adjacent second molar. The fact that the vertical and mesioangular third molars are more prone to develop late infections could also explain this theory, because their crown is in very close relation to the root of the adjacent second molar. The observation that infection is more likely following removal of deeply situated third molar indicate that the surgical aggression and the amount of ostectomy are related to delayed -onset infections. Heavy smokers also seem to be more susceptible to this complication.

**6. Alveolar osteitis (Dry socket):** This is usually regarded as a localized osteitis involving either the whole or a part of the condensed bone lining the tooth socket. The condition is characterized by an acutely painful extraction socket, exposure of bare bone and socket containing broken down blood clot.

Incidence of alveolar osteitis following the removal of impacted mandibular third molars varies between 0.3%

and 25%. In cases treated under general anesthesia in the operation theatre, especially when antibiotic has been administered dry socket rarely occurs. Nevertheless, its incidence is high following operations under local anesthesia. This cannot be attributed to the effect of local anesthesia or the vasoconstrictor adrenalin contained in it. Mandibular extractions are more prone to develop dry socket than maxillary extractions. The pathogenesis of dry socket has not been clearly defined. But it is most likely due to the lysis of the fully formed blood clot before it is replaced by the granulation tissue. This fibrinolysis occurs during the third and the fourth day. The source of the fibrinolytic agents may be from the tissue, saliva or bacteria. Birn (1973)[20] suggested that the trauma associated with extraction causes release of tissue factors leading to activation of plasminogen to plasmin. The plasmin in turn causes fibrinolysis and dissolution of blood clot. The etiopathogenesis of dry socket is shown in Figure 13.12.

A number of bacteria are known to possess fibrinolytic activity and it has been recently suggested that Treponema denticolum may have an etiological role in the onset of dry socket. The role of bacteria is based on the fact that systemic and topical antibiotic prophylaxis reduces the incidence of dry socket by approximately 50 to 75%. The incidence of dry socket seems to be higher in smokers and in female patients who take oral contraceptives. Its occurrence can be reduced by bringing down the bacterial contamination of the surgical site by the following methods:

A. Oral prophylaxis and controlling gingival inflammation before surgery
B. Presurgical irrigation with antimicrobial agents such as chlorhexidine
C. Copious irrigation of operative site with saline
D. Placing small amounts of antibiotics such as tetracycline or lincomycin in the socket
E. Prophylactic administration of metronidazole in a dose of 200 mg eighth hourly starting on the day of the procedure and continued for three days.

Administering only the minimum amount of local anesthetic solution required to produce analgesia and removal of tooth with least trauma as possible can also help to prevent this complication.

In a randomized, double-blind, placebo-controlled, parallel-group study by Hermesch et al (1998)[21] subjects were instructed to rinse twice daily with 15 ml of 0.12% chlorhexidine or placebo mouth rinse for 30 seconds for 1 week before and 1 week after the surgical extractions. This regimen included a supervised pre surgical rinse also. From the study it was confirmed that the prophylactic use of 0.12% chlorhexidine gluconate mouth rinse results in a significant reduction in the incidence of alveolar osteitis after the extraction of impacted mandibular third molars. In addition, oral contraceptive use in females was confirmed to be a risk factor for the development of alveolar osteitis.

Management of dry socket: Essentially it includes irrigation of the socket, gentle mechanical debridement and placement of an obtundent dressing (Fig.13.13). The

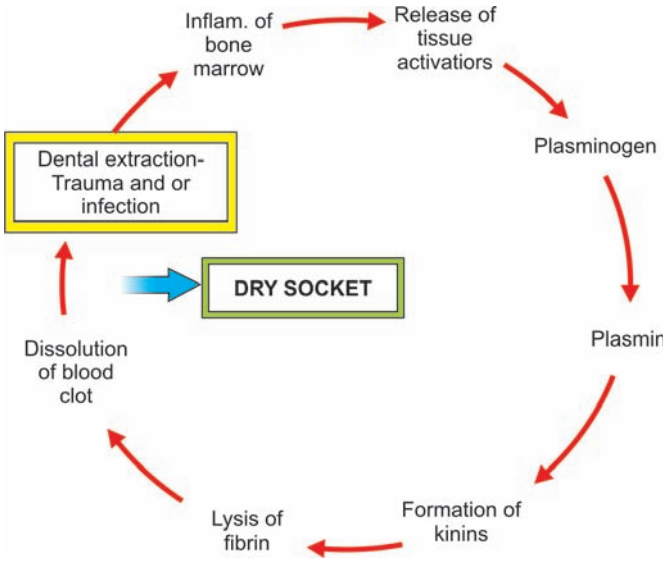



**Fig 13.12:** Schematic diagram showing the etiopathogenesis of Dry socket

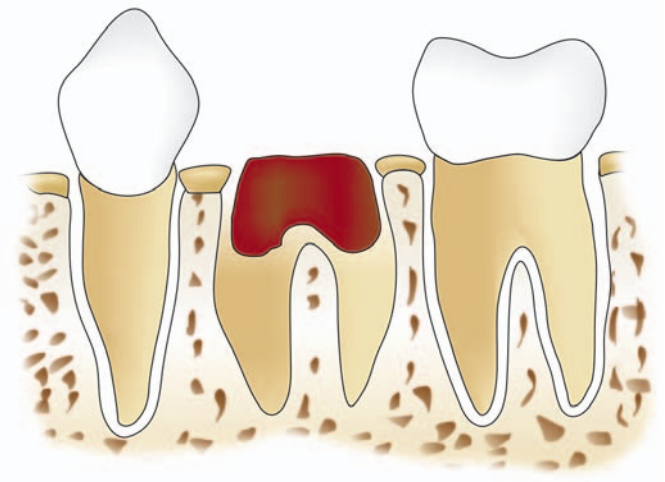


**Fig. 13.13:** Obtundent dressing in dry socket

dressing which usually contains zinc oxide and eugenol on cotton wool is tucked loosely into the socket. It must not be packed tightly or it may set hard and will be difficult to remove it later.

This dressing will have to be changed on alternate days. The pain usually resolves within two to three days. An effective drug for the management of dry socket is "Alvogyl" (Septodont-France). It contains iodoform, butylparaminobenzoate, eugenol, penghawar, excipient ad. It is supposed to be antiseptic,analgesic,and hemostatic. After irrigating the socket take a little of the material using a tweezer (Fig.13.14) and place it in the socket. It may be removed the next day and fresh dressing reinserted if the patient still complaints of pain.

A dressing containing Whitehead's varnish on ribbon gauze is another alternative for hastening the healing and relieving pain. (Whitehead's varnish contains benzoin 10 parts, idoform10 parts, storax 7.5 parts, balsam of Tolu 5 parts, solvent ether 100 parts). Patient should be seen regularly after placement of dressing, which may need to be changed several times to eliminate the symptoms. The use of intra-alveolar dressings in sockets where the inferior alveolar neurovascular bundle is exposed is not recommended. Analgesic tablets and warm saline mouth washes are also advised. But they are often unnecessary after local measures have been undertaken

**7. Nerve Injury:** Surgical removal of mandibular third molar may cause injury of the lingual and inferior alveolar nerve resulting in anesthesia or paresthesia. Nerve injury can occur when surgical procedures are performed close to the inferior alveolar canal, the mental foramen or the lingual nerve. It may be the result of instrument slippage (e.g. scalpel), cutting too deeply with a bur (e.g. while sectioning a tooth), over-zealous retraction (e.g. of a lingual or buccal flap), pushing root tips into a canal or foramen or mechanically damaging the canal contents with an instrument while probing for a root tip. Trauma may result in complete severing of the nerve, partial severing, complex hematoma formation with fibrosis, impingement by bone or a root tip or simple stretching. These injuries can be devastating for the patients because of their effects on speech, mastication, swallowing, and social interactions. Fortunately most of the injuries recover spontaneously. However some may remain permanent with varying outcome ranging from mild hypoesthesia to complete paresthesia and neuropathic responses resulting in chronic pain syndromes.


**Fig. 13.14:** Alvogyl (Septodont-France)

Pain, temperature and proprioception are transmitted centrally through the lingual, mental, inferior alveolar, infraorbital and supraorbital nerves. Each of these sensory modalities must be evaluated in the neurosensory assessment of patients and monitored for recovery postoperatively.

The incidence of neurologic injuries from third molar surgery may be related to multiple factors such as:

a. Experience of the surgeon
b. Proximity of tooth to the inferior alveolar nerve (IAN)
c. Deep horizontal and distoangular impactions
d. Surgery performed under general anesthesia (GA)- due to supine position of the patient, possibility for greater extent of soft tissue reflection and greater surgical force, more difficult case selection for surgery under GA.

   Brann et al (1999)[22] observed that lingual and inferior alveolar nerve damage was five times more frequent when lower third molars were removed under general anesthesia rather than under local anesthesia. This could not be explained in terms of surgical difficulty, preoperative pathology, age or anatomical position.
e. Patients age over 35 years
f. Completely formed roots
g. Depth of impaction
h. Use of rotary instruments
i. Surgical sectioning of tooth

Incidence of nerve injury is about 3 %. The lingual nerve injuries that result from third molar surgery have been reported to occur in 0.5% to 22% of all patients. It is

injured during soft tissue flap reflection or during bone removal. The inferior alveolar nerve is injured during removal of complete bony impaction or during attempted removal of root. Only a small portion of these anesthesia and paresthesia problems remain permanent. Radiographic signs suggestive of intimate association of the third molar with the canal are diversion of the path of the canal by the tooth, darkening of the apical end of the root indicating that it is included within the canal and interruption of the radio opaque white line of the canal. When these signs are noted extra precautions such as adequate bone removal or sectioning of the tooth should be performed. Proper patient education and informed consent are mandatory in such cases to avoid malpractice claims in the future.

## Classification

Nerve injury results in various degrees of axon or nerve damage and these inturn results in relatively recognizable patterns of clinical symptomatology. Seddon (1943) and Sunderland (1951) developed classification of nerve injuries based on the degree of nerve disruption. These classifications are based on the degree of injury affecting the endoneurium, perineurium, and epineurium and supporting tissues. Seddon's classification is based on the time from injury and degree of observed sensory recovery. The Sunderland classification emphasizes the fascicular structure of the nerve and the amount of nerve damage. Seddon proposed three categories of nerve injury viz. neuropraxia, axonotmesis and neurotmesis. Later, Sunderland expanded the Seddon classification to include five degrees of nerve injury. (Table 13.4)

i. Neuropraxia (Sunderland first-degree injury): This is the mildest form of injury usually resulting from stretching or mild compression. The axon and the nerve sheaths remain intact and there is a temporary conduction block. Significant traction injury may result in vascular stasis with focal demyelination. The nerve regains function slowly with an initial onset of tingling followed by the return of normal sensation. This usually occurs within days to weeks of the initial injury. The prognosis is very good. Microsurgery is not indicated unless a foreign body is present.
ii. Axonotmesis (Sunderland second-degree injury): This occurs as a result of damage to the nerve bundle due to crush or significant traction that causes sufficient nerve injury that there is some degree of Wallerian degeneration distal to the site of injury with maintenance of the nerve sheath. There is no degeneration of endoneurium, perineurium or

**Table 13.4:** Showing Seddon and Sunderland classification of nerve injury

| *Injury classification* | *Cause* | *Healing* | *Management* |
|---|---|---|---|
| Neuropraxia (Seddon) First-degree injury (Sunderland) | Minor nerve compression or traction injury | Spontaneous recovery in less than 2 months | Not indicated unless foreign body is impeding nerve regeneration |
| Axonotmesis (Seddon) Second-degree injury (Sunderland) | Crush or traction injury | Spontaneous recovery in 2-4 months.Up to one year for complete recovery | Not indicated unless foreign body is present |
| Third-degree injury (Sunderland) | Compression, traction or crush injury | Some spontaneous recovery, but not complete | Microsurgery is indicated if there is no improvement in three months |
| Fourth-degree injury (Sunderland) | Compression, traction, injection or chemical injury | Poor prognosis for spontaneous recovery. High possibility for neuroma formation | Microsurgery is indicated if there is no improvement in three months |
| Neurotmesis (Seddon) Fifth-degree injury (Sunderland) | Traction, avulsion or laceration of nerve trunk | Poor prognosis. Extensive fibrosis, neuroma formation or neuropathic changes | Microsurgery is indicated if there is no improvement in three months or development of neuropathic response |

epineurium, which allows for the axons to regenerate. Return of sensation requires regrowth of the axons along the nerve sheath. This process may be incomplete and often takes six months to one year for return of sensation. Microsurgery is not indicated unless a foreign body is preventing nerve regeneration.

**Third and fourth degree:** Sunderland injuries does not have a corresponding Seddon category. Third-degree injuries result from moderate to severe crushing or traction of the nerve. Wallerian degeneration is present. Disruption of the endoneurium does not allow complete regeneration of the axon which results in mild to moderate permanent nerve disturbances. Microsurgery is indicated if there is no sensory recovery after three months.

**Fourth-degree** injuries occur with endoneural and perineural disruption. Neuronal loss occurs with possibility of neuroma formation, intraneural scars and fibrosis. Prognosis for spontaneous recovery is poor. Microsurgery is indicated if there is no significant improvement after three months.

iii. Neurotmesis (Sunderland fifth-degree injury): When there has been complete transection of the nerve with loss of continuity of both the axons and the nerve sheath, the prognosis for recovery is much poorer. The nerve responds by proliferation of Schwann cells, nerve buds and fibroblasts. This results in an amputation neuroma at the end of the peripheral nerve. If the ends line up reasonably well and the nerve buds can find their way through the scar tissue to the distal tract, there may be a partial recovery of sensation in the area of lost innervation. The sensations felt by the patient will include: anesthesia or numbness, paresthesia or tingling and/or dysesthesia or pain. If the ends do not line up, there may be complete and permanent loss of sensation. If recovery has not occurred within 18 months then a neurotemesis has almost certainly taken place. Microsurgery is definitely indicated for this group of injuries.

Studies by Robinson (1992)[23] in cats suggest that section injuries are more likely to result in persistent sensory abnormalities of lingual nerve than crush injuries.

## Clinical Neurosensory Testing

Neurosensory testing should be performed to assess the degree of sensory impairment, monitor recovery and to determine whether microsurgery is indicated. Neurosensory testing can be divided into two based on the specific receptor stimulated; viz. mechanoceptive and nociceptive testing. Table 13.5 shows the neurosensory testing, the method of assessment and its significance.

*Mechanoceptive testing:* This includes two point discrimination, static light touch, brush strokes and vibrational sense. Mechanoceptive testing should precede nociceptive testing.

*Nociceptive testing:* This includes pain stimuli and thermal discrimination.

Testing should be performed in a reproducible manner. The affected area is first mapped using bush strokes to differentiate normal from abnormal areas. This is then recorded on a standard testing form or marking directly on the patient's skin and photographing. This is important for documentation.

## Lingual Nerve Injury

The lingual nerve supplies general sensation to the mucosa of the anterior two-thirds of the tongue, sublingual mucosa, and the mandibular lingual gingiva. Lingual nerve injury is a well-known neurological complication of lower third molar surgery. The reported incidence of injury to the lingual nerve after third molar extraction has a range of 0.6% to 2.0% (Pogrel, 1995).[24] Inadvertent injury to lingual nerve can result in various degrees of paresthesia, dysesthesia and anesthesia in the anterior two-thirds of the tongue, floor of the mouth and lingual gingiva. Severance of the lingual nerve will result in a variable loss of taste because of the involvement of the chorda tympani nerve, which runs within the lingual nerve sheath. Consequent to lingual nerve injury patients complaints of drooling of saliva, tongue biting, thermal burns, changes in speech and swallowing and alteration in taste perception. Lingual nerve injury occurs by direct compression during incision or excision of bone during third molar removal, periodontal surgery, tumor removal, in cases of trauma or whenever procedures are performed in the retromolar area.

Studies by various investigators have shown that the following factors related to the surgical technique of

**Table 13.5:** Neurosensory testing, method of assessment and its significance

| *Neurosensory testing* | *Method of assessment* | *Significance/purpose* |
|---|---|---|
| Static light touch | Using Von Frey monofilaments. Monofilament is applied perpendicular to the skin. If this is not available a wisp of cotton is used to stoke the skin. | A-beta fibers and pressure perception |
| Two point discrimination | Using ECG caliper, boley gauge, or two-point anesthesiometer. The test is repeated in 2 mm increments until the patient can no longer perceive two distinct points. | Normal values for inferior alveolar and lingual nerve distributions are approximately 4 mm and 3 mm respectively. |
| Brush directional discrimination | Using fine hair brush or the baseline Von Frey monofilament used for static light touch. Brush is stroked across the skin in a 1 cm area and the patient is asked whether he/she perceive the sensation and direction of the stroke. For a normal result stroke should be appreciated in 90% of the application. | Assesses the integrity of large myelinated A-alpha and A-beta fibers. |
| Pin pressure nociception | Using a sterile dental needle which is applied in a quick prick fashion of sufficient intensity to be perceived by the patient. Appropriate response is the perception of sharp and not just pressure. Alternatively a pressure algesiometer may be used | Asses the free nerve endings innervated by the lightly myelinated A-delta and unmyelinated C-fibers |
| Thermal discrimination | Cold sensation–using a cotton applicator sprayed with ethyl chloride.Heat sensation-using heated gutta percha. Minnesota thermal discs also can be used. | Cold is mediated by the unmyelinated C-fibers Heat is transmitted by A-delta fibers. |
| Diagnostic nerve blocks | Used in assessment of patients who have pain as a presenting symptom. Dilute local anesthetic (LA) agents can block the small nerve fibers, while higher concentrations are required to block the larger myelinated fibers. These blocks are usually initiated at the periphery and then administered centrally along trigeminal nerve pathways. | Helps to isolate the affected region of the nerve and determine what level of fiber is affected.If diagnostic nerve blocks are effective in reducing/in relieving pain microsurgery may be indicated. |

impacted mandibular third molar contribute to lingual nerve damage (Readers may please refer chapter on surgical anatomy for anatomical risk factors contributing to lingual nerve injury):

a. Poor flap design
b. Uncontrolled instrumentation
c. Fracture of the lingual plate
d. Stretching and compression of the nerve while retracting the lingual flap
e. Trauma to nerve as a result of local anesthetic injection-penetration through or into the nerve by the injection needle.

After analyzing the literature, it was interesting to note that the lingual nerve injuries were observed more often (40% to 70% of the time) on the right side (Renton 2001)[25], (Pogrel 1999).[26] According to Len Tolstunov (2007)[27], it could be explained by the hand-eye coordination, an acquired trait that becomes stronger with age, growing motor skills, and professional experience. It appears that most right-handed operators working on the right side of the patient can easily visualize the buccal side of the lower right third molar and the lingual side of the lower left third molar. They cannot directly see the lingual side of the lower right third molar. This blind zone

during the surgery forces the operator to rely on his or her past experience, as well as on tactile sense. This factor may compromise intimate hand-eye coordination, adding a guess factor to the procedure and increasing the risk of lingual nerve injury. The opposite is true for a left handed operator working on the left side of the patient with regard to the mandibular left third molar.

## Prevention of Lingual Nerve Injury

A. *Presurgical recognition of the risk factors:* Distoangular impactions (which are very often the most difficult to remove) and the amount of bone coverage can be determined on initial clinical and radiographic examination. A radiographic examination can also show an overlap of roots of the third and second mandibular molars in case of a distoangular impaction. This may alert an operator of a possible lingual version of the roots of the third molar. Deficiency of the lingual plate may sometimes be palpable or can be determined with a probe during initial examination. Occasionally, palpation of the soft tissue next to the lingual cortex can depict a superficially located lingual nerve. Presence of a chronic inflammatory or infectious condition in the retromolar region, such as chronic pericoronitis, can be obtained from the history and clinical examination. Chronic pericoronitis is a well-known indication for extraction of third molars. An irony is that under certain circumstances it may become a risk factor of the lingual nerve injury. The presence of all the above anatomical risk factors in a clinical situation is rare.

B. *Proper surgical technique:* With the buccal approach under direct vision, with all incisions made buccal to the third molar along the anterior border of the ramus, careful bone removal, management and protection of the flap during drilling and elevation of the tooth structure, the lingual nerve can be preserved during the surgery of mandibular third molars. Obviously, the lingual flap has to be carefully retracted with a safe type of retractor when it is necessary to protect the flap during removal of bone, sectioning of tooth, and elevation of sectioned portions of the tooth. Uncontrolled instrumentation is negligence and is one of the causes of damaging or severing the lingual nerve. Bone removal and tooth sectioning with a relatively high speed drill is another cause of nerve damage especially when the lingual bone is pierced or cut. Again, this can be avoided with careful, adequate, deliberate retraction, controlled instrumentation and direct vision of the surgical field. Aggressive curettage and follicle removal should be avoided on the lingual side of the socket. Although there is a theoretical possibility of residual cyst formation due to retained follicle, this complication is comparatively rare and relatively easy to deal with when it does occur. During suturing, sutures should be placed superficially in the lingual flap to avoid possible nerve trauma.

Following the accepted technique of buccal approach one can gain sufficient access to the third molar, if it is partially or fully impacted. As stated previously, variations in the course of the lingual nerve made clear by anatomical dissections indicate that it occasionally passes through the retromolar pad. This reinforces the obligatory use of the buccal incision.

Distoangular impaction deserves more attention especially when it is necessary to remove bone covering the distocclusal portion of the tooth before removing the tooth. This requires great care in gaining access to the area. The lingual flap has to be retracted to expose the bone to be removed by drilling or by use of chisel. It is of utmost importance that this lingual flap be protected at all times by means of a properly placed and designed retractor so that the lingual flap is not damaged or excessively compressed because this is an area where the lingual nerve might be encountered. Because a periosteal elevator may not be a broad enough retractor to totally protect the nerve, special retractors have been developed for this purpose such as Ward's, Meade's, Hovell's and Rowe's retractors. Recently, attention has been focused on the safety of lingual flap retractors with some studies particularly critical of the narrowness of the Howarth's periosteal elevator. Other articles have also shown that though lingual nerve retraction during third molar removal may cause transient damage, it is not associated with permanent damage and it has been suggested that lingual nerve retraction should be used in the removal of third molars when necessary. A broader lingual retractor as compared to a Howarth's elevator was much less likely to be associated with sensory loss.

In a prospective study by Rood (1992)[28] permanent damage was found to be significantly related to bone removal using a surgical drill. He concluded that

Howarth's periosteal elevator may not provide adequate protection to the lingual nerve when a surgical drill is used.

There are conflicting reports regarding lingual nerve protection using subperiosteal insertion of retractors. In a prospective randomized study reported by Albio et al (2000)[29] designed to evaluate the efficacy of protecting the lingual nerve by subperiosteal insertion of a retractor in 300 patients, only an incidence of 1.33% of temporary lingual nerve dysesthesia was noted. No permanent disturbances were found. The study suggested that routine application of a lingual protecting instrument during surgical removal of a third molar is not necessary in the hands of an experienced surgeon.

Whatever precautions are taken, rarely lingual nerve injury may still occur. The aim of a study conducted in Finland by Irja Ventä et al (1998)[30] was to examine malpractice claims for nerve injuries associated with third molar removals and determine whether they are concentrated among specialists, among less experienced dentists, or in certain geographic areas. During 1987-93 there were 139 claims for permanent sensory or motor disturbances related to removal of lower third molars in Finland. The lingual nerve was injured in 54% and the inferior alveolar nerve in 41% of the claims. In 91% of the cases the injury occurred in relation to surgical removal of the tooth and in 6% in relation to simple extraction. The claims were distributed among 123 dentists, of whom 78% were dental surgeons, 15% specialists in oral and maxillofacial surgery and 7% other specialists. Compensation was paid to the patients in two-thirds of the cases indicating that the dentists authorized to decide claims very often considered these injuries avoidable. The authors concluded that proper diagnosis, treatment planning, good surgical technique and detailed patient information are essential steps in each case. In cases where risks are obvious, referral to an oral surgeon is recommended.

**Inferior alveolar nerve injury:** Compared to lingual nerve, injuries of inferior alveolar nerve have a much more favorable prognosis. The area of the lip supplied by this nerve has a collateral innervation from C II and the mental nerve of the opposite side.

The possibility of sensory impairment of inferior alveolar nerve is less likely to occur following surgical removal of wisdom tooth than compared to that after fracture of mandible or after bilateral sagittal split osteotomy (BSSO).

Razukevicius (2004)[31] in his study on 195 patients, who had fracture of mandibular angle region identified three degrees of inferior alveolar neural lesion. After reduction and fixation of fracture, sensory recovery takes place: in case of minor lesion of nerve in 21 days and moderate lesion in 28 days. In severe lesion of inferior alveolar nerve, the function still does not recover even in 90 days after fracture reduction.

In a prospective study by Becelli et al (2002)[32] to evaluate sensory disturbances development in patients who underwent BSSO; thermal sensibility, nociception, and two-point discrimination, were assessed. It was found that the highest rate of spontaneous recovery of the entire inferior alveolar nerve function was observed at the sixth month. This finding witnesses how neuropraxia and axonotmesis give a spontaneous recovery that most frequently occurs within 6 months from surgery, independently of the age and sex of the patient. The persistence of anesthesia over 12 months could be a sign of neurotmesis.

In a follow-up of 1107 dentoalveolar operations in the post- canine region by Schultze-Mosgau et al (1993)[33] it was observed that 24 (2.2%) had temporary sensory disturbances of the inferior alveolar nerve and 16 (1.4%) of the lingual nerve. Permanent disturbances were not present. Complete recovery had occurred by 6 months in all cases.

Studies have shown that a number of factors have been shown to be associated with a higher incidence of inferior alveolar nerve damage following surgical removal of impacted mandibular third molar. They are:

a. Full bony impactions
b. Horizontal impactions
c. Use of burs for bone removal/ tooth sectioning
d. Apices extending into or below the level of the neurovascular bundle
e. Clinical observation of the bundle during surgery
f. Excessive hemorrhage into the socket during surgery: This can cause pressure on the nerve. Subsequent clot organization and fibrosis may result in additional nerve damage.
g. Age of the patient: In patients over 25 years incidence of nerve damage is slightly higher which may be related to more difficult surgical procedure as age advances.

## Diagnosis and Management of Nerve Injury

The diagnosis of nerve injury is usually obvious. The patient presents post-operatively with the complaint that the local anesthetic effect has not worn off or that they have 'odd' sensations in their lip or tongue. The sensory branches of the trigeminal nerve transmit sensations of pain, pressure, temperature, touch and proprioception. In addition, the chorda tympani nerve which accompanies the lingual nerve carries taste sensation from the anterior two thirds of the tongue. Because these sensations are relayed by different diameters of nerve fiber, differential loss and recovery of these components can and do occur. Hence, it is generally recommended that monitoring of all components of sensation should be done. Loss of all sensory components carries a worse prognosis and is more likely to indicate a continuity defect.

The first step in the diagnosis of nerve injury is to carefully determine the nature of the sensations. If the patient has tingling, the diagnosis is neuropraxia and the prognosis is usually good. It means the nerve has been minimally damaged and that it should return to normal sensation. If the complaint is numbness without tingling, the prognosis is less clear. In these situations the progress overtime is diagnostic. If after three to six months, the patient has a return of tingling and then normal sensation, they have had an axonotmesis and the prognosis is reasonably good. If after six to twelve months there is no return of sensation, it is likely that the nerve has been severed with extensive nerve degeneration (neurotmesis) and the progress is much poorer.

Regular follow-up following nerve injury must therefore be carried out. A suggested regimen (Kaban et al 1997)[34] consists of evaluations (1) every 2 weeks for 2 months; (2) every 6 weeks for 6 months; (3) every 6 months for up to 2 years ; and then (4) annually for an indefinite period. In most cases of nerve damage, recovery occurs over six to eight weeks and the reminder usually within six to nine months. There is still some possibility of recovery up to 18 months, but after two years, further spontaneous recovery is rare.

## Management

Complete transection of the lingual or inferior dental nerve requires immediate nerve repair by an experienced surgeon. Where there is partial damage, gentle debridement and the maintenance of good apposition of the ends is normally undertaken. The patient should be informed of the situation. Recent studies have shown that significant improvement in nerve function can be achieved by surgical intervention and repair.

a. As in all cases, careful diagnosis and risk assessment is the most important management tool in prevention of complications. This involves, first of all a thorough knowledge of the anatomy of the innervation of the mouth and the course of the various nerves. It is important to remember that the lingual nerve lies in the soft tissue on the lingual aspect of the mandible in the third molar area. Careful assessment of radiographs will allow the identification of the position of the mental foramen as well as the relationship of

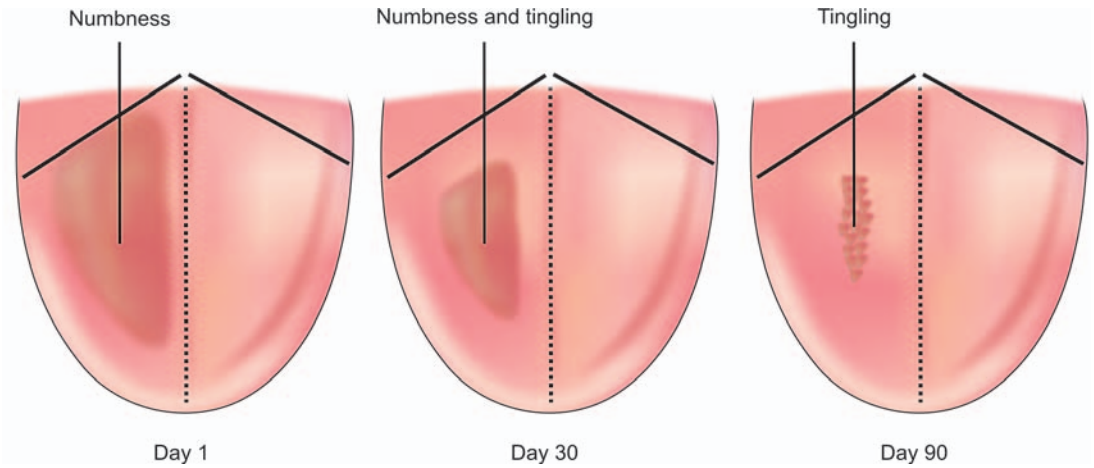



**Fig. 13.15:** Pattern of return of sensation of tongue following mild lingual nerve injury

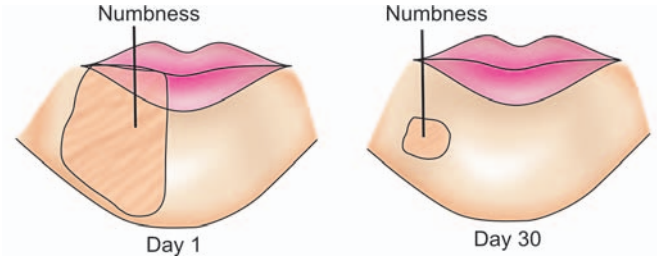



**Fig. 13.16:** Pattern of return of sensation to lip and chin following mild injury to inferior alveolar nerve

the inferior alveolar canal to the roots of the molars, in particular the third molar.

b. If the risk assessment reveals an increased risk, preventative measures must include a thorough informed consent about the possibilities of temporary or permanent nerve damage.
c. If nerve injury occurs, despite appropriate preventative measures, the patient should be followed up with careful documentation of the nature of the sensation (or lack of it) as well as the distribution of the problem. For this record, simple tissue maps are very useful.
d. In most cases very little other than reassurance can be done to improve the situation. Time up to 6 to 12 months is usually required to fully diagnose the nature of the defect. Often patients may be left with a residual defect that is smaller in size and has less dense sense of numbness than the original distribution of the problem.
e. Medical management: Corticosteroids have been tried with variable success. Neurotropic vitamins have been suggested by some authors.
f. Physiotherapy and acupuncture have been tried with varying success rates.
g. Surgical intervention: Microsurgery performed by specially trained surgeons can achieve good results.

## Indication for Trigeminal Nerve Microsurgery

The following are the indications for microsurgery:

1. Nerve transection
2. No improvement in hypoesthesia in three months
3. Development of pain caused by nerve entrapment or neuroma formation
4. Pressure of a foreign body
5. Progressively worsening hypoesthesia or dysesthesia
6. Hypoesthesia that is intolerable to the patient

Contraindications for trigeminal microsurgery: The following are the contraindications for trigeminal nerve microsurgery:

1. Central neuropathic pain
2. Evidence of improving sensory function
3. Hypoesthesia acceptable to the patient
4. Metabolic neuropathy
5. Severely medically compromised patient
6. Extremes of age
7. Excessive time since injury.

Classification of nerve repair: Depending on the timing relative to the initial injury it is classified as:

a. Primary nerve repair: Performed immediately at the time of an observed nerve injury
b. Delayed primary repair: Done within a few weeks following the injury
c. Secondary repair: Performed at a later stage, i.e. before one year if reinnervation of distal end organs is to be expected. Significant distal nerve scarring and atrophy occur by one year which makes microsurgery less predictable.

The case should be referred to a microsurgeon who can perform the repair.

## Procedure of Trigeminal Microsurgery

The procedure is done under general anesthesia using an operating microscope. Repair may also be performed using an operating (surgical) loupe. But an operating microscope with multiple heads allows the surgeon and the assistant simultaneous views of the surgical field. Instruments needed consist of microforceps, scissors, beaver blade, needle holder and nerve hooks.

Basic steps in microsurgery are: (a) exposure, (b) hemostasis, (c) visualization, (d) removal of scar tissue, (e) nerve preparation, and (f) nerve anastomosis without tension.

Transoral approach is commonly used for microneurosurgery. The inferior alveolar nerve (IAN) is exposed either through an intraoral vestibular incision followed by decortication of the buccal plate or through an extraoral approach. The lingual nerve is approached either through a paralingual or lingual gingival sulcus incision.

External neurolysis is the surgical procedure to free the nerve from its tissue bed and remove any restrictive scar tissue or bone in the case of IAN injuries. For some patients, external neurolysis may be the only surgical procedure indicated. The nerve is then examined carefully

to assess the need for any additional surgical procedure. Foreign bodies such as endodontic filling material, tooth fragments or implant materials are removed at this point.

Internal neurolysis is indicated when there is evidence of nerve fibrosis or gross changes in the external appearance of the nerve. This procedure requires opening of the epineurium to examine the internal fascicular structure of the nerve. (Because the trigeminal nerve has a sparse amount of epineurium, any manipulation can lead to further scar tissue formation. Hence some surgeons question the use of this procedure). If complete fibrosis is observed, the affected segment is excised and the nerve prepared for primary neurorrhaphy.

Excision of neuromas is performed to permit reanastomosis of complete nerve injuries in an effort to re-establish continuity and allow for nerve regeneration. After excision of the neuroma or non viable nerve tissue, the resulting segments are examined to ascertain whether normal tissue is present, which is determined by the presence of herniated intrafascicular tissues. The next step is the approximation of the two ends of the nerve without tension, the procedure called primary neurorrhaphy. Approximation is done using a 7-0 or smaller epineural suture. Tension greater than 25 g has been demonstrated to have a deleterious effect on nerve regeneration due to the possibility for gaping and formation of scar tissue.

Nerve grafting: Nerve grafting is indicated in cases where there is a continuity defect or where repair can not be achieved without tension. The selection of a donor site for interpositional nerve grafting is considered based on several factors such as: (a) nerve diameter, (b) fascicular pattern, (c) correlation of neural function such as sensory or motor, (d) ease of graft procurement, (e) donor site morbidity. For trigeminal nerve repairs, the sural and greater auricular nerves meet most of these requirements. The average diameter of IAN is 2.4 mm and for the lingual nerve it is 3.2 mm. While the sural nerve is approximately 2.1 mm in diameter and the greater auricular nerve 1.5 mm diameter. Thus there is no exact match available for trigeminal nerve grafting. Cross-sectional shape of IAN and lingual nerve is generally round; whereas the sural nerve is flat and greater auricular nerve is oval. Moreover the fascicular number and size of the fascicles of these donor and recipient nerve also does not match, which also affects the regeneration of the nerve.

Alternatives to nerve grafting: Several other materials have been suggested for nerve grafting such as alloplastic tubules, skeletal muscles and vein grafts. The technique of entubilization using alloplastic materials is an alternative to nerve grafting because there is no donor site morbidity and the alloplastic material could guide the regenerating axon.

## Outcome of Trigeminal Nerve Microsurgery

The literature available on the postoperative outcome of trigeminal microsurgery is limited.

There is little standardized manner in assessing outcome, and the numbers studied are very limited especially when it comes to the lingual nerve. In clear cases of nerve impingement by bone spicules or root tips, decompression may be helpful depending on the timing after the injury. Removal of traumatic neuromas and reanastomosis may also be performed. Repair may entail decompression, direct suture, or grafting. If continuity defects are noted, nerve grafting has also been attempted with some success. In 1996, Robinson reported 13 patients in whom the lingual nerve was repaired by apposition and epineural suture. The mean duration post injury was 16 months. There was some sensory restoration and some taste recovery.

Pogrel et al (1993)[35] reported that repair between three and six months following injury has the best results. In their study of 43 patients who underwent micro-neurosurgery for various types of injuries, and have been followed for at least one year, found four (9.3%) with essentially complete return of sensation; five (11.6 %) with good return; 19 (44.2%) with some return; 13 (30.2%) with no return; and two (4.6%) with a decrease in sensation.

Dodson and Kaban (1997)[36] performed an evidence based study to formulate treatment guidelines for operative management of trigeminal nerve injury. Their summary of recommendation include; (a) tension free primary repair whenever possible, (b) use of autogenous nerve grafts when direct primary repair is not possible, (c) use of autogenous nerve grafts or hollow conduits used for entubilization of nerve gaps 3 cm or smaller when direct repair is not possible.

In a study reported by Pogrel (2002)[37], 51 patients underwent microneurosurgical exploration and repair of inferior alveolar and lingual nerve. In 5 patients, no injury could be detected at surgery, and no corrective surgery was performed other than decompression. In 26 patients, excision and direct anastomosis were performed, and in

an additional 20 patients, nerve gap reconstruction was performed. In 16 of these 20 patients, reconstruction was performed with an autogenous vein graft, and in 2 patients, a Gore-Tex tube graft (WL Gore and Associates, Inc, Flagstaff, AZ) was used to bridge the nerve gap. In 2 patients, an autogenous nerve was used. 34 of the repairs were made on the lingual nerve, and 17 were made on the inferior alveolar nerve. With the use of established criteria, 10 patients were considered to have had a good improvement in sensation, 18 patients were considered to have had some improvement in sensation, and 22 patients were considered to have had no improvement in sensation; one patient reported an increase in dysesthesia after surgery. The author concluded that microneurosurgery can provide a reasonable result in improving sensation in the inferior alveolar and lingual nerve. More than 50% of patients experienced some improvement in sensation, and dysesthesia did not develop after surgery in any patient who did not have it before surgery.

Transected lingual nerves that undergo microsurgical repair can result in the recovery of taste, regeneration of fungiform taste receptors and recovery of some neurosensory function. Hence early repair of complete lingual nerve injury is recommended to provide the optimal chance for return of gustatory function.

Patients with chronic pain after trigeminal nerve injuries may have varied outcomes based on their specific presenting complaints. Various studies have shown an overall reduction of 50% in pain severity. The greatest reduction in pain was observed in patients with hyperalgesia and hyperpathia.

**8. Surgical Emphysema:** Use of high speed air driven hand piece or excessive gagging during or after oral surgical procedure leads to this complication. Surgical emphysema of the neck and mediastinum as a consequence of attempted extraction of a third molar tooth using an air turbine drill has been reported in the literature. This is a potentially life-threatening complication. Hence the use of air turbines for the removal of bone or for the division of teeth is to be deprecated.

It is postulated that air is forced into the subcutaneous and fascial tissue planes and into the mediastinum. Air-powered drills which are unsuitable for use in oral surgery, are those which vent air forward into soft tissues, the air carrying an unsterile mixture of water and oil with it. Potential microbial contaminants such as *Pseudomonas* and *Legionella* in dental compressed air lines may be passed into tissue spaces. Subcutaneous emphysema has also been reported following the use of air syringes, hydrogen peroxide and patient activities such as sneezing and nose blowing.

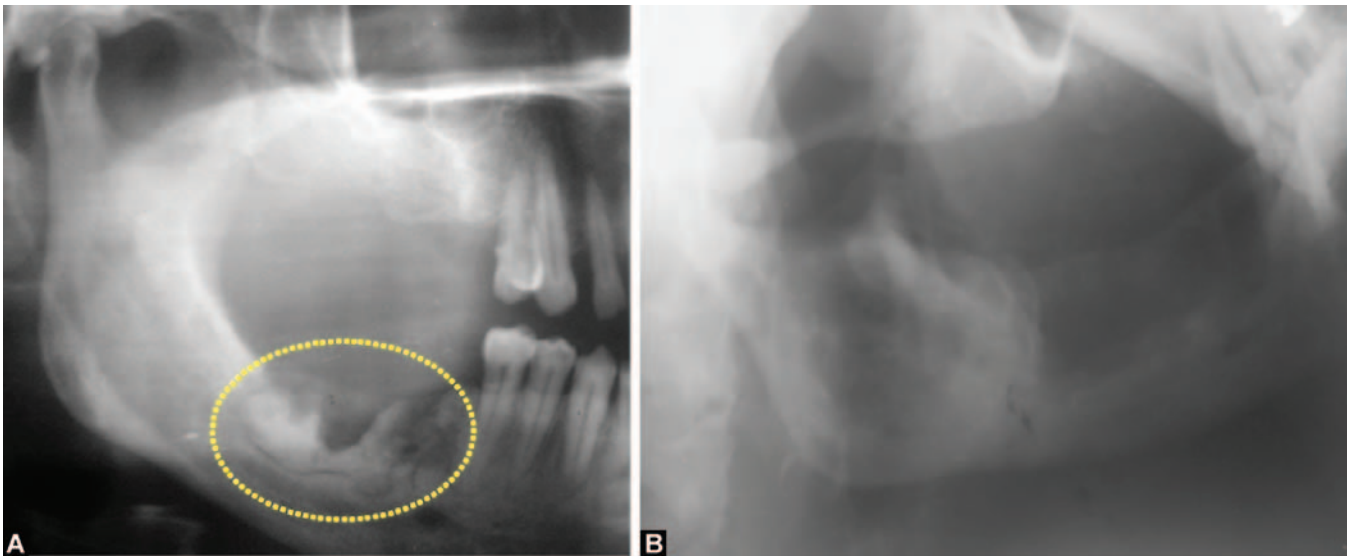
**9. Hematoma:** A hematoma is a collection of blood in a virtual space. Sutures should be placed with minimum tension just to approximate the edges of the wound. Over tight sutures with no wound toilet and further bleeding from bone or soft tissue results in hematoma. Once hematoma is diagnosed, one or two sutures may be removed to drain the collected blood and to control the hemorrhage. Failure to do so will result in organization of hematoma and subsequent infection or fibrosis

**10. Pain during swallowing:** Projecting piece of lingual plate or including the mucosa of the floor of the mouth while suturing frequently results in this. Tearing of the mylohyoid or superior constrictor muscle also results in pain during swallowing. Edema of the pharynx or associated with hematoma formation also contribute to this post operative difficulty. Following operations under general anesthesia, sore throat occurring post operatively can be attributed to use of a dry throat pack or trauma to the soft tissues of the throat from the end of suction tip.

**11. Pyrexia:** Slight elevation in body temperature immediately following surgery is anticipated. This will return to normal in about 12 to 24 hours. If pyrexia continues beyond this time, possibility of wound infection or pyrexia due to systemic causes should be suspected.

**12. Osteomyelitis:** This is a more serious infection of the bone. The commonest type to occur is the subperiosteal type, when pus collects beneath periosteum and obstructs the periosteal blood supply to the outer or inner cortical plates. This will result in sequestration of the cortical plates. The treatment is drainage of the pus and antibiotic therapy. If only small sequestra are present it will be extruded spontaneously along with the pus. Large sequestra when present have to be removed surgically.

Intramedullary osteomyelitis is a more serious complication. When it occurs following surgical removal of impacted wisdom tooth (Fig.13.17), it frequently progress to pathological fracture of mandible. Due to concurrent formation of involucrum there is little mobility or displacement of fragments in such cases.




**Figs 13.17A and B:** (A) Radiograph showing osteomyelitis of mandible that developed following surgical removal of impacted third molar in a 52-year-old lady (yellow oval). The case was managed by sequestrectomy and antibiotic therapy, (B) Postoperative X-ray

Avascular necrosis of bone is another complication similar to osteomyelitis in which portions of buccal or lingual cortical plate gets sequestrated. This occurs due to excessive stripping of the periosteum from the mandible followed by failure of its reattachment. This interferes with the revascularization leading to necrosis due to compromised blood supply. Factors contributing to avascular necrosis are extreme sclerosis of bone, presence of pus beneath the periosteum, and damage to the central blood supply of mandible; the inferior alveolar artery. The condition is manifested as a small swelling at the angle of the mandible with minimum pain. Radiographic examination will give the appearance of an intramedullary osteomyelitis with a pathologic fracture. Surprisingly the patient will have minimum discomfort. Unless secondarily infected the condition does not require active treatment. When large sequestra protrude through the overlying mucosa, they should be removed.

**13. Temporomandibular joint (TMJ) complications:** It has been suggested that because the procedure of extracting mandibular third molars involves the patient opening the mouth wide for an extended period of time and exerting a variable amount of force on the mandible, it is possible to overload or injure one or both TMJs. This is especially so if the surgeon did not use the correct surgical technique or has failed to support the mandible while removing the mandibular third molar or if the patient's protective mechanism for opening was exceeded while performing surgery under general anesthesia.

Studies have shown that in most patients with anterior disk placement with reduction, extraction of third molar was unlikely to have been the etiologic factor.

Due to the result of strain in the temporomandibular joint during removal of impacted mandibular third molar, patient may experience pain in the affected joint area post operatively. This may be due to traumatic effusion or subluxation of the joint subsequent to tearing of the capsular ligament. Frequently the condition resolves by itself but sometimes it requires treatment if pain persists for a longer period. Nonsurgical modalities such as rest, heat, muscle relaxants and a simple bite raising appliance will relieve the pain usually.

Removal of wisdom tooth may exacerbate a preexisting TMJ problem. Epidemiological studies have shown that up to 60% of the population may suffer from some degree of temporomandibular joint dysfunction at some time. Hence oral and maxillofacial surgeons should include an examination of the TMJ region, including an evaluation of joint sounds, opening and excursive movements and temporal / masseter / pterygoid muscle tenderness in all preoperative third molar extraction patients.

Development of post operative TMJ problem can be best prevented by judicious application of force, allowing the patient to bite on a mouth prop and rest every few minutes if the procedure is prolonged.

**14. Fracture of instruments:** Especially that of sharp ones can occur. The tapering end of a periosteal elevator or tip of a cross bar elevator or tip of a bur can get fractured and get wedged deep in the bone. Its presence has to be verified using a radiograph if not clinically visible before attempting its removal. If not retrievable, the patient should be told and the fact is recorded in the notes.

**15. Periodontal pocket formation distal to second molar:** Recently there has been a renewed interest in this direction. Removal of third molars is often carried out to preserve periodontal health or to treat existing periodontitis. Post operative periodontal pocket formation occurs especially when there is an existing periodontal pocket prior to surgery, or when there is poor post-surgical local plaque control. Moreover, the impacted tooth removed will be mesio angularly placed, with pre surgical crestal radiolucency seen in radiographs in association with inadequate plaque control after extraction. This can predispose to a persistent localized periodontal problem (Kan et al, 2002).[38] The use of barrier membrane to prevent this complication has been reported.

The greatest bone defects occur in older patients where there is an osseous defect on the distal aspect of second molar or in whom third molars have already resorbed part of the second molar. In contrast to older patients, in most young patients bone height after third molar removal appears similar to the preoperative level. Some studies have even shown a gain in bone level following surgery. Hence, there seems to be a general agreement that post operative periodontal health around second molar is better if the third molar is removed when the patient is young.

Role of reconstructive technique after third molar surgery to prevent periodontal defects.

There have been a number of studies to find out whether there is a role for reconstructive technique or any specific intervention following third molar removal to improve the long-term periodontal health on the distal aspect of adjacent second molar. The results of the study showed that routine intervention to improve the periodontal parameters on the distal aspect of the second molar at the time of third molar removal is not indicated in all the cases. However, there is a small proportion of patients who are at an increased risk of periodontal defects following third molar removal due to the pre-existing conditions such as: (a) age greater than 25 years, (b) pre-existing periodontal defects i.e. attachment level (AL) greater than 3 mm or probing depth (PD) greater than 5 mm, (c) horizontal or mesioangular impaction. In the event of having all three risk factors present there seems to be a predictable benefit in treating the dentoalveolar defect at the time of extraction. Although nonresorbable guided tissue regeneration (GTR), demineralized bone powder (DBP), and autologous platelet-rich-plasma (PRP) all work well in the setting of high-risk mandibular third molars, DBP is the simplest and most inexpensive to use. Dodson (2007)[39] reported that, having patients with all three risk factors present is an uncommon occurrence. When the risk factors are present Dodson recommends grafting the third molar socket with DBP. Generally 2 cc of DBP is adequate to fill the socket. The wound is closed primarily with a resorbable suture and the patient is placed on an antibiotic mouth rinse and a short course of oral antibiotic (e.g. penicillin) for 5 to 7 days. However the efficacy of the antibiotic or mouth rinse is unknown.

**16. Aspiration /Swallowing of tooth:** This is a possible complication associated with the removal of impacted tooth. All third molar extraction procedures carry the risk of tooth aspiration. The use of properly placed oropharyngeal gauze pack is essential in preventing this complication while operating under general anesthesia. The use of intravenous deep sedation may compromise the protective reflexes of the airway. The aspiration or swallowing of a tooth or portion of a tooth is usually the result of a patient coughing or gagging.

Elgazzar et al (2007)[40] reported a case of an aspirated impacted lower third molar during its removal under local anesthesia. The problem was recognized immediately during the surgical procedure. The patient, a 23-year-old male, was subjected to urgent radiological examination. The aspirated tooth was detected in the right bronchus and eventually removed by rigid bronchoscopy.

Most foreign bodies can usually be removed by skillful application of endoscopic techniques. Nevertheless, spherical foreign bodies, such as teeth remain difficult to manage. In a case reported by Ulkü et al (2005)[41] the treatment of a patient who had a tooth lodged in the right lung by open surgical approach was discussed along with treatment options.

Summary of complications associated with impacted third molar surgery.

The most common complications are as follows:

- Pain, swelling and trismus are common post-operative features of third molar surgery, with maximum pain about 6 hours after surgery. These post operative sequelae/complications can cause significant deterioration in quality of life of the patient for the first 4 to 5 post-surgical days
- Dry Socket/Alveolar Osteitis
- Wound infection/post operative infection
- Post-operative bleeding
- Lingual and inferior alveolar nerve injuries
  - transient disturbances of the inferior alveolar nerve
  - transient disturbances of the lingual nerve
  - permanent nerve disturbances

Most of these nerve injuries are transient in nature.

- Another less common complication is periodontal pocketing, which occurs distal to the second mandibular molar.
- Fracture of mandible is a rare complication with an incidence of 0.0049%
- Other severe, rare and unexpected complications can also occur following third molar surgery due to poor clinical case assessment or due to careless and unorthodox surgical practice.

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CHAPTER

# 14

# Ectopic Teeth and Unusual Cases

The occurrence of ectopic teeth (ectopic simply means 'wrong position') at sites other than their immediate dental environment is rare. A few reports of tooth displacement in the maxillary sinus, nasal cavity, orbit, chin, mandibular ramus, condyle, and coronoid process have been published.[1,2,4] The etiology of ectopic teeth is not always known, but it includes developmental abnormalities, overcrowding, trauma, sepsis or iatrogenic activity such as displaced during extraction.[1,3] Presumably, the etiologic factor is related to the type of tooth (e.g. incisor, canine, third molar, or supernumerary) and its immediate anatomic environment. Patients with an ectopic tooth impaction can remain asymptomatic over the course of their lifetime. But when such a tooth migrates, particularly one that is accompanied by a cyst, patients can experience significant morbidity and require intervention.

There are four treatment options (Wong et al, 2007)[5] for ectopic teeth: observation, intervention, relocation or extraction. If no symptoms or pathology is evident, observation may be the treatment of choice. Intervention consists of a brief period of orthodontic therapy or the removal of the teeth. Relocation refers to the repositioning of an ectopic tooth surgically or orthodontically. The aim of intervention or relocation is to maintain the integrity of the arch and occlusion. However, extraction should be considered if the above measures are deemed impossible or the tooth is symptomatic or associated with infection or pathologies such as cystic changes.

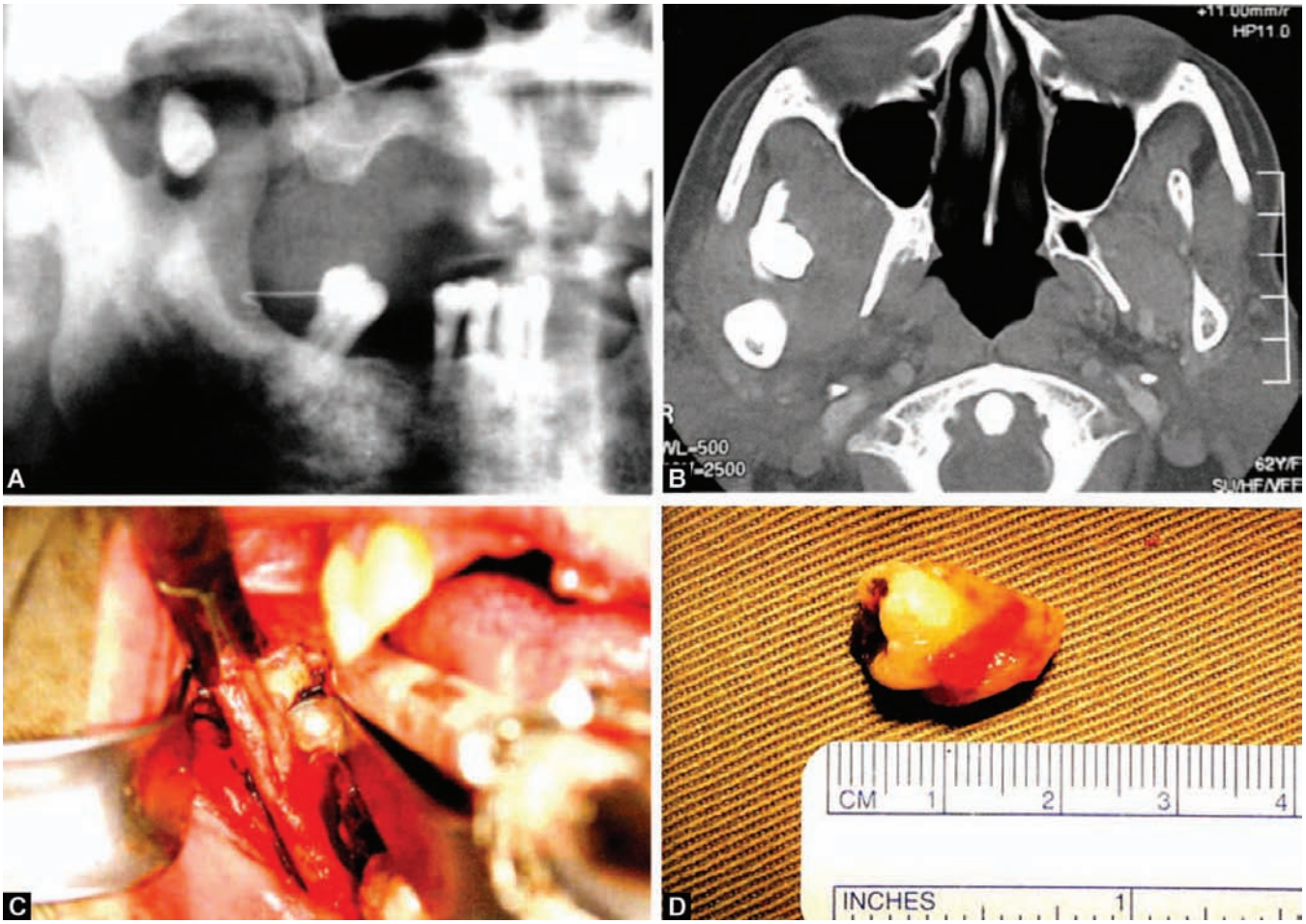
There have been reports of ectopic maxillary molars in maxillary sinus [2,6,7] and of ectopic mandibular third molar in the condylar region. [8,9]

Wong et al (2007)[5] reported a rare case of ectopic molar medial to the coronoid process of the mandible (Figs 14.1A to D) that caused a chronic discharging sinus into the mouth, recurrent facial swelling and pain. The tooth was removed under general anesthesia by an intra-oral approach after making an incision along the anterior border of the ramus.

For ectopic mandibular third molars located in the condylar process of the mandible various approaches have been suggested to gain access for the removal of the tooth. Bux and Lisco (1994)[8] reported a case of third molar located in the subcondylar region removed by a submandibular approach. Tumer et al (2002)[9] reported another case of ectopic tooth in a similar position which was removed through a preauricular approach. Szerlip (1978)[10] reported a case of ectopic third molar located in the condylar process of the mandible removed by an intraoral approach.

Büyükkurt et al (2005)[12] reported a case of ectopic eruption of a maxillary third molar tooth in the maxillary sinus that caused chronic maxillary sinusitis. This was later removed by a Caldwell-Luc approach. Recently endoscopic approach for the removal of tooth in maxillary sinus has been suggested by other authors.

In a recent article Suarez-Cunquerio et al (2003)[11] employed an endoscopic approach to remove an ectopic




**Figs 14.1A to D:** Ectopic molar medial to the coronoid process of the mandible. (A) OPG showing a tooth associated with the coronoid process of mandible, (B) Axial CT scan showing the tooth on the medial side of the coronoid process, (C) Intraoperative view with retractors, (D) The ectopic tooth after removal. (Adapted with kind permission of Wong et al)

mandibular third molar in the condylar process. They claimed the following advantages: (a) good illumination, (b) clear and magnified visualization of the operating field, (c) more conservative surgery, (d) risk of damage to facial nerve is minimal and (e) scars on the skin could be avoided. The authors advocated endoscopy for removal of third molars not only in the condylar process but also in other ectopic locations such as the maxillary sinus and the nasal fossa. However, adequate training is essential.

The following are some of the cases of ectopic teeth treated by the author.

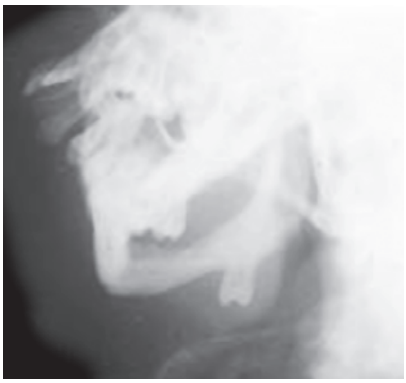


**Fig. 14.2:** Radiograph showing mandibular third molar erupting from the inferior border of mandible. Patient presented with chronic discharging sinus in the left submandibular region. The impacted tooth was removed under general anesthesia by submandibular approach.

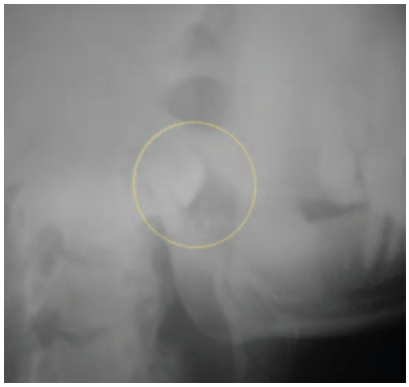
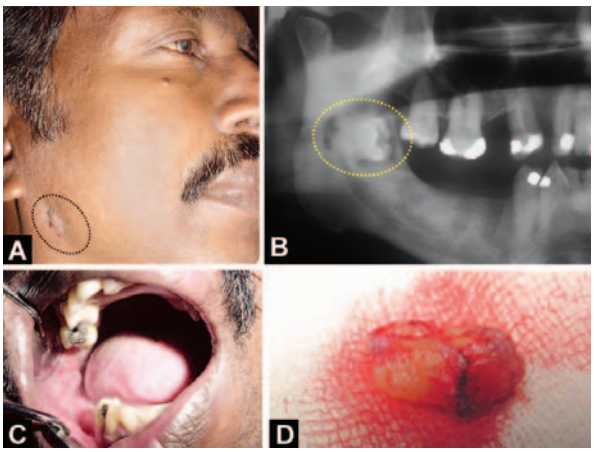


**Fig. 14.3:** Impacted mandibular third molar near the condyle and associated dentigerous cyst. Patient presented with chronic discharging sinus in the right parotid region. The impacted tooth along with the cyst was removed under general anesthesia by submandibular approach




**Figs 14.4A to D:** Impacted 48 in the ramus. (A) A 53-year-old male patient presented with chronic discharging sinus in the right submandibular region (dark broken line), (B) OPG revealed impacted 48 (yellow broken line) in the ramus, (C) Intraoral examination showed missing 46,47, and 48. Note that the bone in the anterior border of ramus is intact. The impacted tooth (D) was removed under general anesthesia by submandibular approach

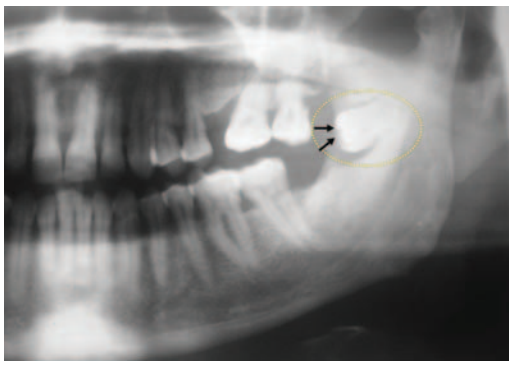


**Fig. 14.5:** Impacted 38 in the left ramus (yellow broken line). Due to chronic infection, there was bone destruction in the anterior part of ramus (dark arrows) in front of the tooth. Surgical removal of tooth was done under local anesthesia via intraoral approach

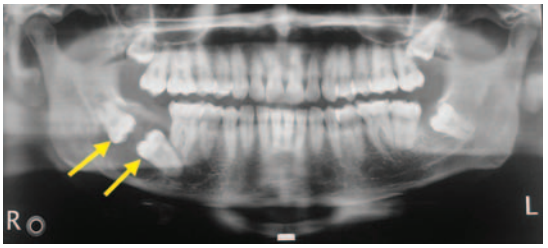
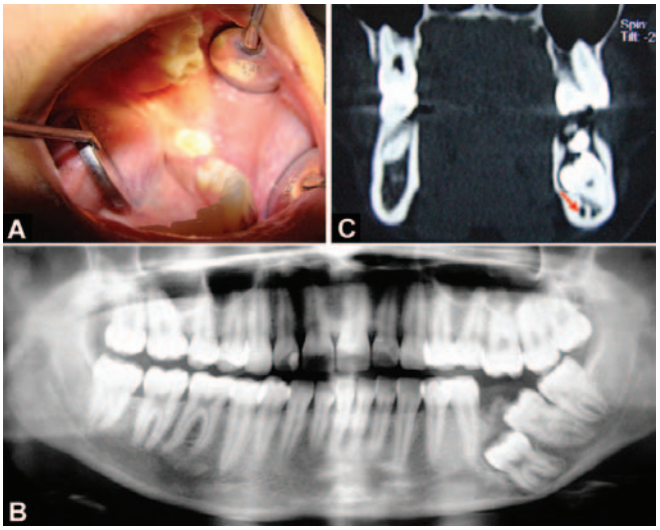
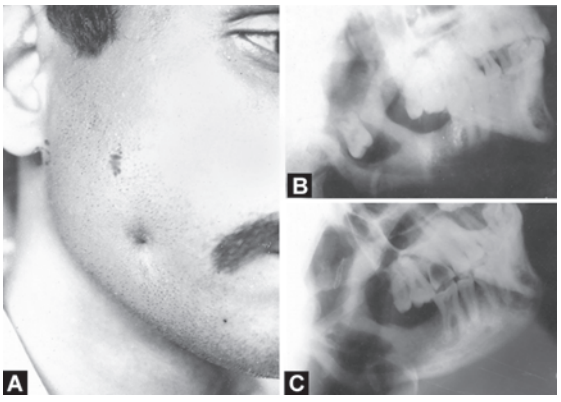



**Fig. 14.6:** Showing all the third molars impacted with 'kissing molars' in the mandible associated with dentigerous cyst




**Figs 14.7 A to C:** An 18-year-old girl reported with complaints of unerupted lower first and second molars on the left side. (A) Intraoral view showing unerupted 36 and 37 and partially erupted 38, (B) OPG showing impacted 36, 37, and 38. CT scan was taken to ascertain the relationship of inferior alveolar nerve (IAN) to the impacted teeth. (C) Coronal CT scan showing IAN (red arrow) lingual to the impacted teeth. All the impacted molars were removed under general anesthesia via intraoral approach




**Figs 14.8A to C:** (A) A 26-year-old male patient presented with chronic discharging sinus in the right cheek, (B) Right lateral oblique view X-ray of the mandible showed impacted mandibular third molar in the ramus in an inverted position with a surrounding radiolucent area suggestive of a dentigerous cyst. The impacted tooth along with the surrounding cyst wall was removed under general anesthesia by submandibular approach, (C) Postoperative right lateral oblique view X-ray of mandible

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CHAPTER

# 15

# Recent Advances and the Future of Third Molars

The advisability of the removal of asymptomatic impacted third molars by early prophylactic surgical extraction has been debated in dentistry for many years. Despite a 1979, conference on third molar removal sponsored by the National Institute of Health, no unanimity of agreement has been reached within the profession and decisions on whether to extract third molars largely are based on practitioners' experiences and bias. The conference did conclude that impacted third molars represent an abnormal state. While proponents of the routine surgical extraction of third molars believe that early extraction is preferable to the potential for pathological degeneration and disease of these teeth later in life, clinicians who do not support routine prophylactic extraction feel that there is a lower risk of pathological degeneration and disease compared with the risks of surgery.

The mandate for dentistry in the 21st century calls for continued efforts directed toward eliminating dental disease and enhancing the overall health and well-being of patients by translating scientific discovery into clinical practice. Hence, there is opportunity to extend the mandate to the paradoxical third molar and the dilemma it creates for patients.

## Intentional Therapeutic Agenesis of the Tooth

Because no third molar exists from birth until nearly five years of age, a window of opportunity exists for the elimination of third molars before they form.

One theoretical clinical possibility is intentional therapeutic agenesis of third molars before initiation when no third molar tooth tissues exist. Gordon and Laskin(1979)[1] and Selinger and colleagues (1966)[2] recognized that some teeth such as third molars pose problems for people and they achieved limited success at inhibiting odontogenesis using cryogenics and sclerosing agents in dogs. Their research focused on stopping succedaneous premolar tooth development after initiation when considerable tooth tissues already had formed. Succedaneous premolars develop in a slightly different manner and position than nonsuccedaneous human third molars.

Since, the initiation of third molars occurs at or near the surface of the jawbone just millimeters below the oral mucosa, their location is relatively accessible in children. In lower mammals that have third molar developmental stages comparable with those of humans, early studies have shown that selective third molar agenesis can be accomplished with several minimally invasive techniques that use electrosurgery and laser energy (Anthony R Silvestri, DMD, unpublished data, January 2002). Even small amounts and concentrations of locally delivered teratogens such as alcohol have stopped third molar development in rats (Anthony R Silvestri, DMD, unpublished data, January 2002). The lack of expression of certain growth factors[3,4] the presence of vitamin-derived retinoic acid derivatives[5,6] and the presence of commonly ingested food additives like citral[7] have been shown in the basic science literature to have dramatic effects on tooth bud initiation and early tooth development. It may be possible to selectively stop the development of third molars by specifically targeting epithelial dental lamina migration, the initiation of tooth bud development or the earliest initial stages of tooth

development with extremely small quantities of a locally delivered therapeutic agent.

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## SUMMARY AND LEARNING POINTS

1. Assessment of the unerupted and impacted third molar must involve history (including medical history) taking, clinical examination and radiological investigations.
2. Asymptomatic and pathology-free impacted third molars need not be removed.
3. Impacted third molars should not be removed to prevent late anterior crowding.
4. The main indications for removal of impacted third molars are dental caries and third molar associated infections.
5. Proper case assessment and careful surgical technique can prevent unwanted complications.
6. In third molar surgery, the buccal approach with minimal lingual soft tissue retraction minimizes the likelihood of lingual nerve injury.
7. Excessive bone removal is not recommended.
8. The routine use of antibiotics in third molar removal is not recommended.

## LEARNING POINTS

### Unerupted and Impacted Third Molars

- Define impaction of teeth and odontectomy.
- Describe the location of mandibular third molars in relation to the osseous areas of the mandible.
- Describe the surgical significance of the osseous anatomy in the region of mandibular third molars.
- Describe the relationship between the neurovascular bundle and mandibular third molar teeth.
- Describe the surgical significance of the position of the inferior neurovascular bundle.
- Describe the surface (soft tissue) anatomy of the area distal to the mandibular third molar.
- Describe the surgical significance of the soft tissue area distal to mandibular third molars.
- Describe the anatomical location of the facial artery.
- Describe the surgical significance of the facial artery.
- Describe the location of the lingual nerve.
- Describe the surgical significance of the lingual nerve including the most likely cause for surgical damage.
- State the primary indications for removal of mandibular third molars.
- State the primary contraindications for removal of mandibular third molars.
- State whether or not a mandibular third molar should be removed given a specific clinical situation
- List the most significant features involved in assessing acceptable radiographs for the degree of surgical difficulty.
- List radiographic features used in the assessment of impacted teeth.
- Analyze any periapical and panoramic radiograph of the mandibular third molar region.
- State the relative degree of difficulty as determined by angulation of the impacted third molar on radiographic examination.
- Describe the outline for mucoperiosteal flaps that will avoid injury to the critical anatomic structures of the mandibular third molar area.
- Describe the technique for removing bone to expose impacted third molar including appropriate instruments.
- Describe the technique for placement of a purchase point and the appropriate instruments for this procedure.
- Describe the instruments used for elevation using purchase points.
- Describe the methods used for tooth sectioning and the appropriate instruments.
- Describe the procedure of preparation of the wound prior to closure.
- Describe the procedure for closure of the incision.
- Describe the step-by-step sequence for the removal of the following classification of impactions, including the names of the instruments you would need:
  - — mesioangular
  - — horizontal

  - vertical
  - distoangular.
- State the relative degree of difficulty from easy to difficult for the various angulations.
- Describe the surgical significance of the following anatomical structures to removal of impacted maxillary third molars.
  - maxillary sinus
  - buccal fat pad
  - infratemporal fossa
  - maxillary tuberosity
  - coronoid process
  - zygomatic process of the maxilla
  - palate.
- State the indications for removing impacted maxillary third molars.
- State the contraindications for removing impacted maxillary third molars.
- Describe the ideal timing for removing maxillary third molars and state reasons
- State the radiographic views and techniques most likely to provide useful information for surgical planning.
- Given a periapical or panoramic radiograph of an impacted maxillary molar, evaluate relative difficulty of impacted maxillary third molar removal based on the following factors:
  - height
  - combined root width
  - follicle
  - relationship to maxillary sinus
  - root number and configuration
  - potential for root fracture
  - root development
  - potential for tuberosity fracture
  - bone density and elasticity
  - relationship to second molar.
- State three clinical factors you should evaluate prior to extraction of impacted maxillary molars and describe how these influence surgical difficulty.
- Describe the outline of the incisions used to expose an impacted maxillary molar in positions A, B, and C.
- Describe the technique for bone removal to expose an impacted maxillary third molar.
- Describe the technique and instruments used for elevation of an impacted maxillary third molar.
- Describe preparation and closure of the wound following removal of an impacted maxillary third molar.
- State the advantages and disadvantages of the mallet and osteotomy technique for the removal of impacted teeth.
- State the advantages and disadvantages of the surgical micromotor/rotary instruments for the removal of impacted teeth.
- List the complications resulting from the removal of impacted teeth.

# Section 2

# Management of Impacted Canine

CHAPTER

# 16 Introduction

The maxillary canine is second only to the mandibular third molar in its frequency of impaction. The permanent maxillary canine is considered impacted when its eruption is retarded in relation to the normal eruption sequence of the other dentition. Maxillary canine impaction is diagnosed by clinical and radiographic findings illustrating that no spontaneous eruption can be expected. Normally, in the mandible, the eruption sequence of the permanent dentition follows an anterior to posterior pattern. However, in the maxilla, eruption of the premolars follow the incisors; the canines are then expected to erupt into the dental arch at 10 -12 years of age (Table 16.1).

**Table 16.1:** Average age of eruption for permanent teeth in years

| | *Maxilla* | *Mandible* |
|---|---|---|
| Central incisor | 7-8 | 6 |
| Lateral incisor | 8 | 7-8 |
| Canine | 10-12 | 9-10 |
| 1st Premolar | 10-12 | 10-12 |
| 2nd Premolar | 10-12 | 12 |
| 1st Molar | 6 | 6 |
| 2nd Molar | 12 | 12 |

The normal eruption path of maxillary canines can be altered as a result of a variable eruption sequence in the maxilla, as well as by limited space conditions such as crowding. Early diagnosis and treatment of this condition is essential to reduce the risk of other tooth eruption disturbances. Optimal management of impacted permanent maxillary canines involves an inter-disciplinary approach combining the specialties of Oral and Maxillofacial Surgery, Periodontology and Orthodontics.

## Incidence and Epidemiology

Permanent maxillary canine impactions occur in 1 to 3% of the general population, second only to the impaction of third molars in frequency. These impactions occur twice as often in women than in men and five times more often in Caucasians than Asians. In about 85% of these cases, the impacted teeth are located palatal to the dental arch, in the remaining 15% of cases, the impactions are located labially. There is some evidence that patients with Class II division 2 malocclusion and tooth aplasia may be at a higher risk to the development of an ectopic canine. Impacted canines occur 20 times more frequently in the maxilla than in the mandible.

## Development and Eruption Pattern

Broadbent (1941)[1] stated that calcification of the permanent maxillary canine crown starts at one year old, between the roots of the first deciduous molar, and is complete at 5-6 years. By the age of 12 months the crown of the tooth is found between the roots of the primary molar. At 3-4 years of age the canine passes over the line of the primary incisors to lie on the labial side of the root of the lateral incisor (Miller, 1963).[2] At the age of four years the primary first molar, the first premolar germ and canine lie in a vertical row. Subsequent growth on the facial surface of the maxilla provides space for the

forward movement of the canine so that its cusp comes to lie medial to the root of the deciduous canine. Moss (1972)[3] stated that the canine remains high in the maxilla just above the root of the lateral incisor until the crown is calcified. It then erupts along the distal aspect of the lateral incisor resulting in closure of the physiological diastema if present and correction of the so called 'Ugly Duckling' dentition ( Kurol et al, 1997).[4]

Coulter and Richardson (1997)[5] quantified the movements of the maxillary canine in three-dimensions using lateral and posteroanterior cephalometric radiographs from the Belfast Growth Study taken annually between 5 and 15 years of age. It was shown that the canine travels almost 22 mm during that time. In the lateral plane the canine showed a significant movement in a buccal direction between 10 and 12 years of age. Before this age the movement was in a palatal direction. About three-quarters of the root is formed before eruption and root formation is complete two years after eruption. Hurme (1949)[6] stated that the gingival emergence of the maxillary canine after 12.3 years in girls and 13.1 years for boys was late. Thilander and Jacobsson (1968)[7] regarded 13.9 years for girls and 14.6 years as very late for boys as by this time 95% should have erupted. The maxillary canine is the last tooth to erupt in the upper arch with a deciduous predecessor and therefore is most susceptible to environmental influences such as crowding.

## Etiology of Canine Impaction

The exact etiology of impacted maxillary canine remains unknown, but probably multifactorial. Primary causes that have been associated with this condition are the rate of root resorption of the deciduous teeth, trauma to the deciduous bud, disturbances in tooth eruption sequence, non-availability of space (Figs 16.1 and 16.2), rotation of tooth buds, premature root closure and canine eruption into cleft areas (Fig. 16.3). Secondary causes of impaction include febrile diseases, endocrine disturbances and vitamin D deficiency. Impacted canine can be associated with other conditions (Figs 16.4 to 16.6).

Arch length discrepancy (crowding and spacing) is also implicated in the etiology. A space deficiency may result in the tooth erupting buccally or its impaction (Jacoby, 1983).[8] Thilander and Jacobsson (1968)[7] stated that crowding may be a factor in labial impaction, but not in palatal impaction. Jacoby (1983)[8] found that in 85

**Fig. 16.1:** Eruption of 13 prevented due to presence of supernumerary tooth

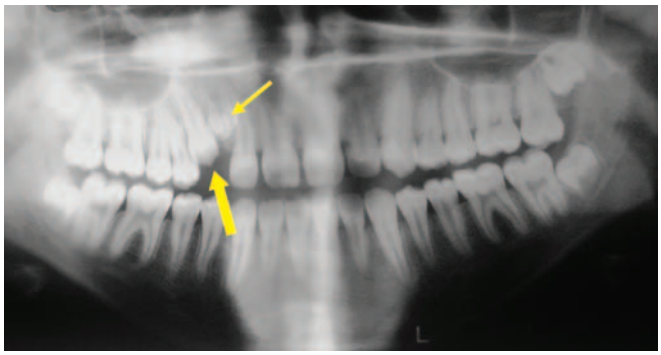


**Fig. 16.2:** OPG of the patient in Fig. 16.1 showing supernumerary tooth (small yellow arrow) preventing eruption of 13 (big yellow arrow)

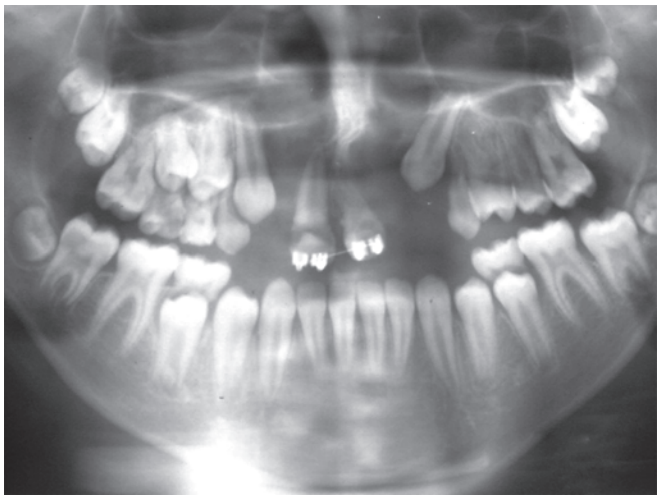
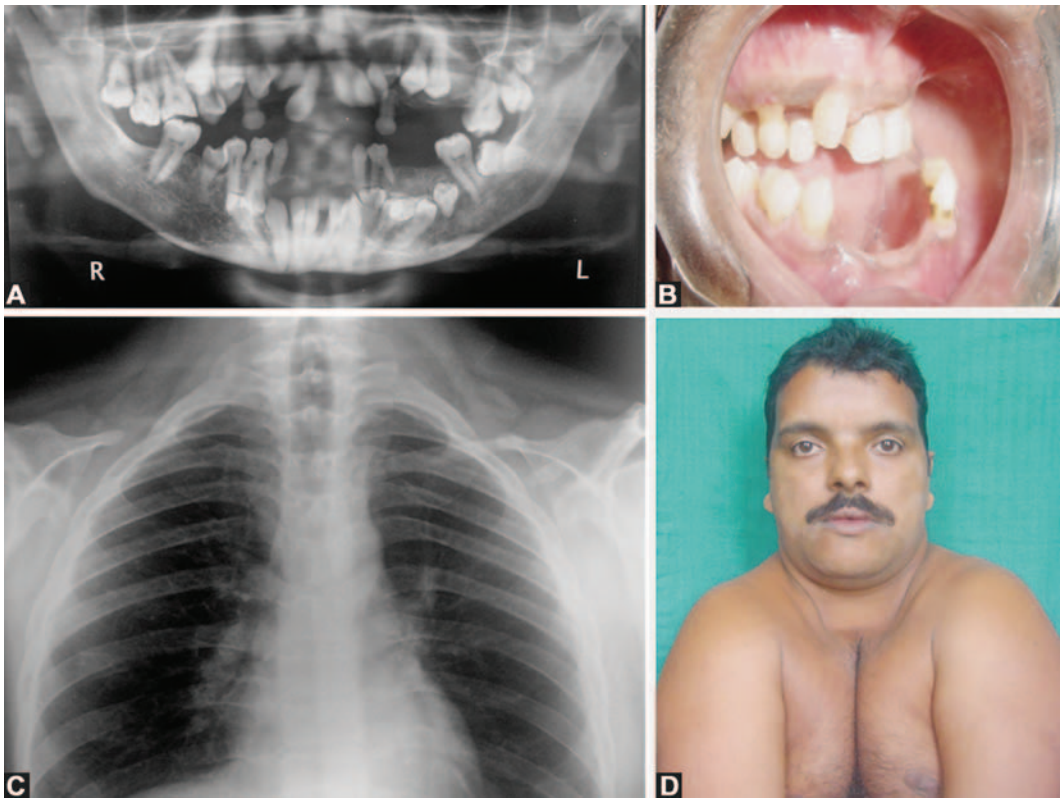
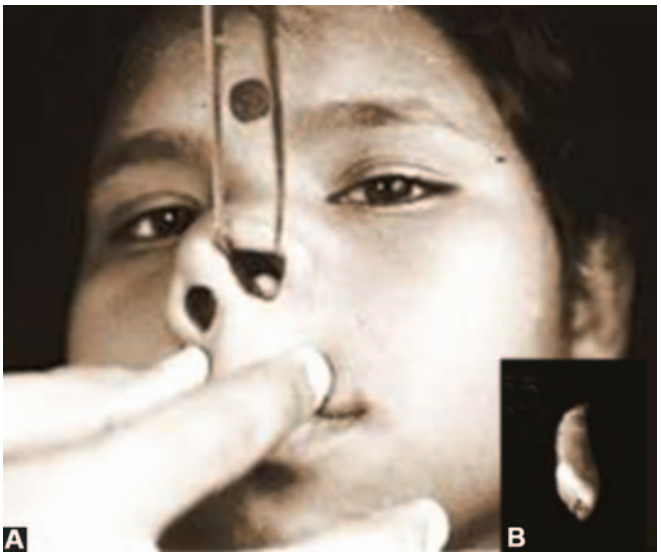


**Fig. 16.3:** Bilaterally impacted maxillary canine in a cleft patient




**Figs 16.4A to D:** A patient with cleidocranial dysostosis showing multiple impacted teeth. (A) OPG of the patient, (B) Intraoral view of the patient showing absence of teeth. Patient is wearing upper denture, (C) Radiograph of chest showing missing clavicle, (D) Due to the absence of clavicle the patient can bring the shoulders together

percent of cases where the canine erupted palatally adequate space was present in the arch. He suggested that a possible explanation for canine impaction to be excessive space in the canine area. Other suggested causes of palatal impaction are trauma to the maxillary anterior region at an early stage of development (Brin et al, 1993).[9]




**Figs 16.5A and B:** (A) Nasally erupting canine, (B) Specimen after extraction

Two theories have been proposed to explain the dental anomaly of canine impaction the guidance theory and the genetic theory.

**Guidance theory:** This theory in its simplest form regards the distal aspect of the lateral incisor root as the guide to allow the canine to erupt safely into position. If the lateral incisor is anomalous or missing this guidance is absent resulting in palatal displacement of the canine. Becker et al (1981)[10] found a 5.5 percent rate of congenital absence of lateral incisors in large group of patients with palatal canines. This was 2.4 times the rate in the general population. It was hypothesized that the lateral incisor was not sufficiently developed at the time when its root would have as the most important factor for the guidance of the canine. Oliver et al (1989)[11] found that lateral incisors on the side of canine impaction were generally smaller than on the non-impacted side in a sample of 31 Caucasian subjects.

Delayed exfoliation of the primary canine may result in continued palatal movement of the permanent successor. However, Thilander and Jacobsson (1968)[7] considered this persistence of a primary canine to be a consequence rather than a cause of impaction. Other possible causes include pathological lesions, ankylosis, odontomes, or supernumerary teeth. There may also be a higher incidence of impaction of the maxillary canine following alveolar bone grafting in patients with cleft lip and palate (Semb and Schartz, 1997).[12]

Maxillary canines which usually develop high in the maxilla, are among the last teeth to erupt and must course a considerable distance before erupting. The following local factors are also attributed to canine impaction:

i. The greater distance the canine has to travel from its point of development to normal occlusion.
ii. The bone as well as the mucoperiosteum on the palatal side is very thick and hinders eruption of canines if their growth is directed palatally.
iii. The root of the canine is more fully formed at the time of eruption, compared to other teeth, and this may minimize the eruptive force.
iv. The crown of the developing permanent canine lies immediately lingual to the long apex of the primary canine root. Any condition affecting the primary canine can cause deviation in the position and direction of growth of the permanent canine.
v. The canines are the last of the permanent teeth to erupt (except the third molars) and hence are vulnerable for a long period of time to any unfavorable environmental influences.
vi. The canines erupt between teeth already in occlusion and the erupting second molar may further reduce the space
vii. The mesiodistal width of the primary canine is much less than that of the permanent one.

Due to the above reasons, there is an increase in the potential for mechanical disturbances, resulting in their displacement and subsequent impaction.

**Genetic theory:** This theory is based on the observation that palatally impacted maxillary canines are often associated with other dental abnormalities, such as tooth size, shape, number and structure, all of which have been found to be genetically linked. These anomalies are thought to arise in embryonic development from a shared hereditary trait. Evidence for this includes the fact that palatal impactions occur in conjunction with other dental anomalies and often occur bilaterally. Furthermore, gender differences are apparent as well as familial and population differences.

Canines play a role in functional occlusion and form the foundation of an esthetic smile. They are considered the 'corner stones' of the dental arch. As such, any factors that interfere with the normal development of canines and their eruption can have serious consequences. Possible sequelae of canine impaction include root resorption of impinging teeth, referred pain, infection, dentigerous cyst and self-resorption. Hence, impacted maxillary canines need necessary attention and management at an early stage and every effort is made to bring them into normal occlusion as far as possible or remove them surgically.

## Classification of Impacted Maxillary Canines

Classification helps much in the diagnosis and treatment planning. The following classification suggested by Archer (1975)[13] is very practical:

**Class I :** Impacted canines in the palate
1: Horizontal
2: Vertical
3: Semivertical

**Class II:** Impacted canines located on the labial surface
1: Horizontal
2: Vertical
3: Semivertical

**Class III:** Impacted canine located labially and palatally - crown on one side and the root on the other side

**Class IV:** Impacted canine located within the alveolar process - usually vertically between the incisor and first premolar

**Class V:** Impacted canine in edentulous maxilla.

Impacted canine can be in unusual positions like inverted position (Fig. 16.6).

## Sequelae of Canine Impaction

1. Internal or external resorption of the adjacent teeth—This is the most common sequela. It has been estimated that 0.7 percent of children in the 10-13 year old age group have permanent incisors resorbed as a result of canine impaction. Root resorption can be expected in about 12.5 percent of the incisors adjacent to impacted maxillary canines. Resorption of the lateral incisor is more common than the central incisor. Females are more likely to be affected than males. If the canine has migrated to a position medial to the mid-root of the lateral incisor, resorption is more likely. In addition, if the angulation of the long axis of the canine to the midline on an orthopantomogram exceeds 25

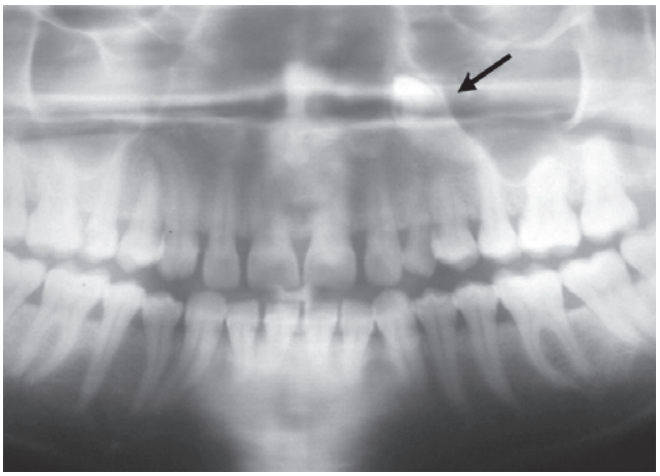


**Fig. 16.6:** OPG showing impacted 23 in an inverted position (black arrow)

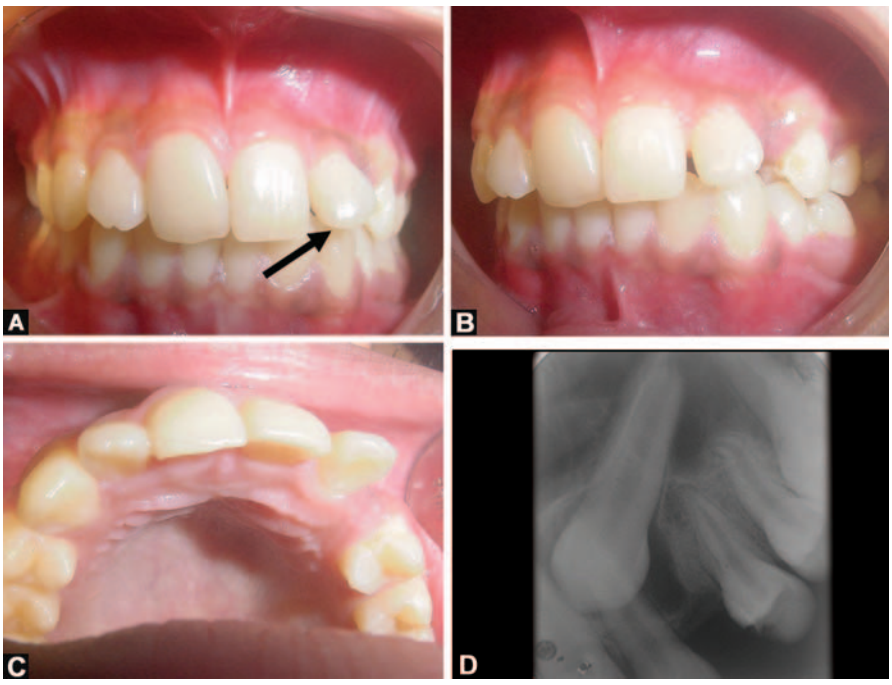
degrees the risk increases by 50 percent. Lateral incisors are more commonly resorbed palatally and at the mid root level than at the cervical or apical regions. There appears to be no association between enlarged follicles surrounding the canine and the potential for resorption.

Diagnosis of resorption from periapical X-ray or OPG is not always reliable due to overlapping of the impacted canine with the lateral incisor. The following findings in a dental film suggest the possibility of resorption:

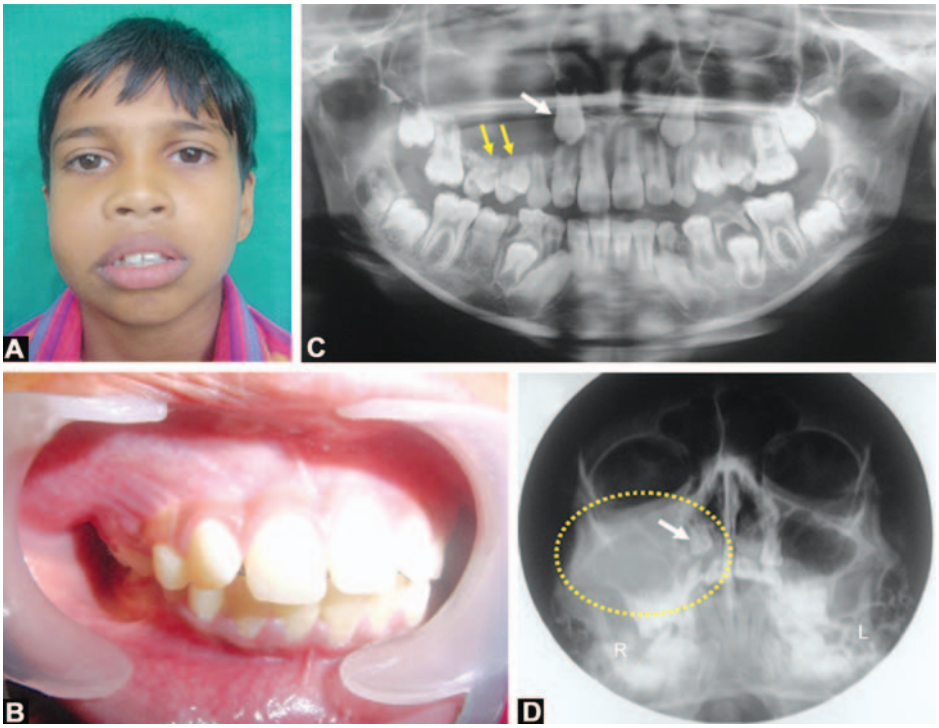
- The cusp of the canine is in contact with the root of the adjacent tooth
- The lamina dura of the alveolus is missing
- The root contour of the adjacent tooth is irregular in an area facing the impacted canine.

Currently tomography is the only reliable diagnostic method for determining the degree of resorption. However, the increase in the radiation dose in the CT, i.e. equivalent to five to six intraoral periapical X-rays is a disadvantage. But some authors consider that this is acceptable considering the diagnostic advantage.

2. Proclination of lateral incisor—Due to pressure effect from erupting cuspid, instead of resorption of root of lateral incisor, there may be proclination of the lateral incisor. Very often the patient consults the dental practitioner for the correction of the proclined tooth or spacing between the upper anterior teeth (Figs 16.7A to D). The patient will be unaware of the impacted cuspid.
3. Cyst formation (Figs 16.8A to D)—Development of dentigerous cyst and adenoameloblastoma in relation to impacted cuspid is not uncommon.
4. Miscellaneous complications—Marginal breakdown of supporting bone around adjacent teeth may occur in certain instances.




**Figs 16.7A to D:** Impacted upper cuspid causing proclination of lateral incisor tooth. (A) A 14-year-old girl consulted the dental practitioner for correction of her proclined left upper incisor tooth (black arrow), (B) View from the side showing unerupted left upper cuspid, (C) View from the palatal aspect showing proclined lateral and spacing between the teeth, (D) Periapical X-ray showing impacted 23




**Figs 16.8A to D:** Impacted canine associated with extensive dentigerous cyst in the right maxilla in a 10-year-old boy (A) Swelling of the right side of the face, (B) Intraoral photograph showing bulge in the right upper buccal sulcus, (C) OPG showing impacted 13 (white arrow). Note the extensive bone destruction in relation to roots of 14 and 15 (yellow arrows), (D) PNS radiograph showing opacity of right maxillary sinus (yellow interrupted oval) extending into right nasal cavity and the impacted 13 (white arrow). The case was managed by enucleation of the dentigerous cyst and removal of impacted 13 under general anesthesia

Resorption of impacted canine may occur at a later stage. Loss of vitality of incisor, poor esthetics of retained primary canine, eruption of the impacted canine under a prosthesis are possible sequelae of canine impaction.

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CHAPTER

# 17 Localization of Impacted Canine

Management of impacted canine requires precision both in planning and execution. It is not enough for the dental surgeon to know that an unerupted tooth is present. Rather the exact position of the tooth and its precise relationship to other erupted teeth should be established. The presence and position of the canines can be ascertained by three simple methods: visual inspection, palpation and radiography.

Patients should be examined by eight or nine years of age to determine whether canines are erupting in a normal position and to assess whether the potential for impaction exists (Abron et al, 2004).[1] Early detection may reduce treatment time, complications, complexity and cost. Locating the exact position is important to decide the best treatment option and also to plan the surgical procedure, if any needed. Impacted maxillary canines are found three times as frequently on the palatal side as on the labial side. They are almost always rotated from 60 to 90 degrees on their longitudinal axis and are usually in an oblique position. Frequently they are found in a horizontal position.

## Clinical Examination

*Inspection:* Evidence of impaction can be observed in an over retained primary canine. Carefully look for any bulge either on the labial or on the palatal side of the arch. Possible signs of impending impaction include: lack of canine prominence in the buccal sulcus by age of ten years, discordance between the exfoliation of the deciduous canine and eruption of permanent canine and the presence of inclination of the lateral incisor crown. Labially impacted canine in contact with the apical third of the lateral incisor root can cause deflection of the root lingually and tilting of the crown labially. However, it should be considered that crown of a palatally impacted tooth, which is in contact with the gingival or middle third of the lateral incisor root, can also move the crown of the lateral incisor labially. All these findings are indicative of a potential impaction of maxillary canines.

Premolar eruption before canine emergence may also indicate a disturbance in the eruption of the latter.

Adjacent teeth should be examined for mobility and to determine the condition of the periodontal tissues. Vitality testing of adjacent teeth, especially upper lateral incisors, prior to surgery should be done as a routine procedure. It is better to discover that an unerupted canine is related to a non-vital lateral incisor of dens invaginatus type before surgery than after the operation. If a sinus is present a probe should be passed along it in an attempt to feel any underlying tooth. The maxillary canine area is a rare site for supernumeraries but occasionally a dentigerous cyst is found to be present in relation to the crown of the impacted canine.

Palpation- Bidigital palpation of the maxillary canine region from labial vestibule and palatal roof is also useful for the localization of impacted canines. Canines are readily detectable one to one-and-a-half years prior to eruption. It should be noted, however, that asymmetries in the alveolar processes of young children might not always be indicative of canine impaction, but may be due to vertical differences in eruption.

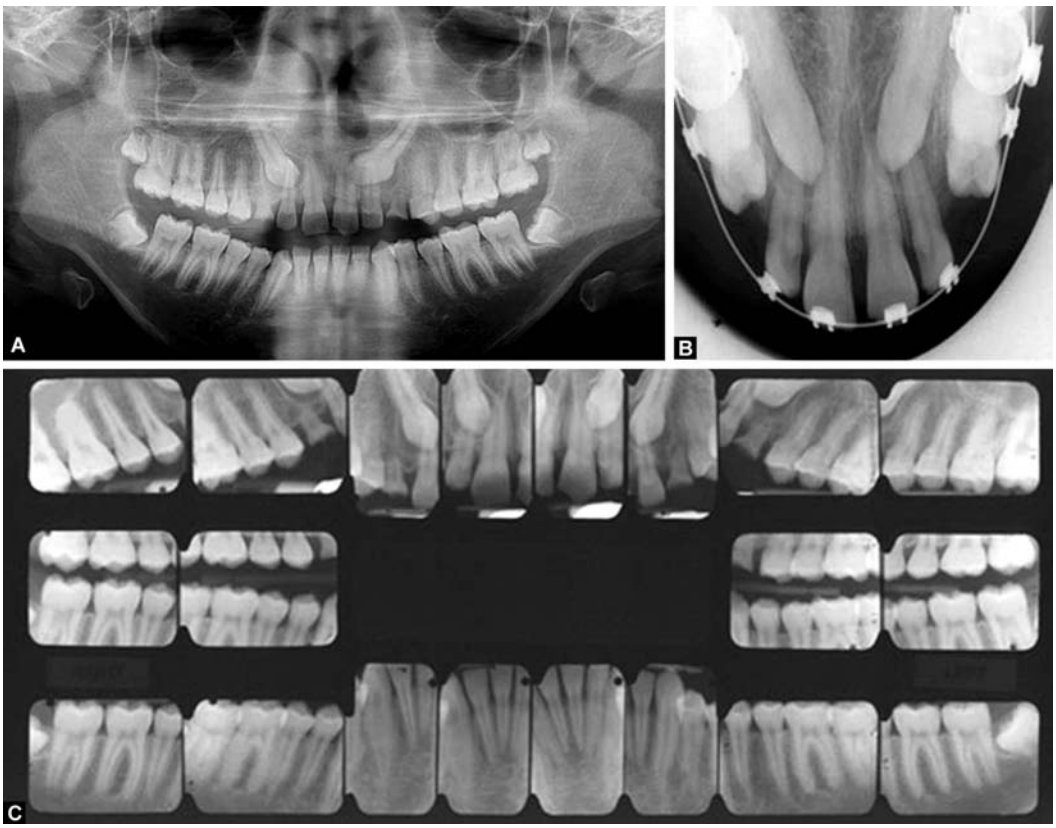
The clinical signs that implicate an impacted maxillary canine include:

1. Delayed eruption of the permanent canine or prolonged retention of the primary canine.[1]
2. Absence of a normal labial canine bulge in the canine region.[2]
3. Delayed eruption, distal tipping, or migration of the permanent lateral incisor.[3]
4. Loss of vitality and increased mobility of the permanent incisors.[4]

Radiographic localization helps to supplement the findings of inspection and palpation. In deeply impacted canine bidigital palpation is inconclusive, very often radiography is the only means of localization.

It has been suggested that radiographic evaluation prior to the age of 10 years are of little benefit. Radiographs are indicated before 11 years of age if there is an asymmetric path of eruption as determined by palpation, if the lateral incisor is late in eruption or is tipped labially, if the lateral incisor is missing or there is a family history of impacted canine. After the age 11, radiographs are indicated in all individuals with unerupted and non-palpable canine.

Radiographic examination should be implemented if clinical methods are inconclusive (Figs 17.1A to C). An ideal radiographic examination of an impacted maxillary canine should reveal not only the shape and position of the root apex, but also the position of the crown, vertical inclination of the canine, presence of any follicular cyst, and above all root resorption of the adjacent permanent teeth. A review of literature revealed that various radiographic and imaging methods have been proposed and are being tried worldwide in the localization of impacted teeth.[5,6] Radiographic examinations can be broadly grouped into two: Accurate methods like computerized axial tomography, cone beam, and 3D CAT elaboration such as 3D imaging; in addition to which real 3D stereo-lithographic models can also be generated. The second group is the less accurate methods, which include plain radiographs like panoramic radiography, occlusal radiography, anteroposterior and lateral radiographic views, which are based on image magnification and superimposition.




**Figs 17.1A to C:** Showing the conventional 2 D imaging (A) Panoramic radiography, (B) Full mouth periapical X-ray with two X-rays of impacted tooth from different angles, (C) Occlusal radiograph

The conventional radiographic methods are based on two main principles:

1. The cone shift or parallax technique, which aims to register the relative displacement of an object in relation to the environment.
2. The degree of magnification of the imaged object, in comparison with the surrounding teeth, may also give an indication of the malposition of the impacted tooth.

## Parallax

This method involves taking of two radiographs and the use of the principle of horizontal or vertical parallax. This method was first introduced by Clark (1909).[7] The horizontal parallax involves taking of two radiographs at different horizontal angles and with the same vertical angulation. Due to parallax the more distant object appears to travel in the same direction as the tube shift and the object closer to the tube appears to move in the opposite direction; the so called Same Lingual Opposite Buccal (SLOB) rule; or this can be equally remembered as Buccal Opposite Palatal Same (BOPS)}. The cone shift technique may also be applied when the radiographs are taken at different vertical angulations (vertical parallax). The different combinations that are commonly tried based on the technique of parallax include:

1. Two intraoral periapical radiographs taken at different horizontal angles (Clark, 1909).[7]
2. One maxillary anterior occlusal and one maxillary lateral occlusal (Southall and Gravely, 1989).[8]
3. One periapical and one maxillary anterior occlusal radiograph (vertical parallax; Rayne, 1969).[9]
4. One panoramic and one maxillary anterior occlusal radiograph (vertical parallax; Keur, 1986).[10]
5. One panoramic radiograph alone when a Panorex machine is being used (Turk and Katzenell, 1970).[11]

Clark's rule is extremely useful in cases in which the position of the canines is such as to give a superimposition with respect to a chosen dental reference point. However, care should be taken about the fact that the radiographs being compared should be identical with respect to all other factors other than the angulation of the X-ray beam. It is also unfavorable from a biologic perspective as a single exposure for an intraoral radiograph amounts to about 2.4 to 4.3 μS (micro Sievert).

## Magnification

For a given focal spot film distance, objects away from the film will be depicted more magnified than objects closer to the film; this is the principle of 'Image Size Distortion' (See Fig. 17.2).

There are two methods based on this principle:

a. Status—X-Radiography (Ostrofsky, 1976)[12]—This technique makes use of the fact that the anode of the status—X-machine is considered to have an almost point source of X-radiation. Here a special tube is inserted in the mouth of the patient and the film held around the face by the patient. Hence, there is a point source of radiation and the laws of central projection apply—the object closer to the source is magnified.

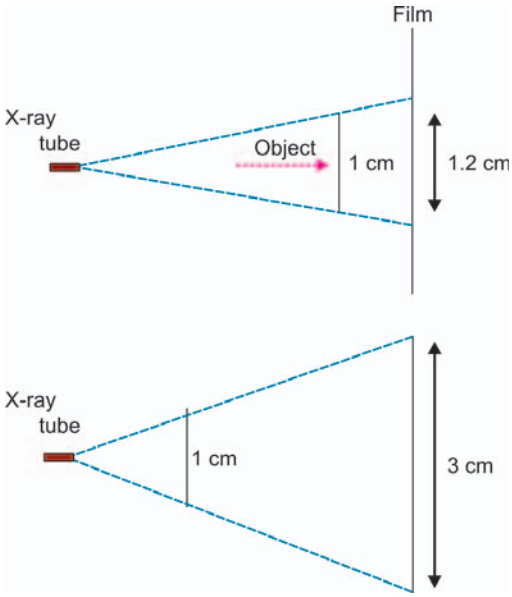



**Fig. 17.2:** Showing how magnification increases with increase in the object film distance

b. Panoramic Radiography (OPG) (Figs 17.3 and 17.4)—This is a fundamental examination which gives an overview but does not permit precise localization of an impacted canine. The principle of image distortion can be applied in panoramic radiography. If a canine is relatively magnified in comparison to the adjacent teeth in the arch or the contralateral canine, it will be located closer to the tube, i.e. palatally, and if the size is relatively diminished it will be located further away from the tube, i.e. labially. This method is most effective when the canine is not rotated, not in contact with the

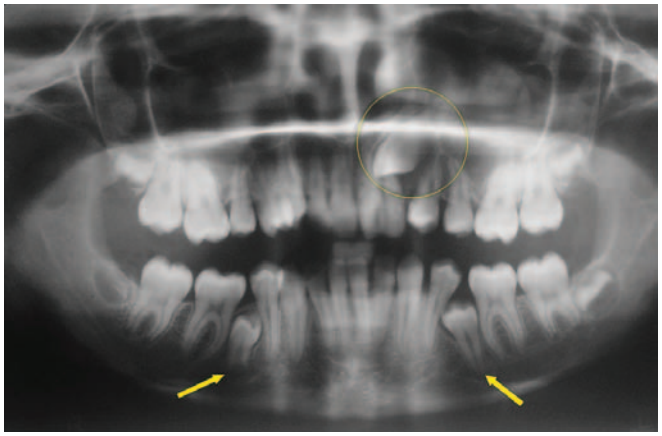


**Fig. 17.3:** OPG of a girl aged 13 years showing impacted 23 (yellow circle), 35 and 45 (yellow arrows). Even though the clinical examination showed a slight bulge on the labial aspect of the region of 23, during surgery it was noted that the tooth was actually laying labiopalatally with the crown on the palatal side

incisor root and there should be no tipping of the incisor roots.[13, 14]

A study conducted by Mason et al in 2001[15] to compare two different radiographic techniques for localization of impacted maxillary canines: vertical parallax (from a panoramic and a maxillary anterior occlusal radiograph) and magnification (from a single panoramic radiograph), showed that localization with vertical parallax was more successful overall than with magnification.[15] Almost 90% of the palatally impacted canines could be correctly detected with both techniques, and only less than half of the buccal canines were detected by parallax and less than 0.1% buccal canines detected

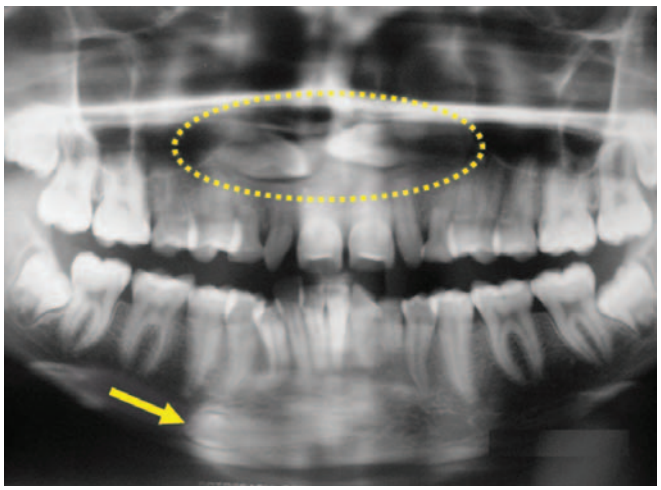
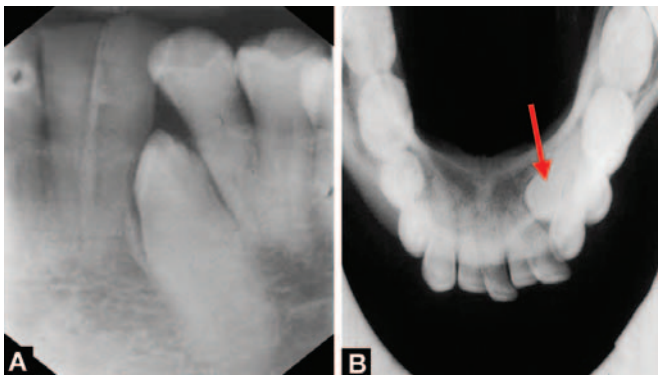


**Fig. 17.4:** OPG showing bilaterally impacted maxillary canines in horizontal position (yellow oval) and left mandibular canine (yellow arrow) transposed to right side

by magnification. It has been suggested by many researchers that a single panoramic radiograph alone is not sufficient for proper localization of impacted maxillary canines.[13, 16-19]

Other methods reported for radiographic localization of impacted maxillary canine are the vertex occlusal radiograph[19] and the panoramic radiograph, where image sharpness and relationship of the canine cusp tip with the lateral incisor root is assessed. The right angle technique involves two films taken at right angles to each other (Figs 17.5A and B) so that the canine can be located in three dimensions, e.g. lateral skull and posteroanterior




**Figs 17.5A and B:** The right angle technique

cephalogram[20] or lateral skull and panoramic radiograph[21] or a periapical X-ray and an occlusal X-ray.

Occlusal radiographs can be made with different angulations. The most frequently used projection for the maxillary canine localization is the true occlusal view (Fig. 17.6). In this view the central ray passes through the glabella and falls perpendicular to the film.

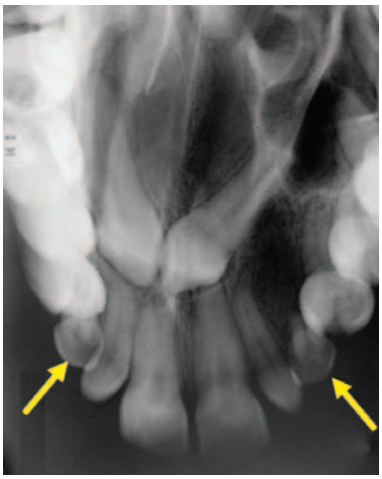


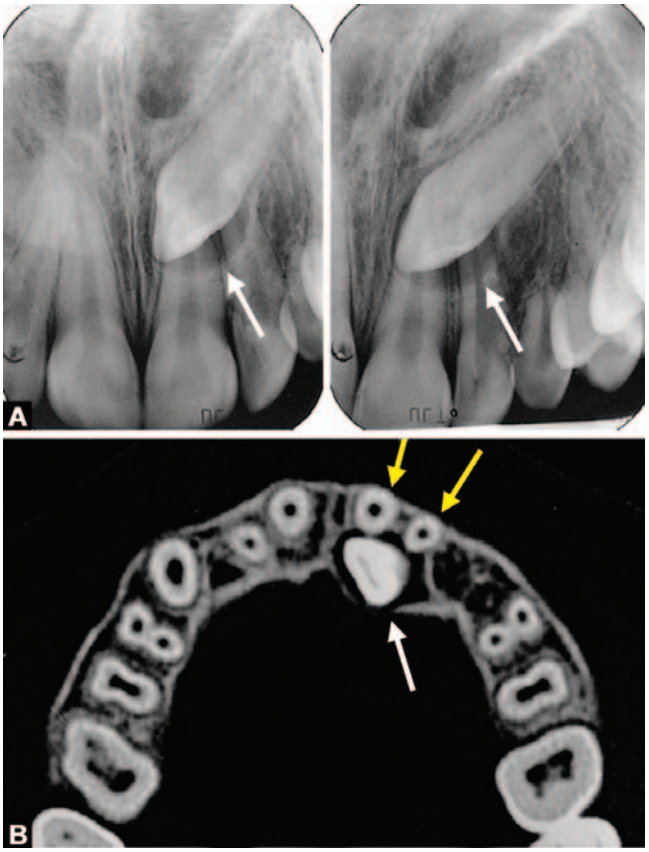
**Fig. 17.6:** True occlusal view of maxilla showing bilaterally impacted maxillary canines and retained deciduous canines (yellow arrows)

By this technique, localization can be done by determining the position of the cusp of the canine in relation to the roots of the lateral incisors in a labial-palatal plane. The disadvantages to be mentioned include high dose of radiation especially to the lens, thyroid and cerebral structures.

## Points to be Noted from the Radiograph

- Labiopalatal position of the tooth- whether the impacted tooth is lying labially, palatally or directly above the standing teeth
- Direction of the long axis of the unerupted canine and its relationship to adjacent tooth
- Size, shape and root pattern of the canine
- Condition of the adjacent teeth
- Position of the its crown and root apex relative to the adjacent teeth, in vertical, mesiodistal, and labiopalatal dimensions
- Presence of associated cyst, odontomes or supernumerary teeth
- Curvature of the root of impacted tooth—In some instances the root appears to be straight with a blunted end; when in actuality it is a hooked root. This happens because the long axis of the tooth coincides with the path of the X-ray.

Other extraoral views like the posteroanterior and true lateral skull views can be used for assessing the mediolateral and anteroposterior position of the impacted maxillary canines. The true lateral view of skull is a cardinal investigation in orthodontic treatment planning as it gives indication of the direction of mandibular growth. With regard to impacted teeth it indicates the position in the vertical plane only. It may not be useful in cases of bilateral impactions as there will be superimposition of both sides. Posteroanterior views of the jaws provide partial indication as to the position of the impacted canines in the vertical plane and give the exact inclination relative to a trans-orbital line, but does not give information of the same in the labiopalatal plane. Radiographic evaluation is used not only to verify the position and location of the impacted tooth, but also to examine the areas adjacent to the impaction, which may play a critical role in the treatment planning. Almost all of the above mentioned conventional radiographic techniques have the disadvantage of superimposition of the shadows, which has led to the need for better imaging techniques like computed tomography.




**Figs 17.7A and B:** (A) Periapical films in a 13-year-old patient show 23 (white arrows) in an impacted position lingual to 21 and 22, (B) CT scans show the crown of the ectopic positioned 23 located palatally (white arrow) close to the roots of 21 and 22. The roots of the incisors are exposed, but there is no resorption of the roots. The width of the dental follicle of 23 indicates low eruptive activity of the tooth

Tomography, e.g. polytomography and computed tomography are useful especially in cases where there is root resorption of adjacent teeth.[22] Computed tomography is a technique which uses a series of radiographic axial sections to produce a computer generated three-dimensional image (Figs 17.7 to 17.10A to D).

CT scan is a precise method of radiographic localization; however, its use is limited by cost and increased radiation exposure. Various studies on the efficacy of CT over conventional radiography have been reported in the literature.[23,24] All of these point out to the disadvantage of excessive exposure and time consumption for completion of the procedure. With the recently improvised Multi Slice Spiral CT using mutiplanar (Fig. 17.11) and 3D reconstruction, there is a marked reduction in the examination time and risk of accidental movement. It also enables a significant

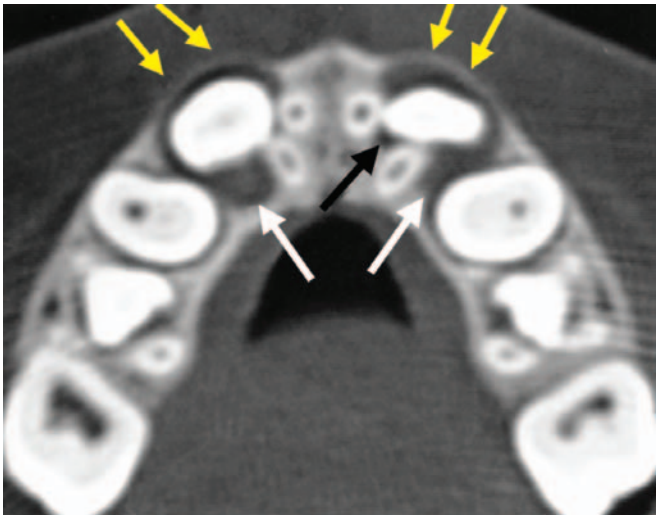


**Fig. 17.8:** CT scan shows 13 and 23 erupting buccally to 12 and 22 respectively. The follicles have caused the buccal plate of the alveolar bone to bulge (yellow arrows) and extend asymmetrically into the cancellous bone (white arrows). There are contacts between the impacted canines and the adjacent roots of the incisors; but with no root resorption of the latter (black arrow)

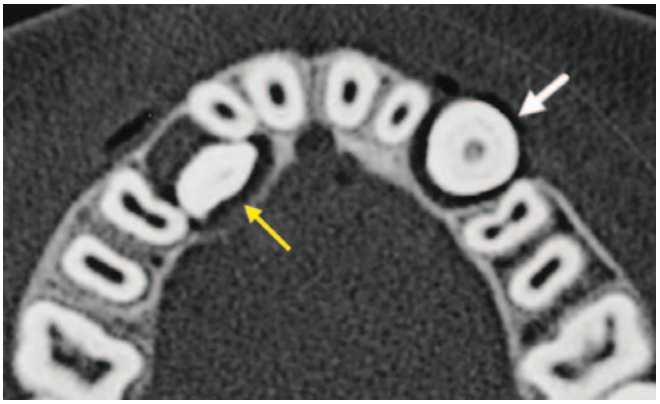
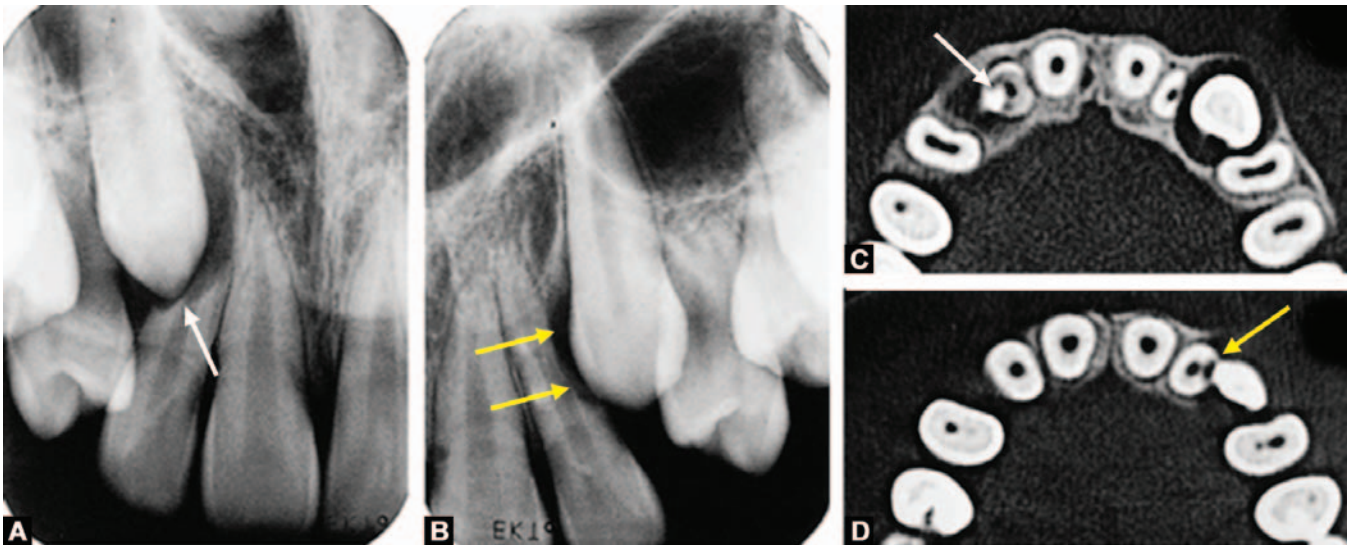


**Fig. 17.9:** CT scan shows 13 (yellow arrow) erupting ectopically and 23 (white arrow) normally. The follicle of 13 is widened at the crypt and surrounded by a cortical lining. The follicle extends buccally and has partly exposed the root of 12. Such follicle should be sent for histopathological examination to rule out development of a dentigerous cyst

reduction in radiation exposure without loss of image quality.[25-27] The CBCT (Cone Beam Computerized Tomography) represents a real technologic breakthrough in the recent years. This is a variation of CT imaging technique and provides excellent quality images with much lower radiation than conventional medical CTs.[28] The CBCT shoots out a cone-shaped X-ray beam and captures a large volume of area requiring minimal amount of generated X-rays. The machine rotates 360° around the head within 10 seconds and captures 288 static images. The computer then reassembles these primary images and creates a secondary reconstruction of 512 conventional CT slices that contain all volumetric data acquired from the patient scan (Figs 17.12 to 17.16). Recent studies on the comparison of all available imaging modalities for localization of impacted maxillary canines have also concluded that CBCT provides elements which escape during traditional radiographic analysis and




**Figs 17.10A to D:** (A,B) Intraoral periapical films of erupting maxillary canines. (A) Extensive apical resorption of root of 12 (white arrow) due to pressure from impacted 13, (B) Resorption of the root distally on 22 (yellow arrows) due to impacted 23, (C) CT scans showing the canine 13 cusp tip in contact with root of 12 (white arrow), (D) CT scans showing the canine 23 in contact with 22 (yellow arrow)

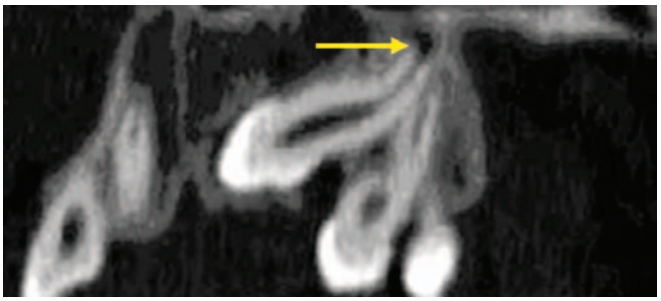
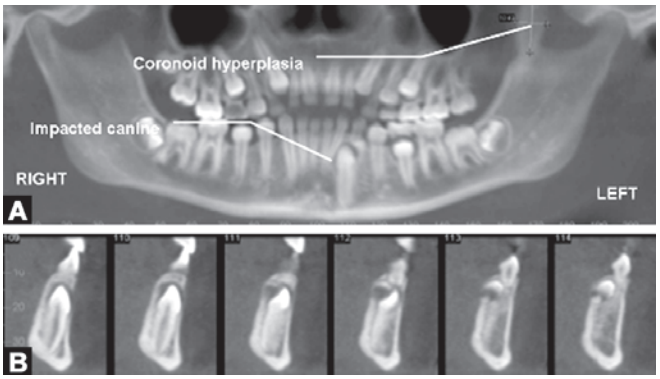


**Fig. 17.11:** Reconstructed multiplanar sagittal image demonstrates an impacted maxillary canine with dilaceration of root




**Figs 17.12A and B:** (A) Reformatted panoramic image from CBCT showing impacted left mandibular canine and hypertrophy of left coronoid process, (B) Sequential cross-sectional images of the left mandibular canine

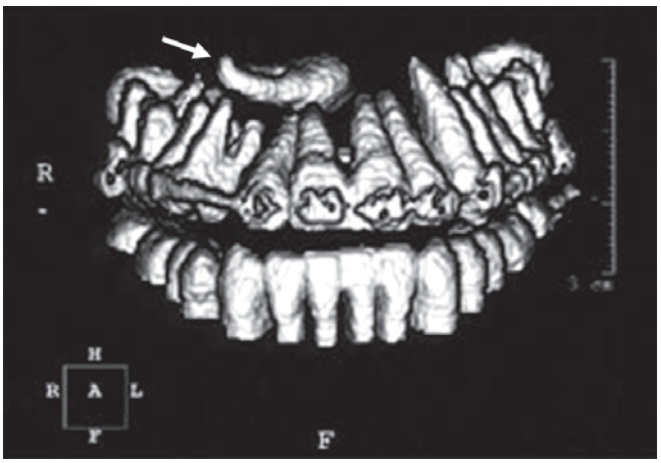



**Fig. 17.13:** Three dimensional computed tomography image of the upper and lower teeth using shaded surface display software

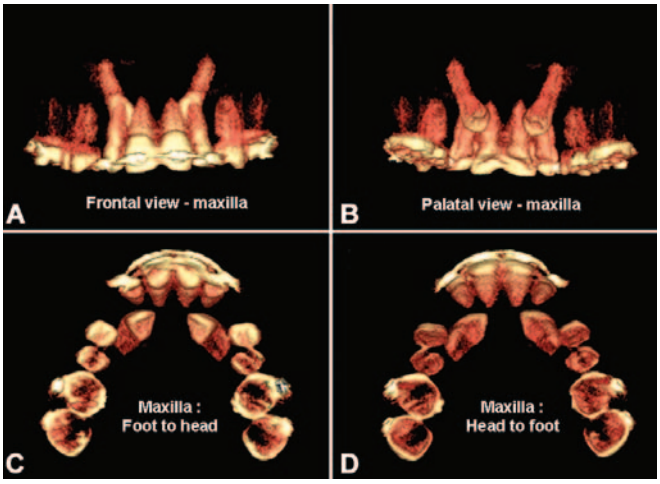
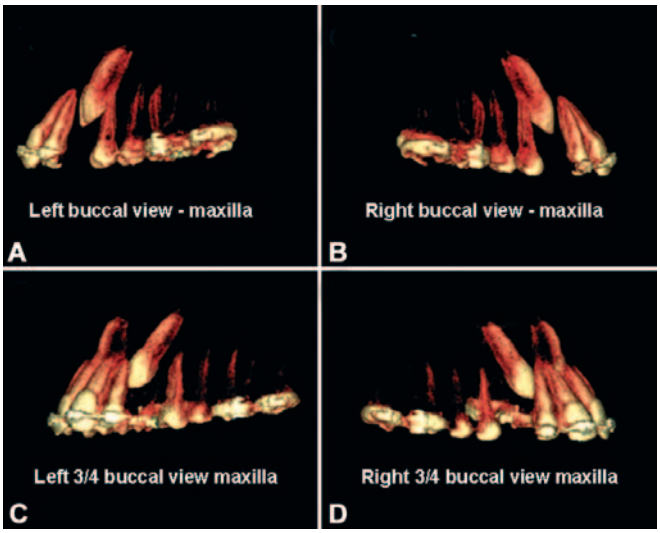


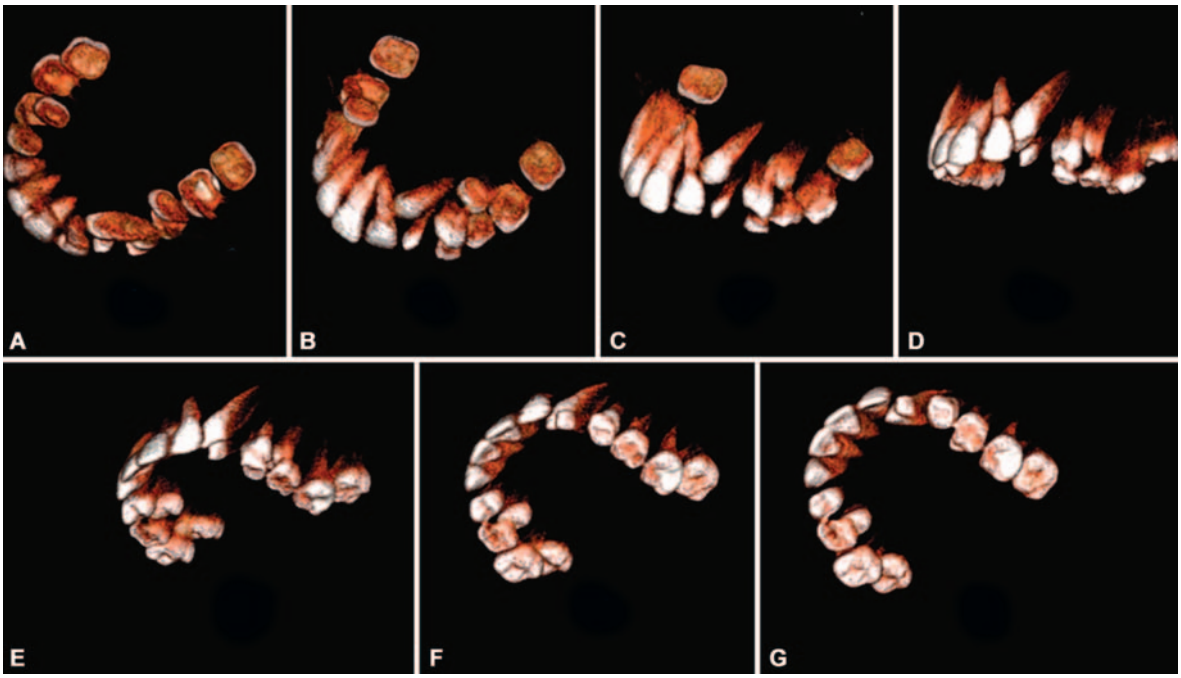

**Fig. 17.14A to D:** 3-D CBCT images of impacted maxillary canine—Frontal and palatal views



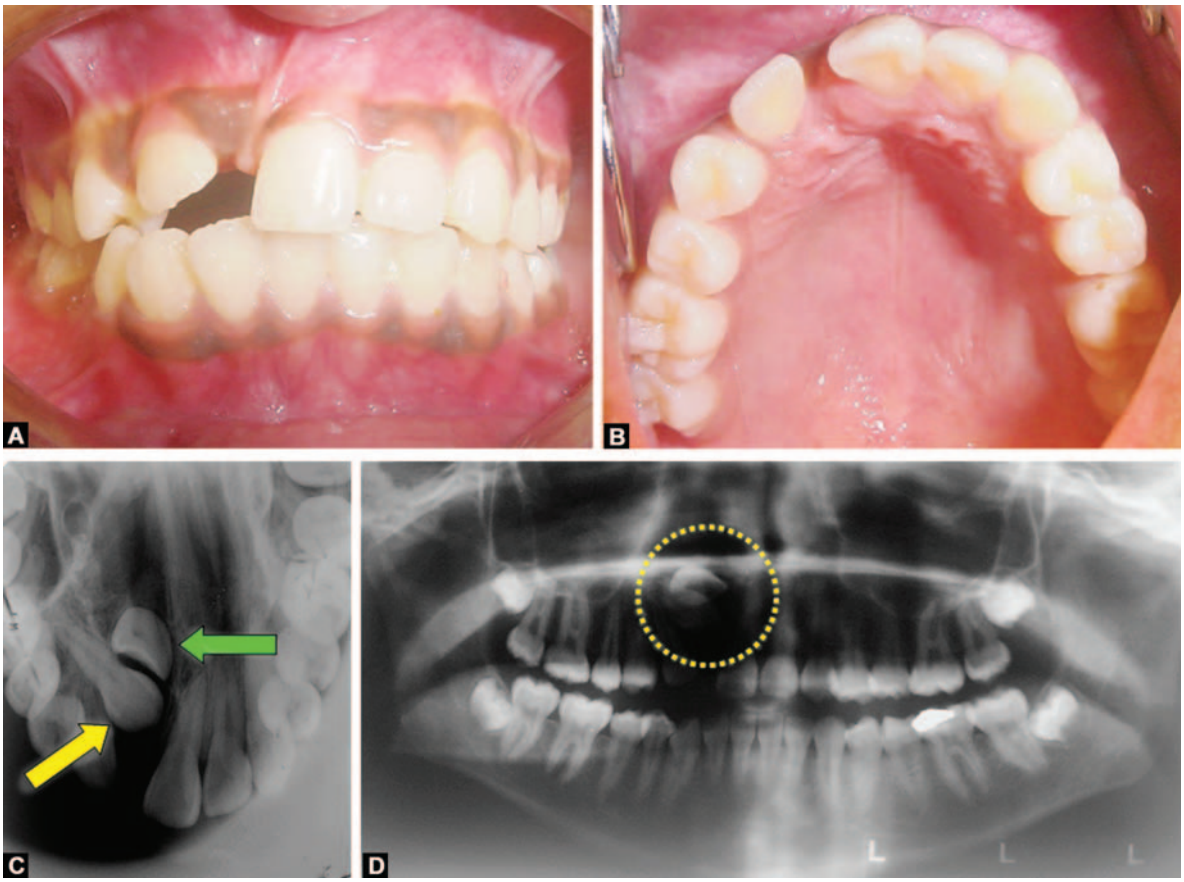

**Figs 17.15A to D:** 3-D CBCT images of impacted maxillary canine—Lateral and ¾ lateral views

therefore recommended for impacted teeth localization as well as for other craniofacial structural anomalies.[29]

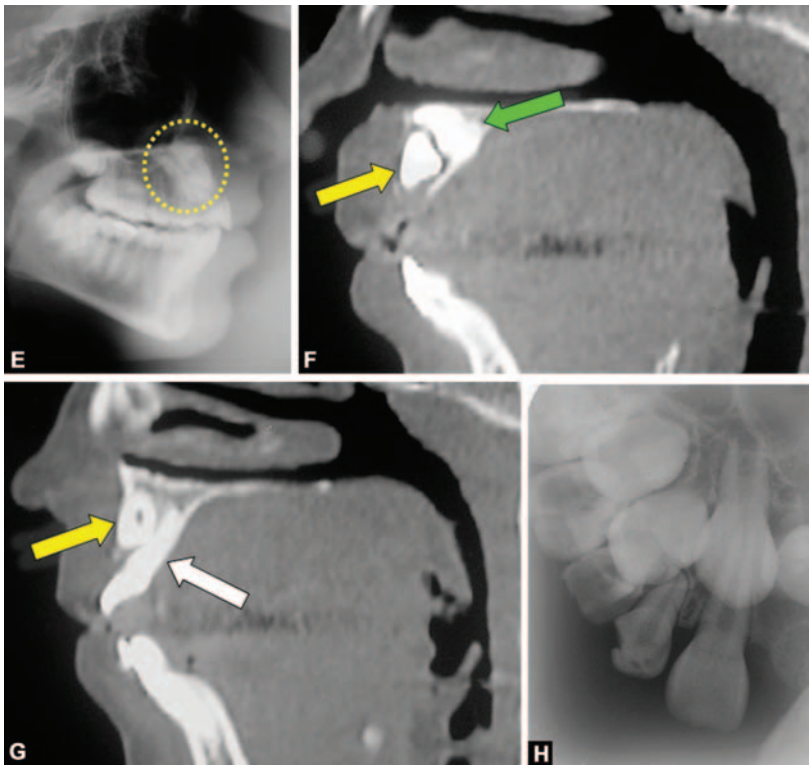
**Case report:** A 13-year-old girl reported to her dental practitioner with complaints of spacing in the upper anterior region. On examination, there was missing (possibly impacted)11 and 13 (Figs 17.17A and B). Unerupted 11 and 13 could neither be visible nor palpable on the labial or palatal aspect. Occlusal X-ray (Figs 17.17 C) showed impacted 11 (green arrow)and 13 (yellow arrow). However, the root of 11 was not visible, suggesting the possibility of a labiopalatal position of 11 or a dilacerated 11. OPG (Fig. 17.17D) also did not yield



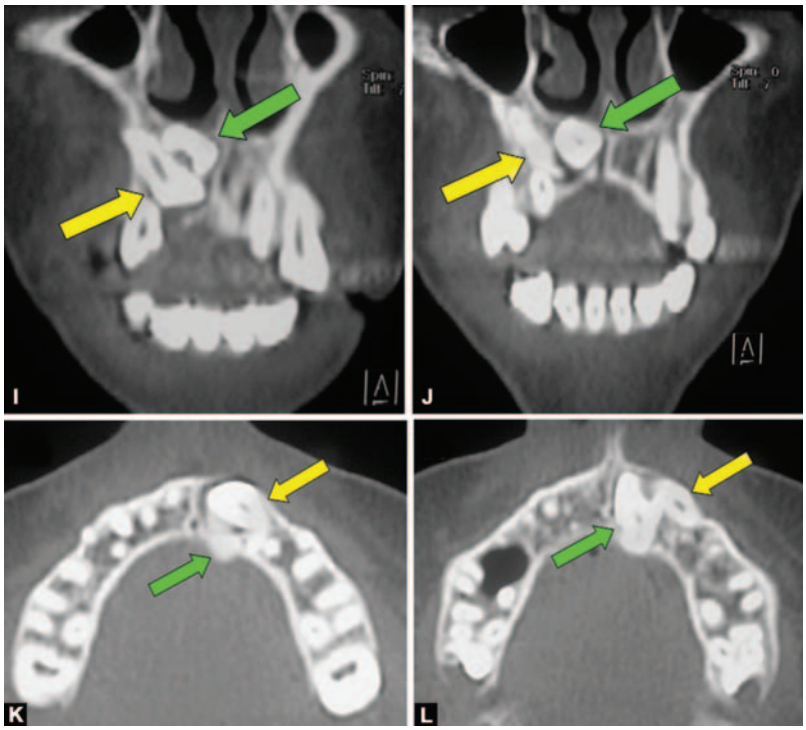

**Figs 17.16A to G:** Root visualization of left maxillary central incisor and canine using CBCT



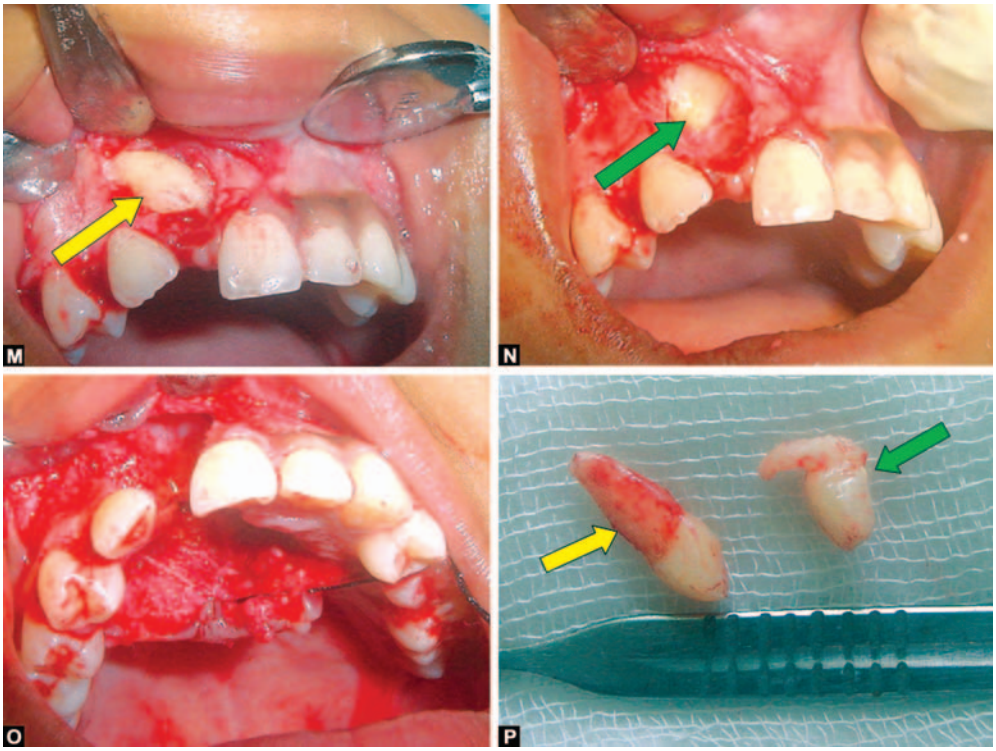

**Figs 17.17A to D:** (A) Preoperative labial view of the patient showing unerupted 11 and 13, (B) Palatal view, (C) Occlusal X-ray of maxilla showing impacted 11 (green arrow) and 13 (yellow arrow), (D) OPG showing the impacted teeth (yellow circle)




**Figs 17.17E to H:** (E) Lateral view of maxilla showing impacted teeth (yellow circle), (F) Sagittal CT scan image showing impacted 11 (green arrow) and 13 (yellow arrow), (G) Sagittal CT scan image showing impacted 13 (yellow arrow) and erupted 12 (white arrow), (H) Periapical X-ray




**Figs 17.17I to L:** (I) Coronal CT scan image showing impacted 11 (green arrow) and 13 (yellow arrow), (J) Coronal CT scan image showing impacted 11 (green arrow) and 13 (yellow arrow), (K) Axial CT scan image showing impacted 11 (green arrow) and 13 (yellow arrow), (L) Axial CT scan image showing impacted 11 (green arrow) and 13 (yellow arrow)




**Figs 17.17M to P:** (M) Impacted 13 visible (yellow arrow) after raising the flap and adequate bone removal, (N) Impacted 11 (green arrow) visible after removal of 13, (O) Surgical site after removal of impacted central incisor and canine tooth, (P) Specimen after removal -dilacerated central incisor (green arrow), canine (yellow arrow)

additional information (yellow circle). True lateral view of maxilla (Fig. 17.17E) revealed impacted 11 and 13 (yellow oval) at a high level close to the floor of the nose. With all the information available it was still difficult to ascertain the exact location of the impacted teeth as well as to choose regarding the type of approach to be used, i.e. labial or palatal approach. Hence, a CT scan was considered. Sagittal, coronal and axial cuts of the region were obtained. Figure 17.17F shows sagittal image in the edentulous region of 11. It depicts impacted 13 (yellow arrow) anterior to 11 (green arrow), the latter being close to the floor of the nose. Figure 17.17G shows sagittal image in the region of erupted 12; i.e. this image being more lateral to the previous one. In this cut the impacted 13 (yellow arrow) is labial to erupted 12 (white arrow). Impacted 11 is not visible, suggesting that it is close to the midline. IOPA X-ray (Fig. 17.17H) of the region is given for comparison which shows that not much of useful information is provided by it regarding the labio-palatal position of the tooth. Figure 17.17I is the coronal CT image at the level of the canine showing impacted 13 (yellow arrow) and impacted 11 (green arrow), the crown of the latter being close to the nasal floor. Since the root of 11 is not visible, it is suggestive of a labiopalatal position of the tooth. Figure 17.17J is the coronal CT image at the level of the premolars, i.e. a little more posterior to the previous one showing impacted 13 (yellow arrow) and cross-section of the root of 11 (green arrow), suggesting that 11 is lying in a labiopalatal position. Figure 17.17K shows the axial CT at the level of the middle 1/3 of the roots of the erupted teeth. This image depicts the crown of impacted 13 (yellow arrow) and a part of impacted 11 (green arrow). Figure 17.17L is the image at the apical third of roots of the erupted teeth, i.e. an image at a more superior level than the previous image. It shows a part of the impacted 13 (yellow arrow) and impacted 11 (green arrow) which appears to be in a labiopalatal position. The conclusion from the above imaging studies were as follows:

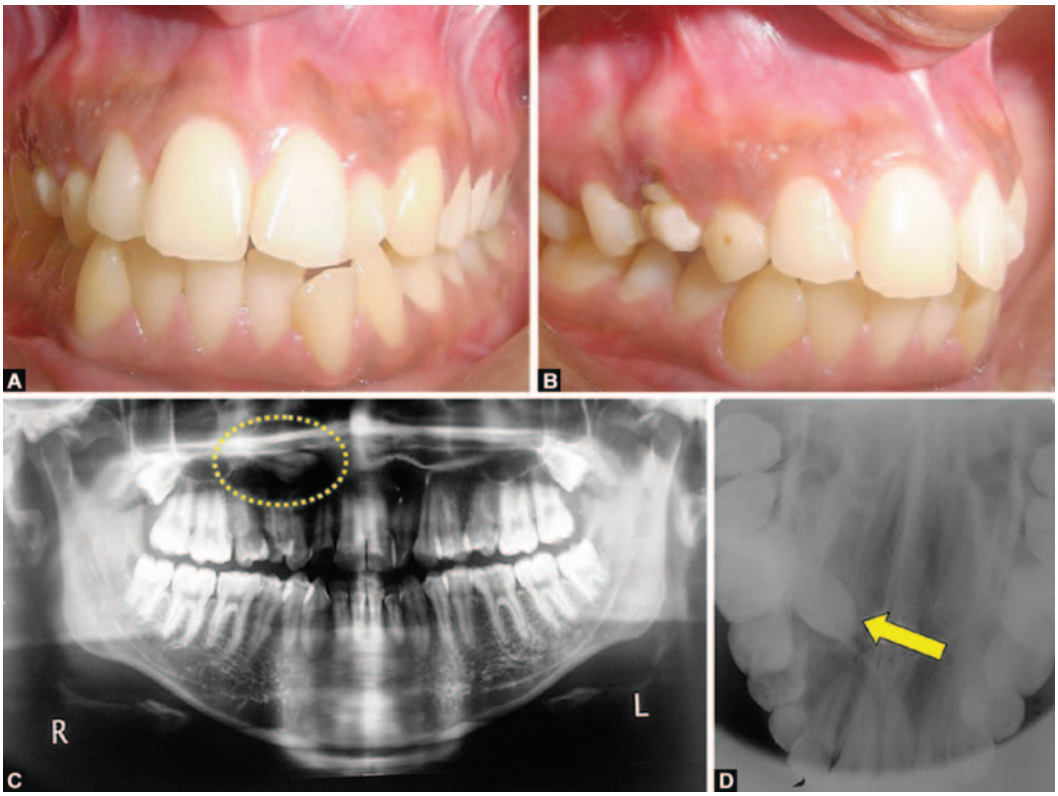
1. Impacted 13 is in a semi vertical position, located on the labial side close to the root of 12.
2. Impacted 11 is in a labiopalatal position, close to the floor of the nose.
3. Impacted 13 is in a more labial position than impacted 11.

4. The tip of the crown of impacted 13 is at the level of the coronal third of the root of 12.
5. The level of the crown of impacted 11 is at the level of the apical third of the erupted teeth.
6. The tip of the root of impacted 11 extends up to second molar region (in CT images not shown here).

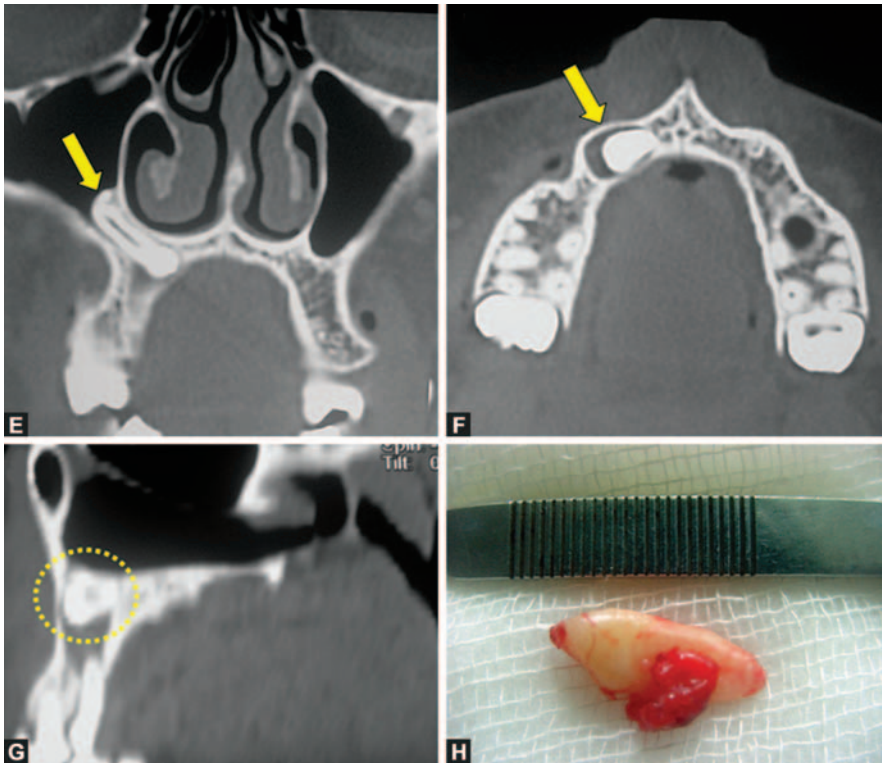
With all the above information the case was posted for surgery under local anesthesia with premedication. A combined labial and palatal approach was planned. A labial mucoperiosteal flap was first elevated. Following adequate bone removal, crown of impacted 13 (yellow arrow) was visualized (Fig. 17.17M). Impacted 13 was then removed. The crown of impacted 11 came into view (Fig. 17.17N). Surprisingly it was the palatal aspect of crown of 11 (green arrow) that came into view suggesting a dilaceration for the tooth. Next a palatal flap was elevated. After adequate bone removal impacted 11 was removed in toto. Figure 17.17O shows the surgical site after debridement before closure. Specimen of 11 (green arrow) shows the dilaceration of the tooth and normal root (yellow arrow) of 13 (Fig. 17.17P).

CT scans are also extremely useful in determining the relation ship of impacted canine to structures like maxillary sinus or roots of adjacent teeth as shown in the figures below ( Figs 17.18A to H and 17.19A to F).

To summarize the traditional radiographic techniques form an indispensable part of diagnosis and treatment planning in cases of impacted teeth. They are easy to carry out, cost effective, providing useful information and a general vision of the position of the impacted tooth with respect to the surrounding structures. However, it does not permit the exact localization of the canines in three-dimensional space. Computer-assisted tomography; particularly CBCT provides high resolution images with superior quality. They reveal information that can never be obtained from conventional radiographs and hence can be considered as the imaging modality of choice in cases of impacted teeth or other craniofacial anomalies in selected cases. However, selection of cases should be judicious to avoid unnecessary radiation to the patient. Moreover, the risk versus benefit ratio should be considered in each case.




**Figs 17.18A to D:** (A) Intraoral frontal view of the patient showing retained deciduous canine in the right maxilla, (B) Lateral view of the patient, (C) OPG showing impacted 13 (yellow circle); the relationship of the root of canine to maxillary sinus is not clear, (D) Occlusal radiograph (yellow arrow)




**Figs 17.18E to H:** CT scan of the patient: (E) Coronal CT showing the tip of the root is seen projecting into the right maxillary antrum (yellow arrow) and the tooth lies in an oblique fashion, (F) Axial CT showing a follicle is seen surrounding the crown of the impacted tooth and anteriorly the crown is covered only by a thin buccal cortical plate (yellow arrow), (G) Sagittal CT showing impacted canine lying superior to central and lateral incisor (yellow circle), (H) The tooth was removed in one piece by a labial approach

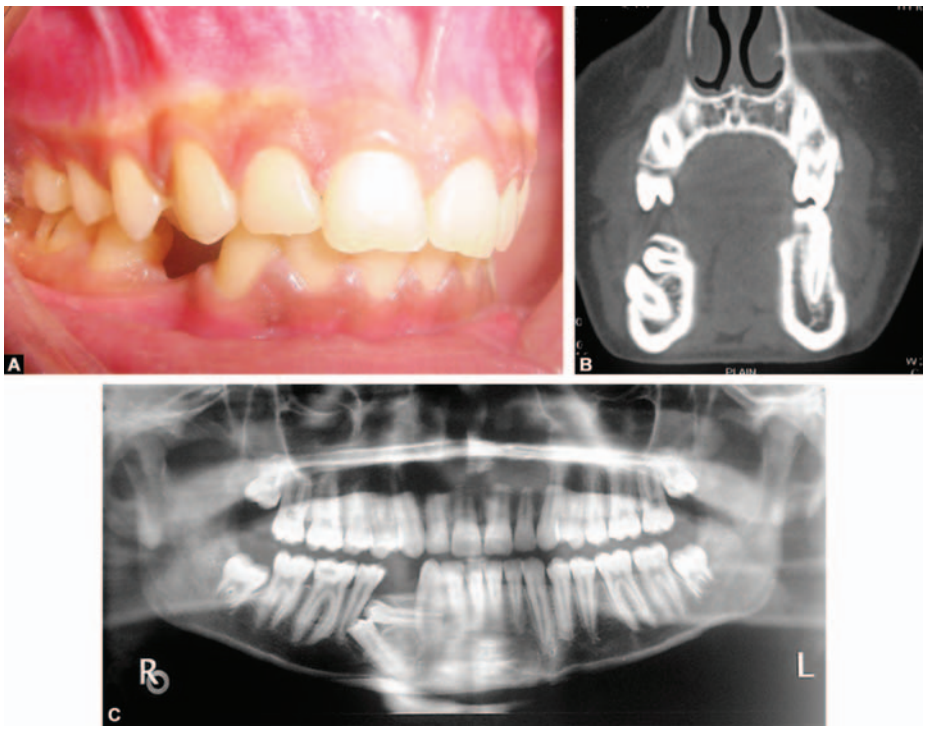
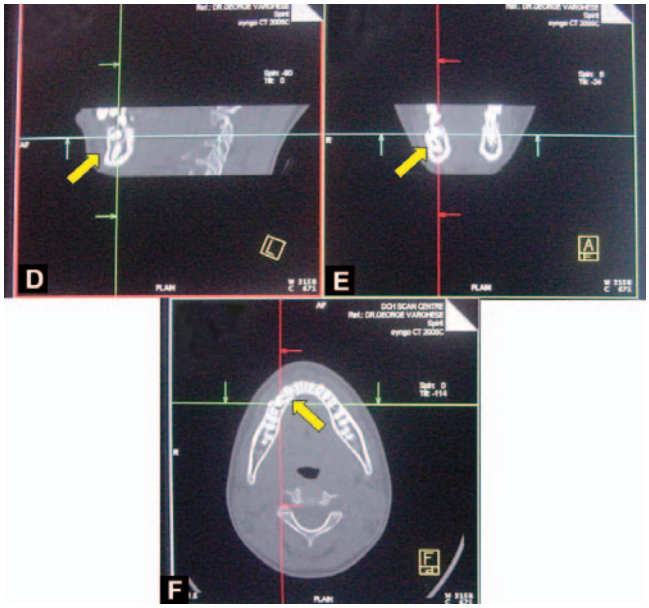



**Fig. 17.19A to C:** (A) Intraoral view of the patient showing missing/impacted 43, (B) OPG showing impacted 43 and supernumerary, (C) Coronal CT showing oblique position of impacted 43 and supernumerary




**Figs 17.19D to F:** Computer screen image showing CT sections through mandible in the region of impacted teeth (yellow arrows), (D) Sagittal view, (E) Coronal view, (F) Axial view showing the close relationship of impacted tooth to the roots of lower incisors. Considering the deep position of the impacted teeth necessitating removal of considerable amount of bone and the possibility of damage to incisors it was decided to defer the surgery for a later date with frequent follow-up

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CHAPTER

# 18 Modalities of Management of Impacted Canine

A systematic approach should be employed in the treatment of unerupted canine. Before any sort of treatment procedures are undertaken, a diagnosis, assessment and treatment plan must be made; a complete treatment plan which includes the surgical, orthodontic, periodontal, prosthodontic and conservative treatment is required.

There are different lines of management of the impacted maxillary canine depending on the age of the patient, stage of root formation, presence of associated pathology, condition of the adjacent teeth, position of the tooth, patient's willingness to undergo orthodontic treatment, available facilities for specialized treatment and patient's general physical condition. The specific surgical procedure and the orthodontic mechanisms involved for treatment of impacted canines will vary depending upon the degree of impaction, the horizontal overlap of the impacted tooth, the canine angulation, and localized crowding.

Studies have addressed horizontal overlap in reference to the canines and lateral incisors. The chance of canine impaction recovery is poor when the horizontal overlap of the maxillary canine root is more than one-half of the width of the lateral incisor root. An achievement of 91% resolution for palatal impaction has been reported in cases where the crown of the canine is distal to the midline of lateral incisor when treatment was initiated. In contrast, the success rate was reported to be less than 64% when the canine crown is mesial to the midline of the lateral incisor. Palatally impacted permanent maxillary canines are usually located over the roots of the lateral and central incisors or horizontally high in the roof of the mouth.

Before deciding upon any treatment, all options should be discussed with the patient in detail and a written consent obtained if any surgical treatment is planned. Every effort should be made to bring the impacted canine into normal occlusion if possible.

## Extraction of Deciduous Canine

This is considered as an interceptive method of management. This is indicated when the maxillary canine is not palpable in its normal position and the radiographic examination confirms palatally impacted canine. Removal of the primary canine may show less favorable results where the permanent canine is located in a more medial position or when the patient is older than the ideal age group of 10 to 13 years. Studies have shown that the extraction of primary canines at 10 to 13 years of age may resolve the palatally impacted permanent canines in approximately 60-80% of cases, when local space conditions are favorable. However, this treatment does not necessarily eliminate or ensure correction of the problem and therefore, surgical intervention should be considered if desired results are not obtained within one year of the deciduous extraction. Even though this is the standard approach each case should be planned accordingly.

In patients over 13 years of age other alternative treatment options should be considered. Shown below is the radiograph of a 14-year-old boy who reported with a swelling of the left maxilla, multiple unerupted permanent teeth and retained deciduous root stumps. OPG showed a dentigerous cyst involving the left maxilla in relation to impacted 25 (yellow oval) and impacted

canines and premolars (Fig. 18.1). The case was treated by enucleation of cyst, removal of impacted 25 and extraction of retained deciduous teeth. The case was followed up regularly. A follow-up OPG taken six months later revealed that all the impacted teeth have started erupting (Fig. 18.2). The case report substantiates the view that it is always advisable to wait for a while before a decision is taken regarding surgical removal of impacted teeth, especially when the impacted teeth are in a favorable position to erupt, even though it is beyond the normal time of eruption.

The elimination of dental crowding in the arch particularly in the canine/premolar area can possibly stimulate eruption into the arch (Kurol et al, 1997).[1] However, Kuftinec et al (1995)[2] recommended that irreversible decisions such as extraction of permanent teeth to allow canine eruption should be delayed as long as possible.

## No Treatment—Leave the Tooth in situ

In some cases it may be preferable to carry out no active treatment except that of regular clinical and radiographic follow-up. The most frequent complication appears to be follicular cystic degeneration, although the frequency of this is unknown. Other odontogenic tumors may arise very rarely. There may be localized loss of attachment and marginal breakdown of the adjacent teeth, which may necessitate the removal of the canine and the affected teeth. There is a need to regularly monitor the unerupted canine with respect to the possible complication mentioned above. It is not known what is the optimal time interval between radiographs should be, to reduce the radiation dosage for the patient and detect any lesion. No active treatment could be recommended if:

The patient does not want treatment

There is no evidence of resorption of adjacent teeth or other pathology.

Ideally, there is a good contact between the lateral incisor and first premolar or good aesthetic/prognosis for deciduous canine.

There is severely displaced canine with no evidence of pathology, particularly if it is remote from dentition, provided it is monitored radiographically.

Completely formed canine tooth without any associated pathology and well above the apices of the adjacent teeth especially in an elderly individual can be left alone. But regular check-up may be needed.

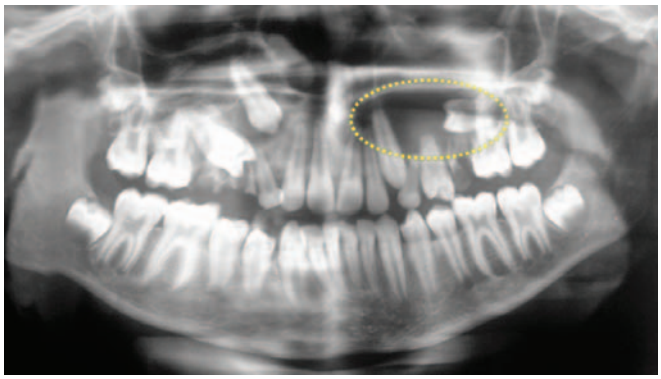

**Fig. 18.1:** OPG showing a dentigerous cyst involving the left maxilla in relation to impacted 25 (yellow oval), impacted canines and premolars in maxilla and retained deciduous root stumps

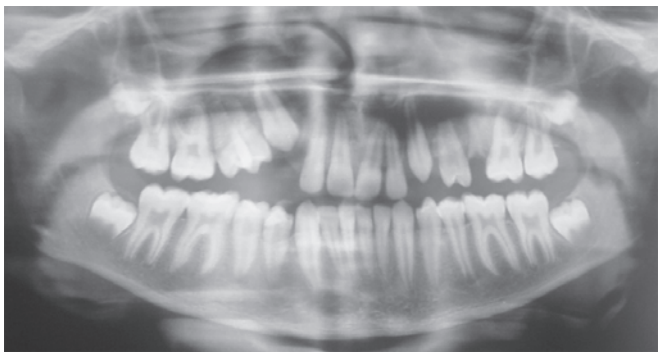

**Fig. 18.2:** OPG taken six months later showing the teeth that were impacted previously, i.e. 13, 14, 15, 23 and 24 have started erupting

## Surgical Exposure of the Tooth

In cases where there is sufficient space for eruption of the canine and where the root formation is not complete, simple exposure of the crown of the tooth may help to utilize the eruptive force and aid in normal alignment of the tooth.

## Surgical Exposure and Orthodontically Assisted Eruption

This is the most desirable approach for an impacted canine provided all the criterias are fulfilled. This method is dealt in detail in the next chapter.

Criteria to be fulfilled before attempting surgical orthodontic management of impacted canine include:

1. Favorably impacted canine
2. Good patient cooperation for the long orthodontic and surgical approach
3. No associated medical problems

Often, maxillary canines that are displaced palatally will not erupt without orthodontic treatment because of the dense palatal bone, thick palatal mucosa and increased horizontal angulation associated with these impactions. In case where spontaneous eruption of the tooth is not expected as in oblique position of the tooth and completely formed root apex, orthodontic traction of the tooth may be required to bring it into occlusion.

When there is insufficient space for alignment of the canine, extraction of the lateral incisor or first premolar tooth may be required, or space should be gained by the orthodontic movement of these and other teeth.

## Surgical Removal of the Impacted Tooth

Teeth in an unfavorable position which are likely to create problems in the future, are best removed at an early stage. When a patient is not willing for or cannot afford orthodontic treatment, even teeth in a favorable position may have to be sacrificed.

## Surgical Removal of the Impacted Tooth with Orthodontic Space Closure

In case of an unfavorable canine and if patient doesn't want to spend extra time for orthodontic traction along with an indicated case of first premolar extraction, this approach could be tried. Instead of first premolar to be extracted on the impacted side the canines could be removed and space could be closed orthodontically. Later on the first premolar could be shaped to resemble canine. When the ipsilateral first premolar and lateral incisor are suitably positioned the planned and timely removal of an unerupted labially placed maxillary canine may produce an acceptable aesthetic result and minimize the length of time of orthodontic treatment.

## Surgical Removal of Impacted Tooth with Prosthetic Replacement

This could be tried in an unfavorable canine with no need for otherwise extraction correction. Also in cases where patient is not willing for the long process of orthodontic traction. After proper healing a removable or fixed prosthesis could be given. A single tooth implant also could be a good option.

## Surgical Removal with Posterior Segmental Osteotomy

The unfavorable impacted tooth is surgically removed and the space left in the region of canine, if cannot be orthodontically closed or if patient denies a prosthetic appliance it could be closed with a lateral segmental osteotomy and sagittal advancement. Post surgical minimal orthodontic intervention could close the residual defect or step deformity. A re-contouring of premolar could be considered to have the canine look.

## Surgical Repositioning/Autotransplantation

Impacted, malpositioned canines with a favorable root pattern (without hooks or sharp curves) can be tried to be transplanted in the dental arch. This is done utilizing the socket of deciduous canine or first premolar, depending on the space available.

Table 18.1 shows the summary of eruption activating procedures/intervention for developing permanent canines. The same procedures are applicable for developing permanent incisors and premolars also.

**Table 18.1:** Eruption activating procedures for permanent

| *Eruption stage* | *Intervention* |
|---|---|
| 1 Intraosseous stage | a. Primary tooth removal<br>b. Primary tooth + bone removal<br>c. Primary tooth + bone removal + coronal follicle removal, exposure site kept open<br>d. Surgical repositioning<br>e. Space augmentation<br>f. Removal of obstacles to eruption |
| 2 Mucosal stage | a. Mucosa removal<br>b. Space augmentation |
| 3 Preocclusal stage | a. Orthodontics<br>b. Space augmentation |

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CHAPTER

# 19 Surgical Exposure of Impacted Maxillary Canine

The conventional treatment option for impacted canine is exposure and orthodontic alignment.

Factors' influencing the prognosis—The prognosis for alignment is dependent on a number of factors which include the age of the patient, spacing/crowding and the vertical, anteroposterior, and transverse position of the canine crown and root. If the inclination of the canine in relation to the midline is greater than 45 degrees then the prognosis for alignment worsens. The closer the tooth is to the midline the poorer the prognosis. For successful alignment, the root should be neither ankylosed nor dilacerated. The further the canine needs to be moved, the poorer the prognosis for a successful outcome. Similarly as with all orthodontic treatment co-operation and motivation of the patient is supreme. The general dental health should be excellent since the treatment time in these cases is often prolonged. It is generally agreed that the optimum time for alignment is adolescence.

As for any surgical procedure, proper history of the patient should be taken, including the general medical history.

Local examination should emphasize on any bulge labially or palatally, which might give a clue to the position of the tooth.

Radiographs are taken to confirm the position of the impacted tooth and its relationship to the adjacent teeth. Necessary hematological examinations should be done prior to anesthetic assessment.

Choice of anesthesia: Local anesthesia is sufficient in almost all cases of this minor surgical procedure and is the safest in dental outpatient setting. However, with the change in the social set up, changing out looks of the patient as well as the surgeon and the availability of modern equipments, medicines and techniques general anesthesia has become more popular than earlier times. Another choice is local anesthesia supplemented with intravenous sedation but requires monitoring facilities.

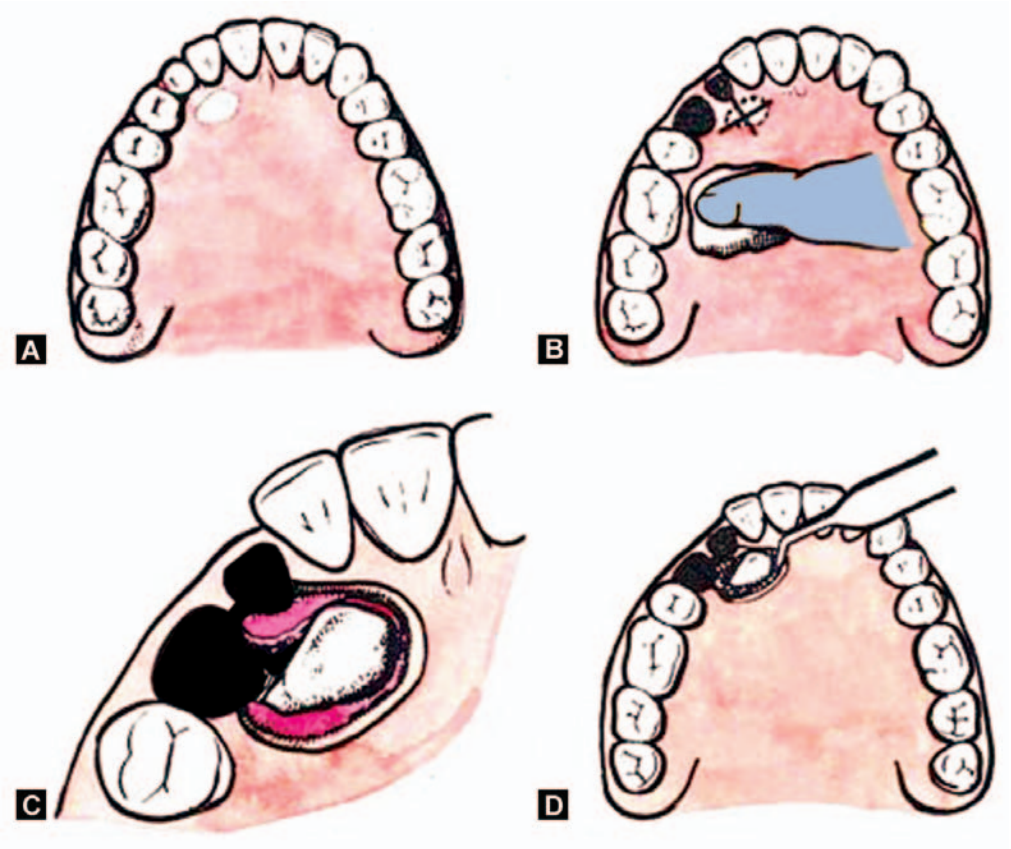
## PROCEDURE

**a. Palatally positioned canine**

The position of the crown of the tooth is determined with the help of radiographs, and a cruciform incision is made with its center over the estimated position of the crown of the buried tooth. The flaps (on four sides) are raised to expose the tooth crown. And once completely exposed, the flaps are excised. Resultant hemorrhage can usually be controlled by pressure. The bone over and surrounding the crown of the tooth is removed in such a way that the crown will be left lying in a saucer-shaped bony cavity, without any sharp ledge of bone at the edges. A pack is inserted to prevent the soft tissues growing over the exposed tooth. The pack can be perio pack or roller gauze impregnated with iodoform or antibiotics, which can be sutured into place (Figs 19.1A to 19.2I).

Surgical exposure of palatally impacted canine by excision of overlying mucoperiosteum (Figs 19.2 A to I):

**Case report:** A 12-year-old girl reported with complaints of unerupted right upper canine and excessive spacing of upper anterior teeth. Intraoral examination showed retained deciduous right upper canine and




**Figs 19.1A to D:** Schematic diagram showing exposure of impacted canine in the palate. (A) Position of the crown of the canine is localized by clinical examination and with the help of radiographs, (B) Incision, (C) Excision of the overlying flap and exposure of the crown, (D) Debridement and insertion of the pack

impacted upper permanent canine (13) and missing upper laterals (Figs 19.2A and B). Periapical X-ray showed that impacted 13 is in a favorable position for orthodontic eruption (Fig. 19.2C). Under local anesthesia, excision of the overlying mucoperiosteum was done to expose the impacted 13 (Figs 19.2D and E). Retained deciduous canine was also extracted (Fig. 19.2F). Zinc oxide eugenol pack was placed to cover the raw area (Fig. 19.2G). After 10 days when the healing has completed, brackets were fixed to the maxillary teeth (Fig. 19.2H). Arch wire was then applied to the maxillary arch and impacted 13 connected to arch wire (Fig. 19.2 I).

Surgical exposure of palatally impacted canine by creating a window (Figs 19.3 A to I):

In cases where the crown of the tooth cannot be localized, the palatal mucoperiosteal flap is reflected from premolar on the involved side to the canine on the other side, after placing an incision around the neck of the teeth. The crown of the impacted tooth is then exposed by removal of sufficient amount of bone. The part of the mucoperiosteum overlying the crown is excised with a scalpel. The flap is then repositioned and sutured back into place. A pack is placed as explained before (Figs 19.3 A to I).

**b. Labially positioned canines**

Depending upon the depth and position of the impacted tooth anyone of the following three methods can be employed to expose the crown:

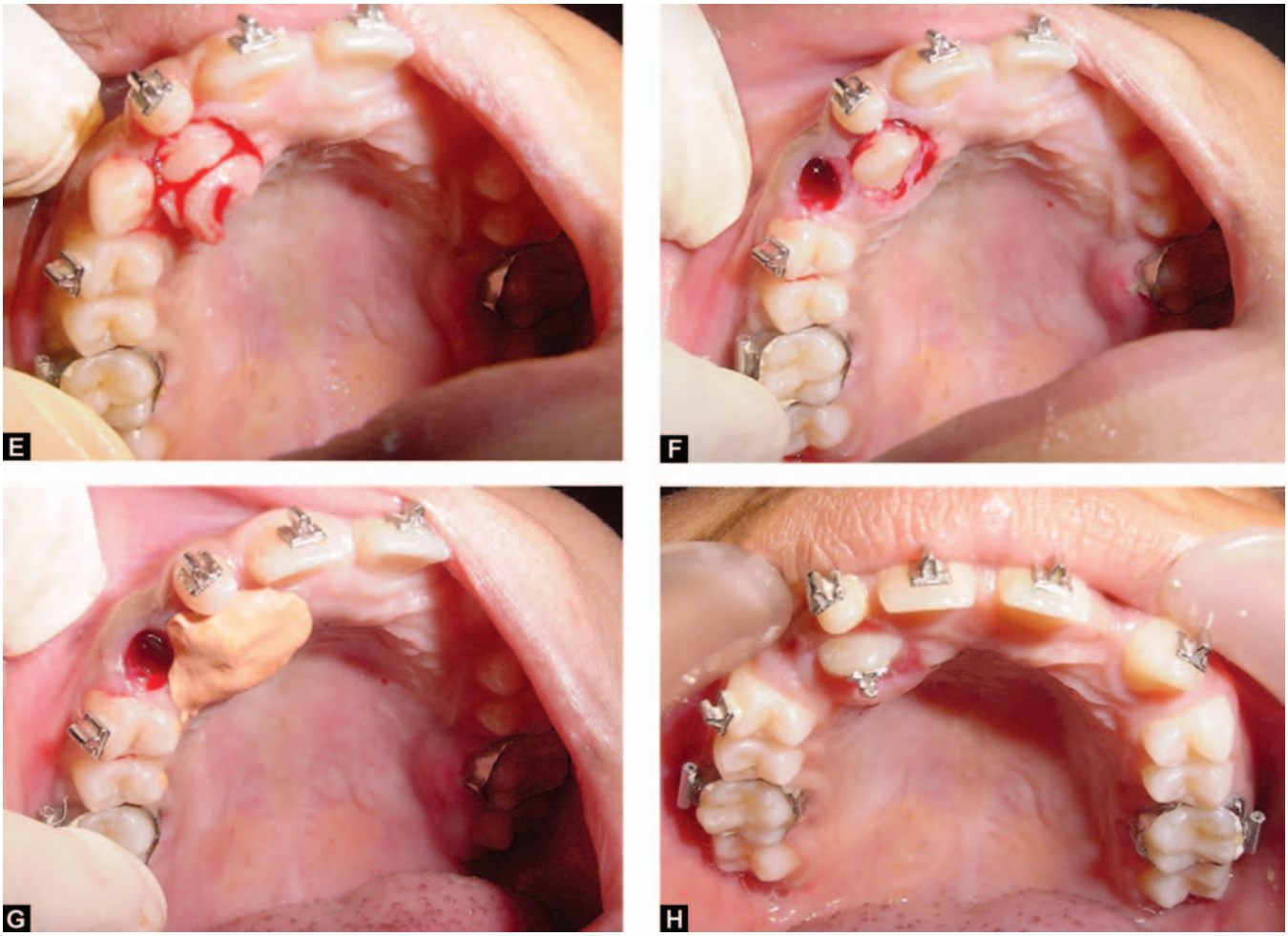
- Creating a surgical window/Gingivectomy
- Closed eruption technique
- Apically positioned flap


**Figs 19.2 A to D:** (A) Intraoral view of the patient showing retained deciduous right upper canine, impacted permanent canine (13) and missing upper laterals, (B) Palatal view showing bulge of impacted 13, (C) Periapical X-ray showing impacted 13, (D) Incision marked to expose impacted 13

**A. Creating a surgical window/Gingivectomy (Figs 19.4 A to C):** If the tooth is situated just beneath the gingiva, simple excision of the overlying soft tissue is enough to expose the crown.

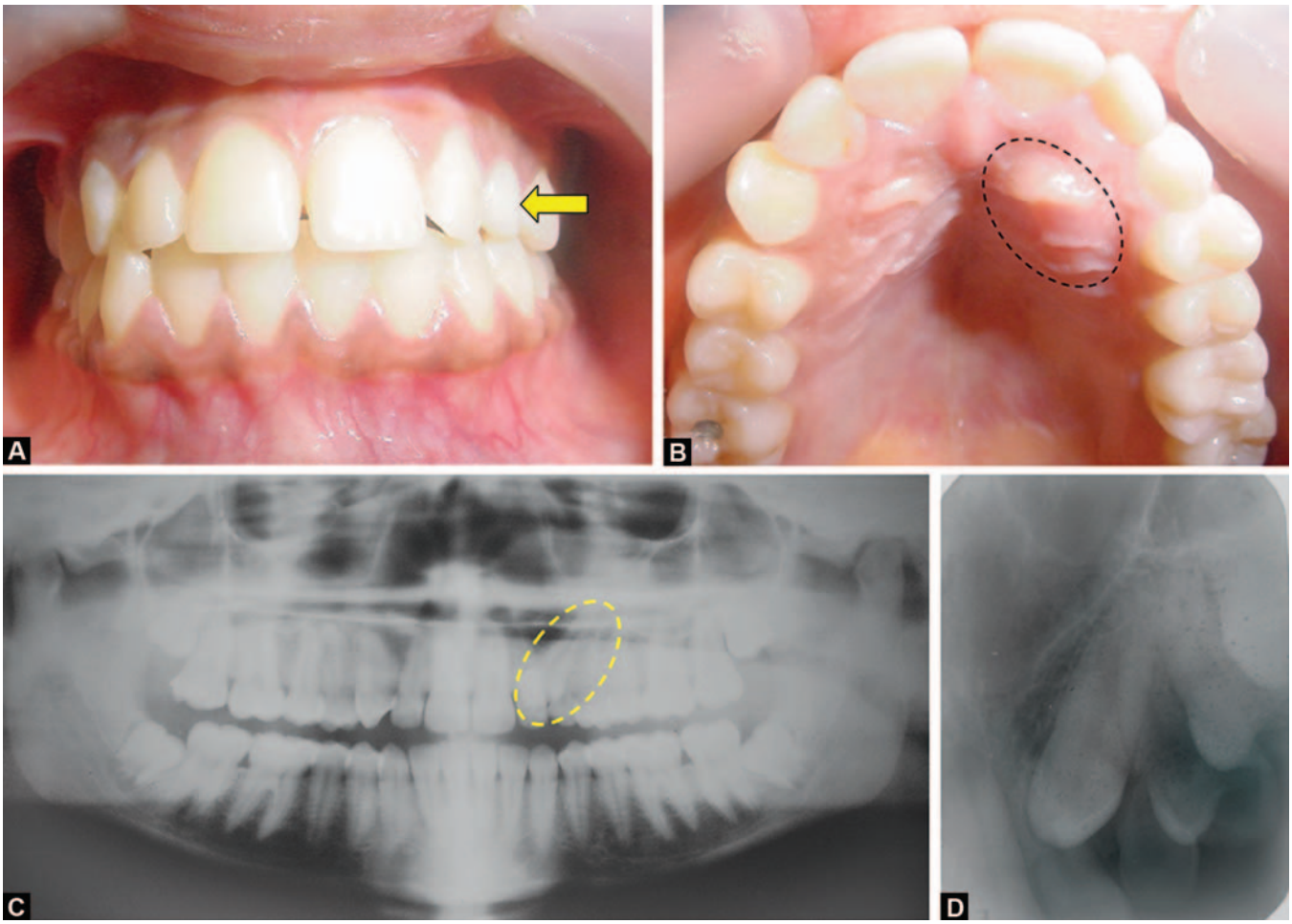
A surgical window or gingivectomy is suggested for shallow, labially positioned maxillary canine impactions close to the alveolar crest or when a broad band of keratinized tissue is present. Implementing the window approach involves resecting a full thickness flap and then repositioning the flap back with a fenestration being opened in the area of the crown. The tooth may erupt normally once the soft tissue obstruction is removed, and in such instances orthodontic treatment may not be required. A gingivectomy procedure is indicated when one half to 2/3 of the crown can be uncovered leaving at least 3 mm of gingival collar. In most instances, the tip of the impacted tooth is near the cemento-enamel junction of the adjacent tooth. This technique is simple but it sacrifices attached gingiva (Kokich et al, 1993).[1]

B. **Closed eruption technique ( Figs 19.5A to F):** A closed eruption technique is indicated if the tooth is impacted in the middle of the alveolus, near the nasal spine, high




**Figs 19.2 E to H:** (E) Overlying mucoperiosteum being excised, (F) Mucoperiosteum excised and retained deciduous tooth removed, (G) Zinc oxide eugenol pack placed to cover the raw area, (H) After 10 days when the healing has completed, brackets were fixed to the maxillary teeth


**Fig. 19.2 I:** Arch wire applied and impacted 13 connected to the arch wire using ligature wire. An elastic thread also can be used instead of a ligature wire

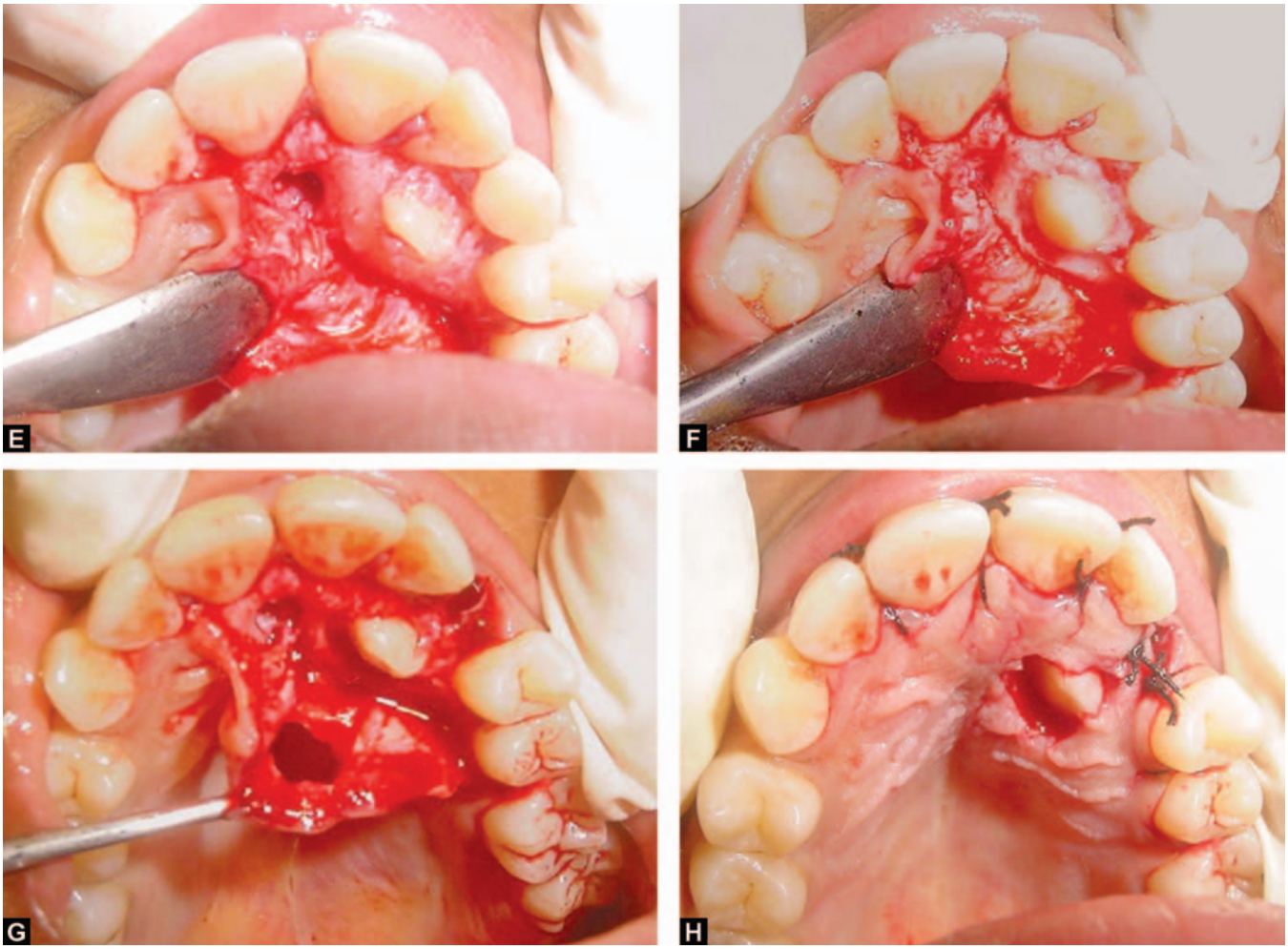



**Figs 19.3 A to D:** Surgical exposure of palatally impacted canine by creating a window - (A) Intraoral view of the patient showing retained deciduous left upper canine (yellow arrow) and impacted permanent canine, (B) Palatal view showing impacted 23 (black oval), (C) OPG showing impacted 23 (yellow oval), (D) Periapical X-ray showing impacted 23

in the vestibule or in the palate (Vermette et al, 1995).[2] A flap is first reflected over the area of the impacted tooth (Fig. 19.5B). The crown is then exposed (Fig. 19.5C) after removal of the overlying bone if necessary. An orthodontic bracket is bonded to it. A traction wire is connected to the bracket. The flap is closed over the crown, exposing only the traction wire to the oral cavity (Fig. 19.5D). Adequate time is given for the initial healing of the flap. Later the traction wire is connected to an arch wire and optimal force needed to erupt the impacted tooth is exerted (Fig. 19.5E). Figure 19.5F shows the final position of the canine in the arch. Disadvantages of this technique include that once the flap is closed, direct inspection of the tooth is impossible. Moreover, it is difficult to isolate the area and studies have shown a longer eruption time compared to procedures used in open techniques.

**Apically positioned flap (Figs 19.6 and 19.7):** If the cervical part of the crown of the impacted tooth is not within the attached gingiva, removal of the soft tissue by gingivectomy can lead to loss of attached gingiva. Later on this can cause periodontal problems. In such a case an apically repositioned flap is advisable.

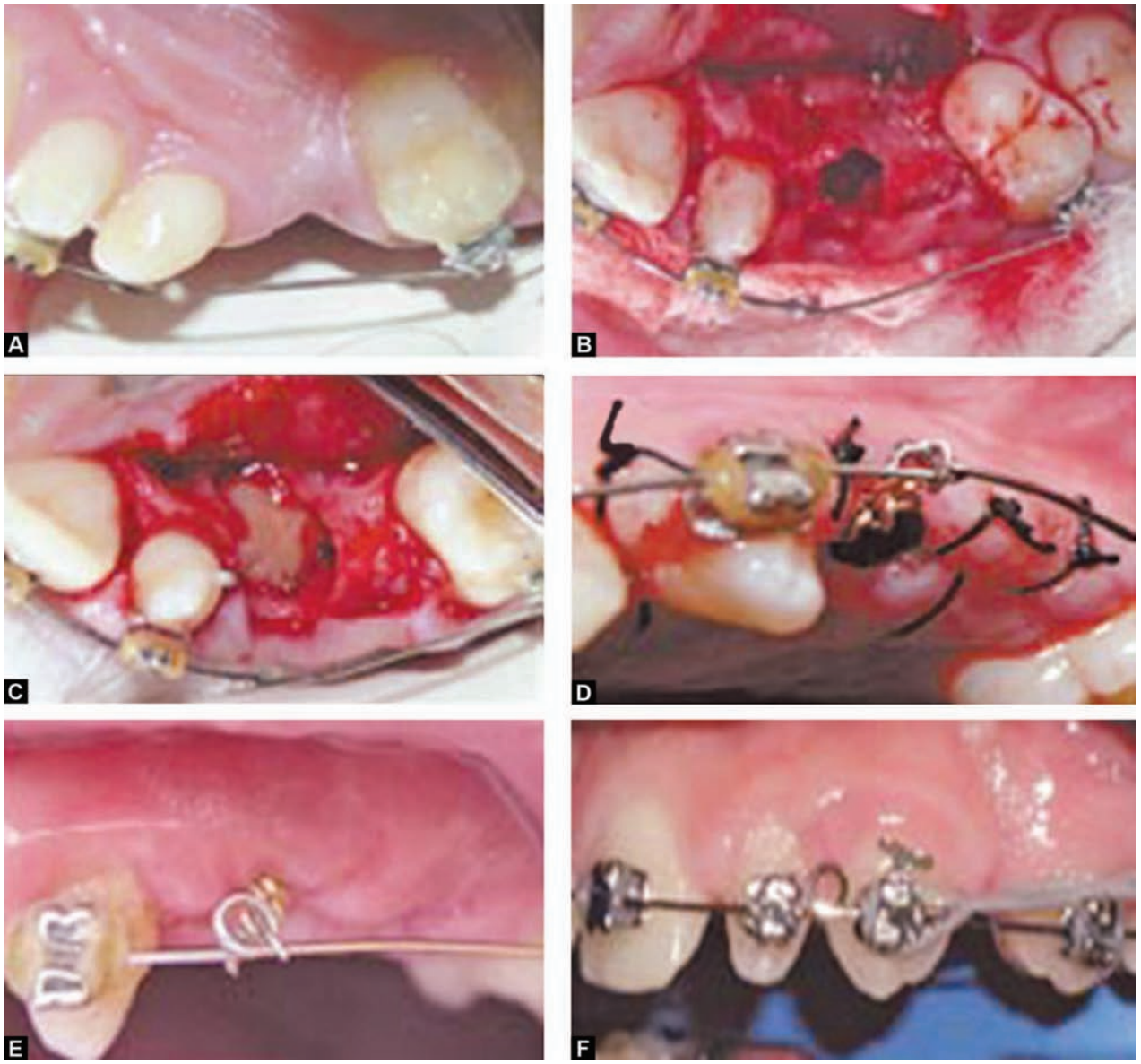
This technique is indicated when the tooth is apical or lateral to the edentulous area but is used primarily for labial impactions due to the inability to apically reposition the palatal tissue. The flap is designed so that there are vertical incisions adjacent to the distal aspect of the lateral incisor and the mesial side of the first premolar and a horizontal incision connecting the two (Fig. 19.6A). Next, the crown of the impacted tooth is located and the flap is secured back into place apically so that the crown remains exposed in the oral cavity (Fig. 19.6B).



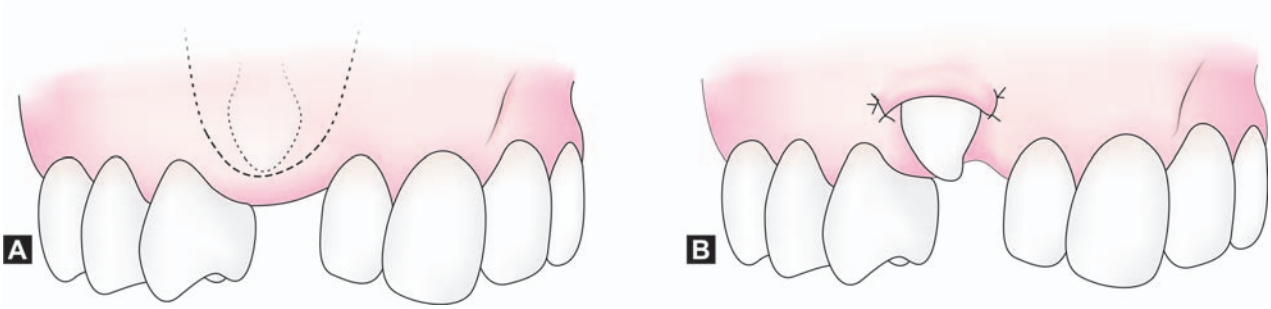

**Figs 19.3 E to H:** (E) Mucoperiosteum reflected to expose the incisal tip of impacted canine, (F) Bone surrounding the crown of impacted 23 removed to expose the crown fully, (G) A window created in the flap after excising an oval piece of tissue to accommodate the crown of 23, (H) Flap replaced back and sutured in position. Note the crown of impacted 23 protruding through the window in the flap


**Fig. 19.3 I:** Raw area of the mucoperiosteum covered with zinc oxide eugenol pack

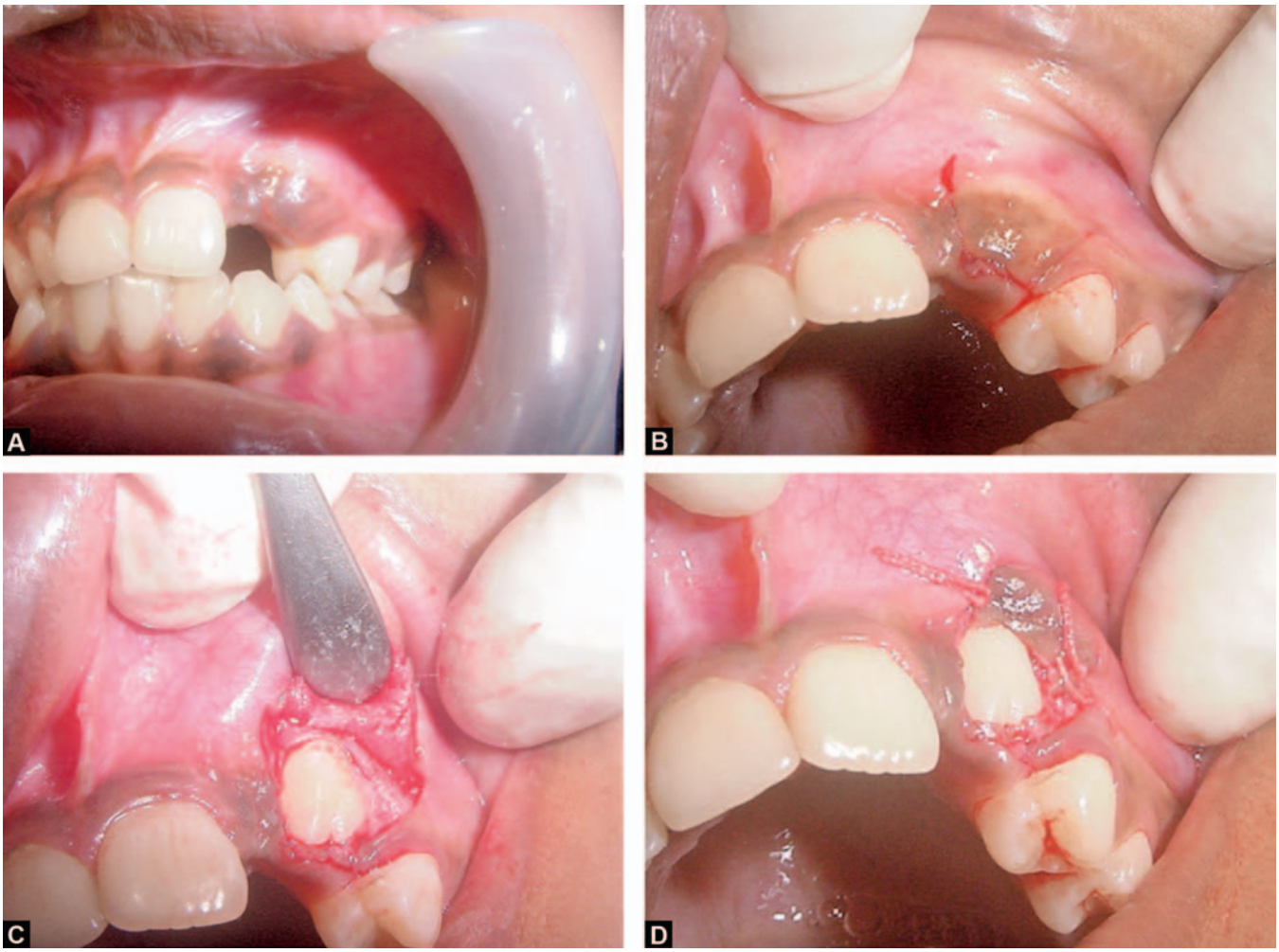

**Figs 19.4 A to C:** Steps in creating a surgical window / gingivectomy - (A) Labial bulge of the canine, (B) Gingivectomy performed, (C) Bracket fixed to the exposed canine crown and traction wire attached to the arch wire




**Figs 19.5 A to F:** (A) Palatal view showing edentulous space between the lateral incisor and first premolar tooth, (B) Reflection of mucoperiosteal flap, (C) Bone overlying the tooth removed to expose the crown, (D) Traction wire connected to the orthodontic bracket bonded to the impacted tooth, (E) Labial view showing traction wire connected to the arch wire, (F) Final position of the canine in the arch




**Figs 19.6 A and B:** Schematic diagram of apically positioned flap for exposure of a labially positioned crown. (A) Incision, (B) Suturing




**Figs 19.7 A to D:** Surgical steps in developing an apically positioned flap. (A) Intraoral view of the patient showing missing lateral and impacted left upper canine, (B) Incision marked, (C) Flap reflected, (D) Suturing completed to secure the flap apically

If necessary, a bracket ( Fig. 19.7 E) can then be placed on the erupting tooth to orthodontically guide it into position (Jarjoura et al, 2002).[3] This is a quick and simple procedure that allows accurate control and helps to maintain the mucogingival complex. However, this technique cannot be used when the tooth is positioned high in the palate.

Whatever be the position of the tooth, care is taken to remove the bone over the crown without leaving any ledge of unsupported bone. Chisel and mallet are preferred for bone removal as it minimizes the chance of damage to the crown of the tooth. When bur has to be used, utmost care should be taken as it can easily damage the crown surface.

## Aids for Orthodontic Eruption

As mentioned earlier, some times orthodontic alignment of the impacted tooth may be required. Simple exposure of the crown and leaving it as such can lead to in growth of soft tissues to cover the crown again. So to start orthodontic treatment, re exposure may be required. To avoid this, at the time of exposure initially any attaching device can be fitted on to the exposed crown, which can later be utilized for orthodontic traction. These devices include placement of a metal crown, stainless steel traction wire, cementation of preformed orthodontic band or drilling a hole in the crown and insertion of a threaded pin. A simple method is to do a direct bonding of a special orthodontic bracket with a gold chain attached to it. The gold chain will be visible outside even if soft tissue grows to cover the crown and it can later be attached to the orthodontic arch wire with ligatures or elastics to apply the necessary traction. One of the drawbacks of this method is the difficulty in maintaining an absolutely dry crown surface within the surgical field, for proper etching and bonding of the bracket.


**Fig. 19.7 E:** Orthodontic bracket fixed and then connected to the arch wire

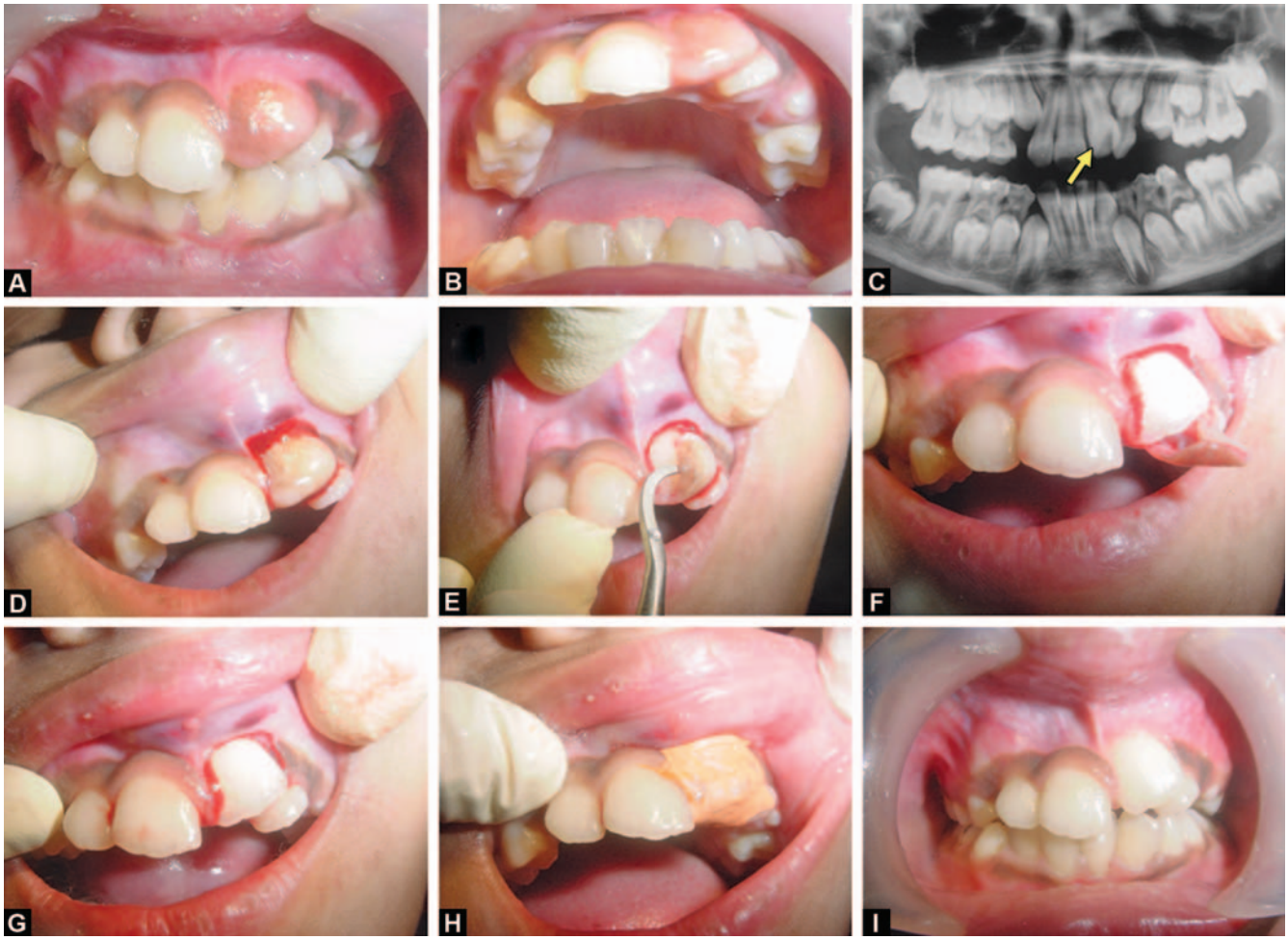
Studies by Quirynen et al (2000)[4] has shown that orthodontic extrusion of impacted front teeth does not jeopardize their periodontal health. This procedure appears to be a satisfactory alternative to extraction and/or transplantation. In any surgical procedure, the manner in which the soft tissue is handled ultimately affects the results of the treatment. Potential complications involving the soft tissue include attachment loss, recession, and gingival inflammation. Vertical relapse, intrusion of adjacent teeth, root resorption and debonding of brackets are other complications that may occur from impacted maxillary canine treatment. Furthermore, studies have shown that ankylosed teeth can cause adjacent teeth to tip in the space provided by the impaction. More details on aids for orthodontic eruption are given in the next chapter (Chapter 20).

## Surgical Eruption of Upper Incisors

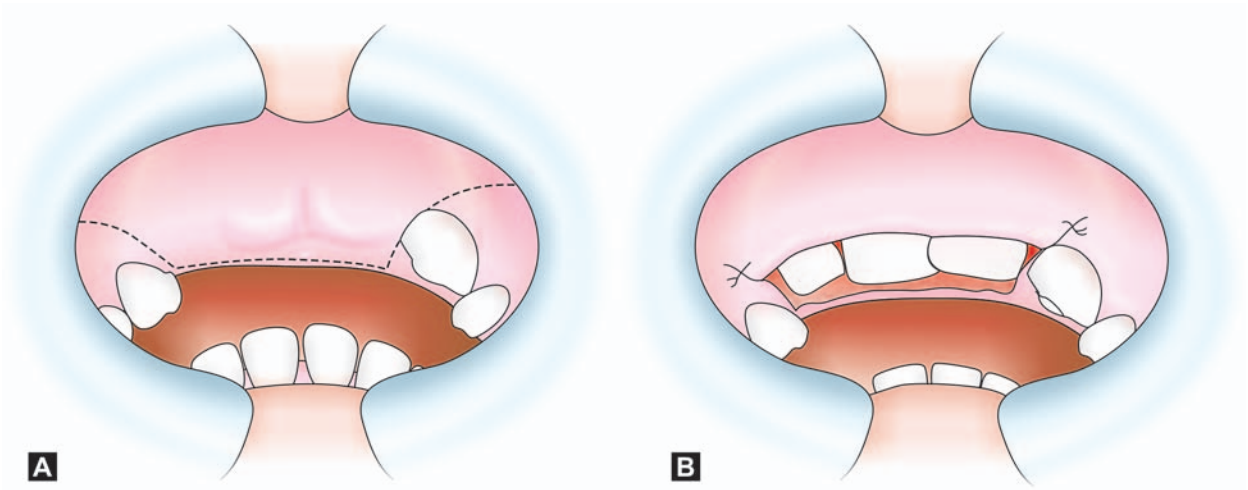
In cases where the root of the tooth is not fully formed and when the position of the tooth is at a near normal position, surgical exposure (excision of the overlying gingiva) alone is sufficient to promote the eruption of the unerupted tooth. However, in cases where the root of the impacted tooth has been fully formed, the tooth lacks its inherent potential to erupt and in such instances orthodontic guidance will be required to facilitate eruption. Figures 19.8 A to I shows the steps in the surgical eruption of an unerupted central incisor tooth in a twelve year-old boy.

**Surgical orthodontic management of impacted incisors (Figs 19.9 A and B):** The procedure is similar to that applied for the management of impacted canines.

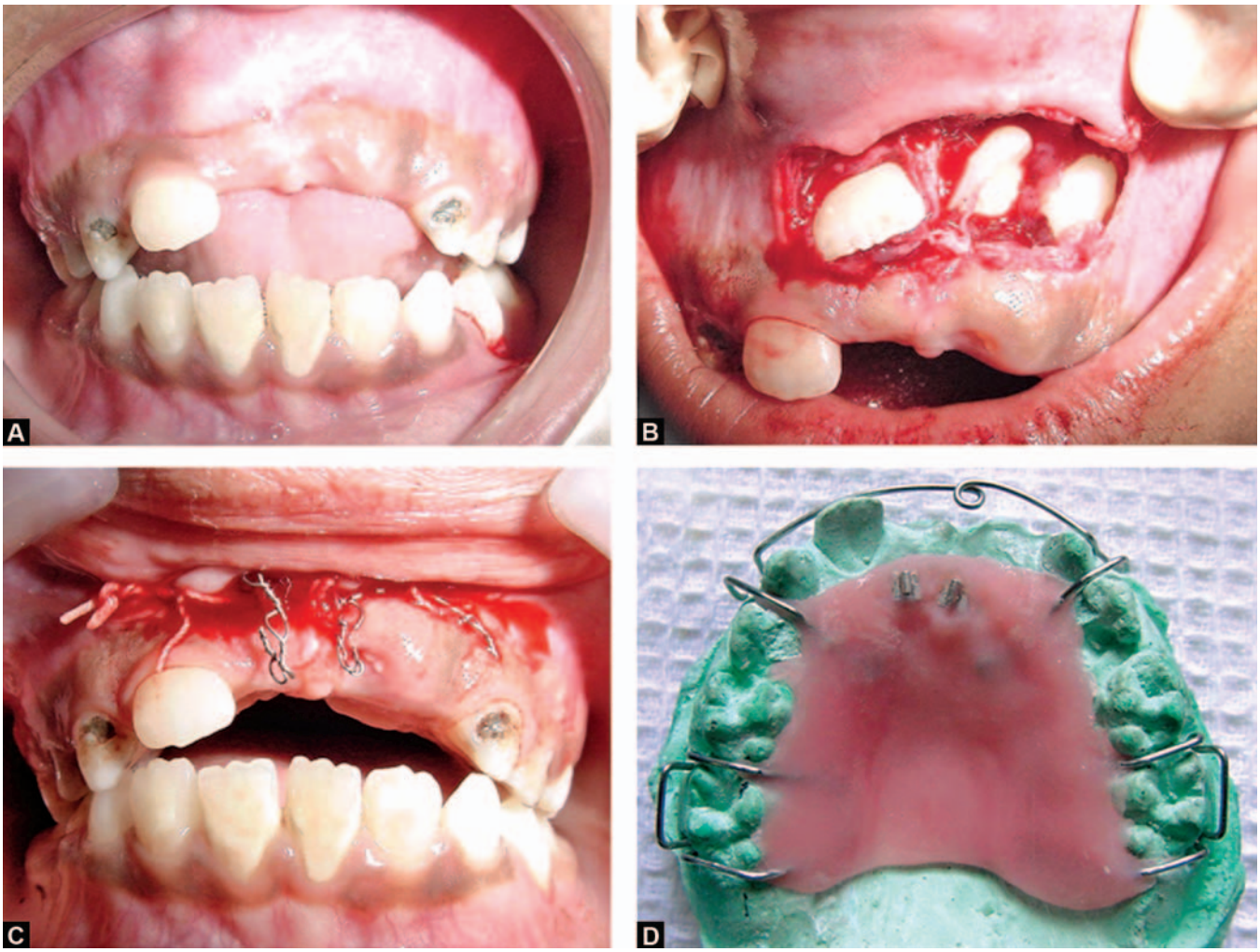
**Case report (Figs 19.10 A to D):** The following case report illustrates the steps involved in the procedure of employing removable orthodontics for incisor guidance. A nine-year-old boy reported complaining of unerupted upper central incisors (Fig. 19.10 A). A diagnosis of impacted upper centrals was made. The diagnosis was confirmed with periapical X-ray. Under local anesthesia




**Figs 19.8 A to I:** Steps in the surgical eruption of upper central incisor. (A) Intraoral labial view of the patient showing impacted 21, (B) Palatal view, (C) OPG of the patient showing impacted 21 (yellow arrow). Note the incompletely formed root of the tooth, (D) Incision marked, (E and F) Incision deepened with surgical blade and overlying gingiva removed. Alternatively electrocautery may be employed to excise the gingiva, (G) Crown of the tooth fully exposed, (H) Surgical site covered with zinc oxide eugenol paste, (I) Healed surgical site after two weeks




**Figs 19.9 A and B:** Schematic diagram showing the type of incision (A) to expose the crown and (B) the closure method after fixing the bracket and attaching the traction chain



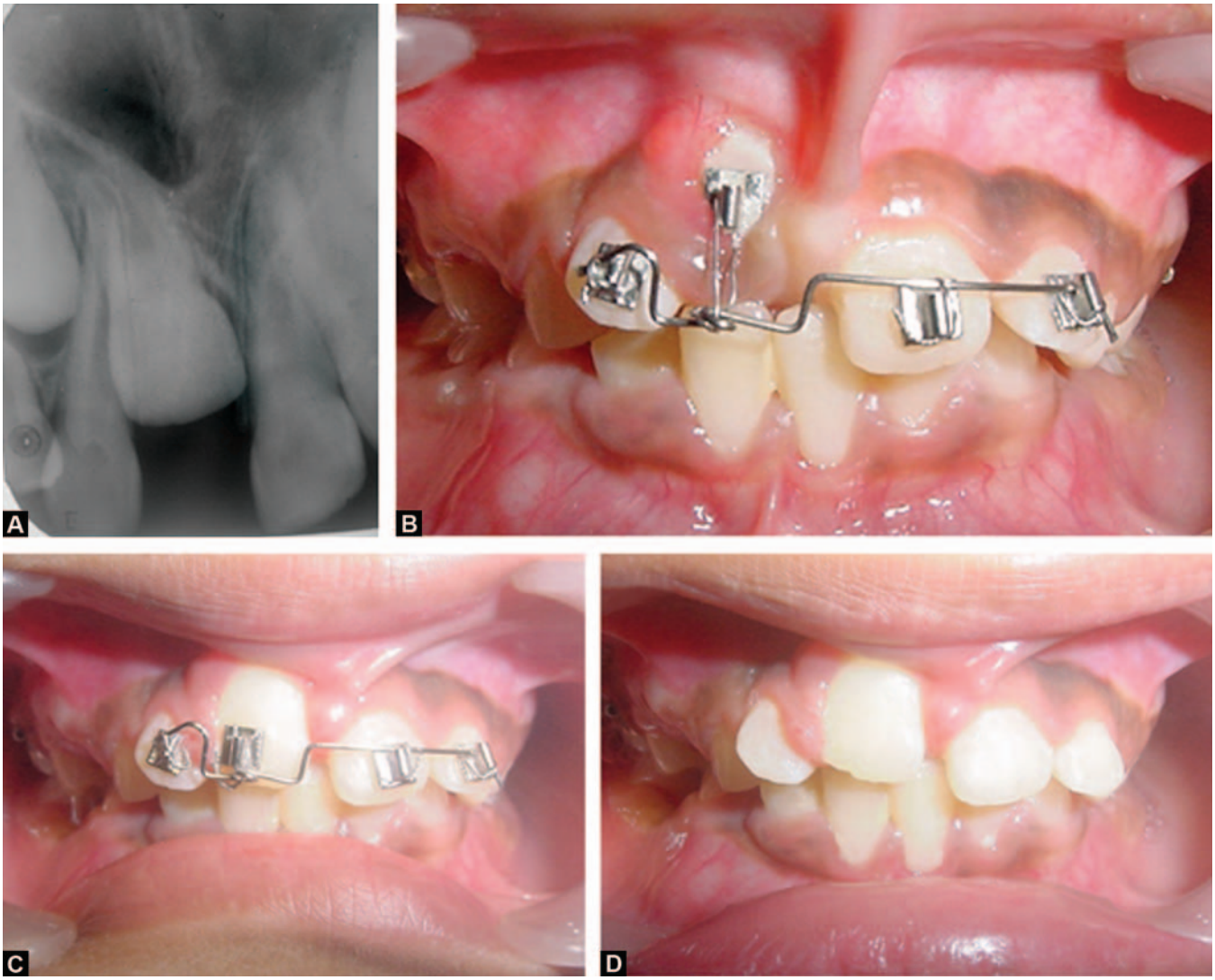

**Figs 19.10A to D:** Orthodontic eruption of impacted upper incisor using removable orthodontics. - (A) Intra oral view showing impacted 11 and 21, (B) Surgical exposure of impacted teeth, (C) Brackets bonded to the teeth and traction chain attached to the brackets, (D) Removable appliance fabricated for use in the case

the impacted teeth were surgically exposed (Fig. 19.10 B). Brackets were then bonded to the impacted teeth. Traction chain was tied to the brackets (Fig. 19.10 C). Tip of the traction chain was kept out side the wound. The wound was then sutured. After the wound has healed using the traction chain orthodontic force was applied using removable appliance (Fig. 19.10 D) to guide the tooth into position.

**Orthodontic eruption of impacted upper incisor using fixed orthodontics (Figs 19.11A to D):**

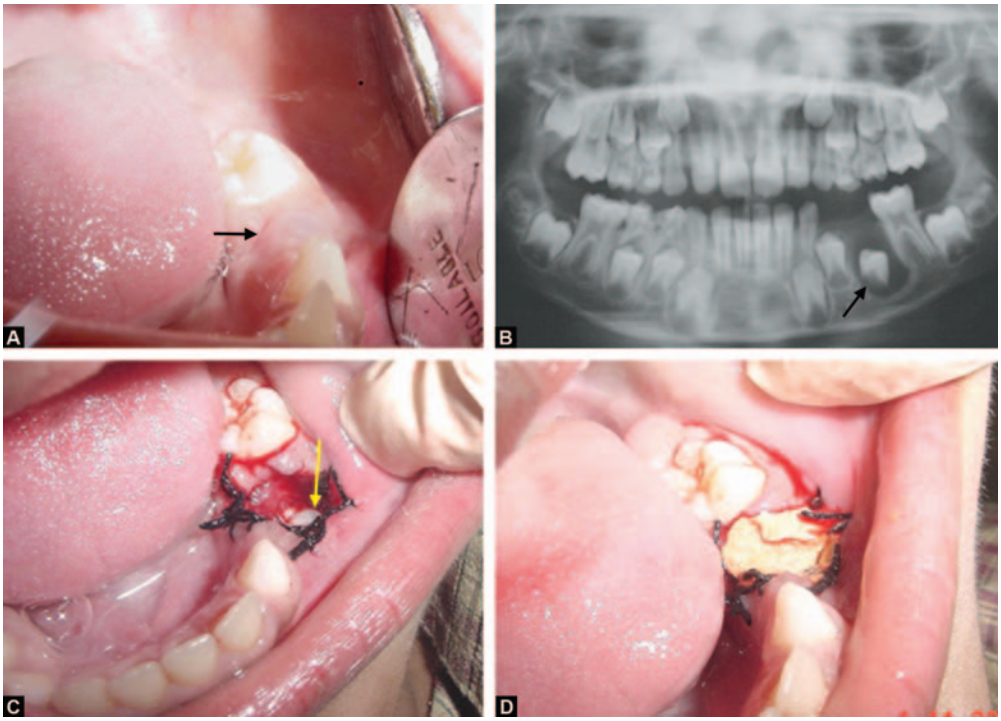
**Complications of orthodontic treatment:** Orthodontic treatment is not without risks. This includes root resorption, decalcification, periodontal problems, canine ankylosis and failure to complete treatment.

**Management of impacted canines / premolars with associated eruption cyst:** Impacted canines or premolars may be associated with dentigerous cyst or eruption cyst in children. The conventional method of management is enucleation of the cyst along with the removal of associated teeth. However, in cases where the cyst is small or if the impacted tooth associated with the cyst is in a favorable position to erupt, marsupialization can be tried to permit the eruption of the tooth into a functional position. This is especially applicable in case of growing children where the root formation is incomplete and bone formation is very rapid. Figures 19.12 A to D illustrates the technique in case of an impacted premolar associated with an eruption cyst in a seven-year-old child.

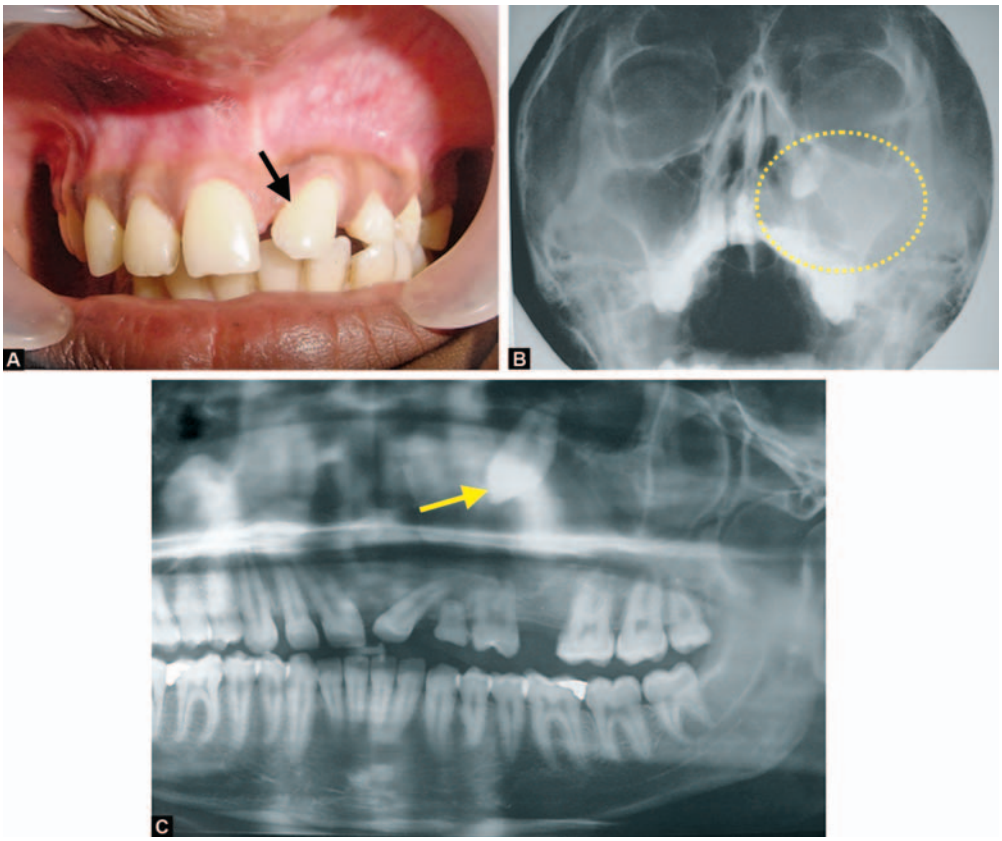



**Figs 19.11 A to D:** Orthodontic eruption of impacted upper incisor using fixed orthodontics. (A) Periapical X-ray showing impacted right upper central incisor, (B) Impacted right upper central incisor 2 months after surgical orthodontic eruption, (C) Orthodontic eruption completed, (D) Appliance removed after completion of treatment

If the impacted canine is associated with a large cyst and the patient's age is above the growth period it may not be possible to marsupialize the cyst so as to permit the eruption of the canine. The following figure (Figs 19.13 A to C) illustrates this point. A patient aged 20 years reported with unerupted left upper canine and displaced lateral incisor (Fig. 19.13 A, black arrow). PNS radiograph showed opacity of left maxillary antrum with impacted canine tooth suggestive of a dentigerous cyst (Fig. 19.13 B, yellow circle). OPG showed impacted 23 placed very much superiorly (Fig. 19.13 C, yellow arrow). The cyst was enucleated under general anesthesia along with the removal of impacted canine.




**Figs 19.12 A to D:** Marsupialization of an eruption cyst associated with an impacted lower premolar tooth. (A) Bulge seen in the area of eruption cyst associated with impacted 35 (black arrow), (B) OPG showing eruption cyst in relation to 35 (black arrow), (C) Marsupialization completed. Note the erupting 35 (yellow arrow), (D) Cavity covered with ZOE paste for a week to prevent entry of food. The pack will be removed a week later with instruction to keep the area clean to permit the eruption of impacted 35




**Figs 19.13 A to C:** Management of maxillary impacted canine with dentigerous cyst (A) Intraoral view of the patient showing unerupted left upper canine and displaced lateral incisor (black arrow), (B) PNS radiograph showing opacity of left maxillary antrum with impacted canine (yellow circle), (C) OPG showing impacted canine placed superiorly in the maxilla

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CHAPTER

# 20 Orthodontic Eruption of Impacted Canine

An impacted canine should be given an opportunity to erupt into the oral cavity and serve its role as cornerstone of dental arch. Hence, the possibility of orthodontic repositioning of impacted canine should be explored before undertaking surgical removal of such tooth.

If the decision of the clinician is to undertake an orthodontic traction of canine after surgical exposure the following points have to be considered before attempting it.

Factors to be considered before attempting surgical orthodontic management of impacted canine are:

1. Favorably impacted canine.
2. Good patient cooperation for the long orthodontic and surgical approach.
3. No associated medical problems.
4. Good interdisciplinary support.

## Determining the Favorability of an Impacted Canine for Orthodontic Treatment

Step 1 Assess whether the impaction is unilateral or bilateral.

Step 2 Clinically palpate for the buccal or the palatal bulge. If there is no bulge it might be in a mid alveolar position.

Step 3 Proper radiographs to confirm the bucco-lingual position and mesiodistal angulation should be made. Radiographic localization is described in Chapter 2. Intraoral periapical radiograph (IOPA) and occlusal radiograph are invaluable aids in deciding the exact position of the impacted canine.

Step 4 Locate the root apex of the impacted canine using radiograph (IOPA) and determine the root apex if the canine would have been normally erupted. Assess the difference in root apex location, the more it is deviated from the ideal apex mesially or distally the more difficult it will be to position. If the apex of the impacted tooth is close to the ideal apical position of the canine, it will be easier to position orthodontically. An assessment regarding the horizontal position also should be considered. Also if the incisal tip is displaced mesially more than the long axis of the lateral incisor it is again difficult to position.

**Canines favorable for orthodontic eruption**

- Labially positioned canines.
- Root apex close to the normal apex.
- Incisal tip not displaced too much.
- Good patient cooperation.

Recently three-dimensional CT scans (Ericson S et al, 1988)[1] have been used to precisely locate the impacted canine. They described the use of high-resolution computed tomography (CT) in the diagnosis of both the location and extent of root resorption of permanent incisors due to ectopic eruption of the maxillary canine. The CT image proved to be superior and more information was obtained than when conventional radiographic methods, including polytomography were used. Although CT is an expensive method, it is not time-consuming or complicated. (Refer Chapter 2 for more details regarding use of CT scan).

Utilizing all the above diagnostic criteria the clinician should develop a mental picture about the possible placement of canine three dimensionally within the bone (almost similar to a 3D CT reconstruction image).

Bilateral, palatally placed and unfavorably angulated canines are usually difficult to position orthodontically but not impossible. Cost effort benefit analysis should be done before orthodontically attempting to position these teeth.

## Good Patient Cooperation

Good patient cooperation (Becker A, 1998)[2] is the key to success in surgical orthodontic positioning of impacted canine. The treatment time can vary depending on the placement and angulation of the impacted tooth. At times there can be bond failure during traction which may need further surgical opening and reattachment. The extra time required should be explained to the patient.

## Associated Medical Problems

This aspect should be assessed as with any surgical case and necessary precautions should be taken to avoid complications. A risk benefit analysis should be made before attempting the surgical orthodontic positioning. If it is difficult to position the canine considering the medical condition, an alternative approach like surgical removal and replacement with prosthesis or leaving in its place may be considered.

Bilateral, palatally placed and unfavorably angulated canines are usually difficult to position orthodontically

## Good Interdisciplinary Support

The need for surgical opening with minimal trauma and at the same time with maximum visibility and accessibility for bonding will need the service of an oral surgeon. Efficient orthodontic bonding, traction with directional control and precise aesthetic positioning may need the help of an orthodontist. Radiographic localization needs the support of a radiologist. Final gingival aesthetics may be enhanced by a cosmetic periodontist. Hence, all the concerned specialist should work in unison for the successful orthodontic management of an impacted canine.

## Orthodontic Treatment Planning

a. *Evaluate the space requirement for canine*: This can be done by utilizing the mesiodistal width of the contralateral canine. Radiographs usually made of paralleling technique may be used in some cases especially for non rotated normally inclined canines.
b. *Measures to gain additional space*: Retained deciduous canines if present, might have maintained some space. Calculate any space that is present or possible means to gain it. Remember to create some extra space because there is every possibility to lose some space during the repositioning process.

   Also determine whether additional extractions of premolars are required for correction of proclination along with impacted teeth, which should be based on facial aesthetics and occlusion status.

**Orthodontic treatment planning**
- Space requirement
- Space gaining measures
- Anchorage reinforcement
- Planning for correction of associated orthodontic problems.

c. *Anchorage planning/reinforcement*: Good anchorage source is very essential for successful positioning of canines (Becker A, 1998).[2] The more unfavorable the tooth is, more the anchorage is needed. Unwanted movements of adjacent teeth should be expected and necessary steps to reinforce anchorage are essential. In case of bilateral impacted canines the anchorage requirement is more. A transpalatal arch or Nance palatal button may be considered to reinforce the molar anchorage. A molar distalization appliance could be considered to distalize the molar to create additional space in a non extraction case (Fig. 20.1).
d. *Planning for correction of associated orthodontic problems*: If the patient has associated problems like proclination or crowding along with impacted tooth, the question of which one to be carried out first will put the clinician in a dilemma. Waiting to complete one and then go for the other problems will unnecessarily increase the total treatment time. Here the clinician's wisdom should be applied to carryout the entire process in a clinically justifiable short period.

**Fig. 20.1:** Creating space for canine positioning using intraoral molar distalization appliance

## Orthodontic Treatment Strategy

The aims of orthodontic treatment for an impacted tooth are:

1. Provide a secure attachment on the crown to apply adequate force for its eruption.
2. Allow the tooth to erupt through the keratinized mucosa.[2]
3. Precisely position the tooth in the arch without compromising periodontal aesthetics.

The opening of space in the arch may initiate the movement of an unimpeded impacted tooth.[2] By the time the space is adequate and the arrangement for surgery have been made, a new periapical radiograph may show a more positive change and often the clinician feels the tooth may erupt spontaneously.[2] If it erupts by its own it is well and good, but if the eruption process is slow it is better to intervene surgically and initiate orthodontic traction.

The placement of orthodontic appliance carries some amount of risk to the tooth in terms of caries and periodontal problems. Every clinician should aim and attempt to finish the treatment in the shortest time frame to avoid this risk factor. When orthodontic treatment has created enough space to accommodate the impacted tooth, surgical procedures to remove any associated pathology as well as to initiate traction are to be undertaken simultaneously. If the pathology associated is a cyst or a space occupying lesion it may have to be treated initially and sufficient time should be given for healing and new bone formation. Here orthodontic strap up could be delayed to reduce the risk of periodontal damage.

## Attachments

The placement of orthodontic attachment on the correct buccal side of the tooth crown is another important aspect in the interdisciplinary management of the impacted canine. Bonding an attachment to the crown could be performed either during the surgical opening (Becker et al, 1975)[3] or can be performed several days or weeks later, i.e. an open method. Both have its advantages and disadvantages as detailed below. In a closed eruption or a full flap closure method, the attachment should be bonded on the same appointment.

## Advantage of Bonding on the Same Appointment

a. A closed method of eruption which is superior to the open method could be carried out.
b. Bond strength is found to be superior as the newly exposed tooth is covered only with the enamel cuticle which is only one micron thick and could be easily removed by the application of the orthophosphoric acid used for etching.(Becker et al 1996).[4]
c. Healing could be achieved by primary intention.

***One of the main disadvantages of bonding at the same appointment is the problem of moisture control during bonding.***

## Advantages of Bonding in a Second Visit

a. Dry field could be easily achieved, which is very critical for bond strength.
b. Appointment can be scheduled as per the doctor's will and the long process of surgical opening and bonding at same visit could be avoided.

The **disadvantages** of bonding in a second visit are:

a. After few days of exposure of the tooth to oral environment there is plaque and food debris accumulation on the crown. This needs to be removed prior to bonding by polishing with rubber cup and pumice paste. If the opening is not wide enough adequate cleansing is difficult.
b. The edematous tissue may bleed which can result in poor bond strength.
c. The surgeon needs to create a wide opening to prevent the spontaneous closure and to facilitate polishing, which can affect the future periodontal health and aesthetics.

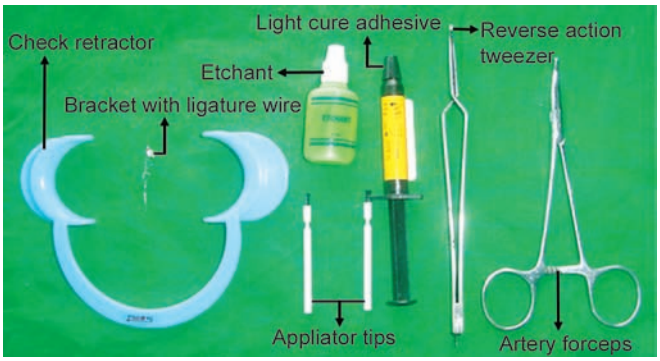



**Fig. 20.2A:** Armamentarium used for orthodontic bonding

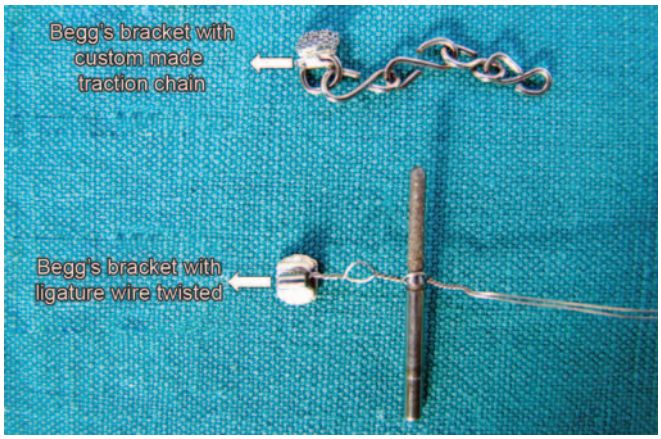



**Fig. 20.2B:** Begg's bracket with custom made traction chain and ligature wire twisted

## Armamentarium for Successful Bonding (Figs 20.2A and B)

1. The selected attachment with ligature tie.
2. Reverse action tweezer.
3. Orthodontic adhesive system comprising of phosphoric acid gel, bonding agent (if required as per the manufacture's specification), and applicator tips.
4. Polishing cup and pumice paste.
5. Ligature director.
6. Artery forceps.
7. Elastic thread or chain depending on the mode of force application.

## Procedure of Bonding (in the same visit approach)

After the flap is raised, the impacted tooth which is now visible in the oral cavity should be carefully inspected for the position, angulation and rotation. Even though it was analyzed by radiographic method a live direct visualization can only give the accurate picture of the tooth. The point of bonding and direction of force application should be assessed. As far as possible the attachment should be bonded on the mid buccal position and light continuous force should be applied along the long axis of the crown. If the mid buccal position is not accessible an alternate location could be selected. The treatment time will be increased in the latter case as the attachment needs repositioning for dental rotation and axial inclination correction. In case of palatally impacted teeth, bonding can be done on the palatal aspect initially and the force is redirected appropriately for its eruption through the keratinized area.

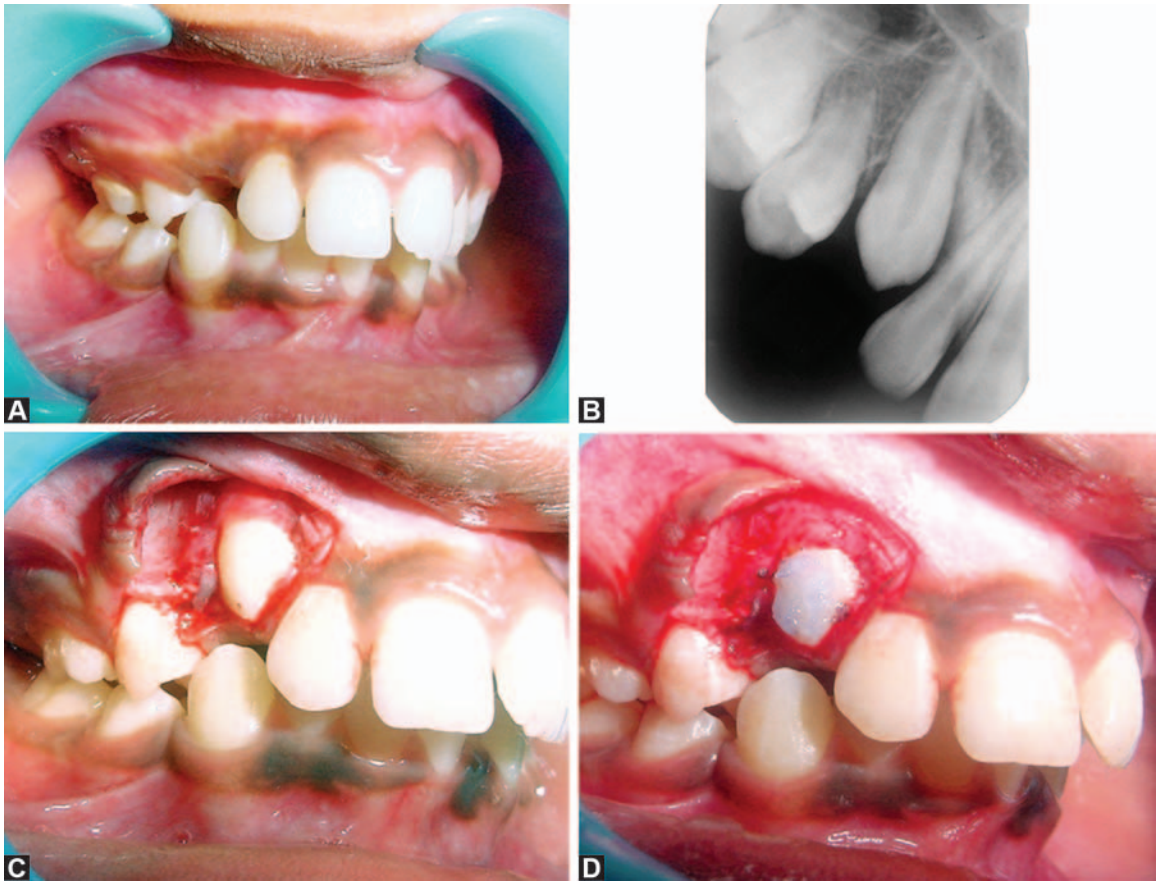
Detailed description regarding surgical exposure is given in Chapter 4.

Once the location of the attachment and type of attachment is finalized bonding can be started. (Figs 20.3 A to H).

## Hemostasis

A dry field is of utmost importance for successful bonding. After raising the flap it should be retracted sufficiently. Bleeding can be arrested by means of a pressure pack. Further oozing from the bone margins may necessitate additional pack for some more time or use of bone wax.[2] Use of electrocautery will control soft tissue bleeding. Adequate suction and proper illumination is very essential as with any case of surgery. A fine suction is highly useful during the process of bonding to maintain a dry field.

If the bonding is done immediately after raising surgical flap polishing with pumice paste is not required. After proper drying with fine suction tip, 37% orthophosphoric acid etching gel should be applied with an applicator tip over the area to be bonded for 30 seconds. Acid solutions should not be used as the area of application cannot be controlled (Kokich, 1993).[5] Care should be taken to prevent acid from contacting the cemento-enamel junction. After 30 seconds the acid is drawn through a fine suction tip until the surface is dried. A syringe loaded with saline can be used to wash out all the residual etchant. After this, rinsing with distilled water using a syringe could be done to prevent the salts of saline from accumulating on the etched surface. Drying is usually done with the suction alone until the characteristic 'chalky white' appearance is achieved.[2] If



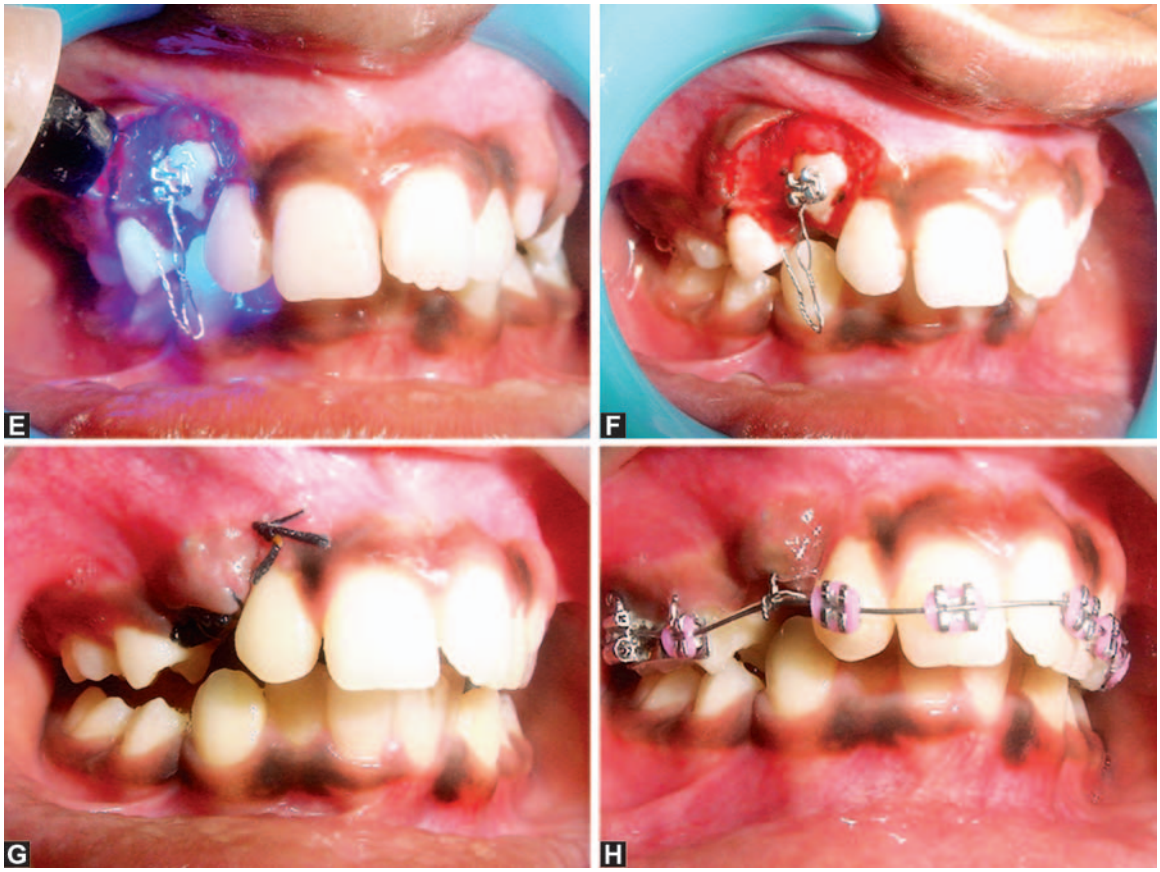

**Figs 20.3 A to D:** Steps in bonding: (A) Preoperative intraoral photograph showing unerupted right upper canine, (B) Periapical X-ray showing the crown position and angulation of the impacted canine three months after removal of first premolar, (C) Raising the flap to expose the impacted tooth, (D) Etching gel application after isolation and hemostasis

required drying with gentle air from the three way syringe could be done carefully.

Now the tooth is ready for bonding. Light activated or chemically cured adhesives may be used. A thin layer of primer is coated over the etched surface. A reverse action tweezer is used to hold the bracket or eyelet used for bonding. The ligature wire should be passed through the bracket and the remaining wire is twisted to form an extension from the attachment base. The wire should swing from the bracket.

A layer of primer is applied over the base of the bracket and adequate amount of composite is applied over the base which is carried to the tooth surface and left in place for some time. Continuous pressure application until it sets is unnecessary. It is better to leave the bracket in place after correct positioning and an initial pressure application to squeeze out the excess adhesive. Avoiding disturbance during the initial crystallization of bond is critical to the bond strength. Holding with an instrument like tweezer or artery forceps should be avoided. Instead a ligature director or the reverse end of a reverse action tweezer could be used to apply some pressure and its removal will not produce any jolting of the attachment.[2]

The bracket should be left in place for a few minutes for the complete bonding and isolation should be maintained during this period. After this it could be tested for strength and suturing could be done. The free end of the extension from the bracket is placed in such a way that it should exert force along the long axis of the tooth; usually the wire is directed through the alveolar crest. In certain cases, especially in palatal canines if the tooth is angulated in such a way that the force application along long axis is not possible or detrimental to the root of other teeth, the direction should be initially altered.[2] A pin hole could be placed in the appropriate location of the flap




**Figs 20.3 E to H:** Steps in bonding contd: (E) Curing light applied after placement of bracket with ligature tie for traction, (F) Bonded attachment after curing, (G) Postoperative view after 1 week, (H) After placement of arch wire

and wire is extended into the oral cavity through this hole which is attached to appropriate spring for traction.

**Essentials of orthodontic bonding**

- Adequate exposure and hemorrhage control
- Isolation with cheek retractor, tongue guard, cotton and suction.
- Etching with phosphoric acid gel
- Drying
- Application of primer and curing
- Placement of attachment with adhesive and curing.

It is better to apply force in the same visit itself, as subsequent manipulation later after a few days will be painful. The reliability of the bonding procedure in the above described pattern is found to be high (Becker et al, 1996).[4] This depends on the creation of a moisture free area developed for bonding, avoidance of disturbance in the initial crystallization process and adaptability of the bonding surface to the tooth. Conventional brackets are designed to bond on the mid buccal surface. If it is used on any other surface the adaptability is poor. Hence in other areas a custom made attachment should be developed which can perfectly adapt to the surface. Using an eyelet welded on a mesh base is a good option.

## Various Attachments

1. **Bonded attachments:** This include: (a) bondable traction chain, (b) conventional bondable bracket and (c) bondable lingual button
   a. *Traction chain:* Orthodontic traction chains with bondable base are available. Bonding bases with gold chains were used initially. To the holes of the chain the arch wire can be ligated either by ligature wire or elastic thread. As the tooth moves down the chain is activated by re-ligation. This type of

an attachment could be made in an average practice by using a bondable Begg's bracket or a Tip edge bracket with small circular rings made of 0.6 mm stainless steel wire which resembles like a chain (Fig. 20.2B).

b. *Conventional bondable bracket:* Conventional bondable bracket is the most widely used attachment mode for traction. It is best suited if the midbuccal surface is accessible, since most preadjusted brackets are designed for this position. Contoured Begg's bracket could be used on the buccal side. Contour can be altered to some extent by manipulation with How's plier. If the closed method is to be used then the ligature wire should be used to tie to the bracket or passed through the bracket for attachment to the arch wire. Usually the ligature wire should be passed through the slot in a Begg's bracket or tied around the wings of edgewise bracket. Then this ligature wire is twisted with an artery forceps to form a twisted wire. The connection between the bracket and the twisted wire should be free enough to permit free swinging of the bracket i.e. it should not be too rigid. This will avoid undue pressure on the bracket during bonding. While making the twisted wire small circles could be incorporated by placing a round wire or a micromotor bur in between to resemble a traction chain (Fig. 20.2B). This will help to tie elastics for activation.

c. *Bondable lingual buttons (Fig. 20.4)* also could be used for attachment to the tooth especially in cases where the canines are left open. To this, later elastic chains or threads could be tied for activation.

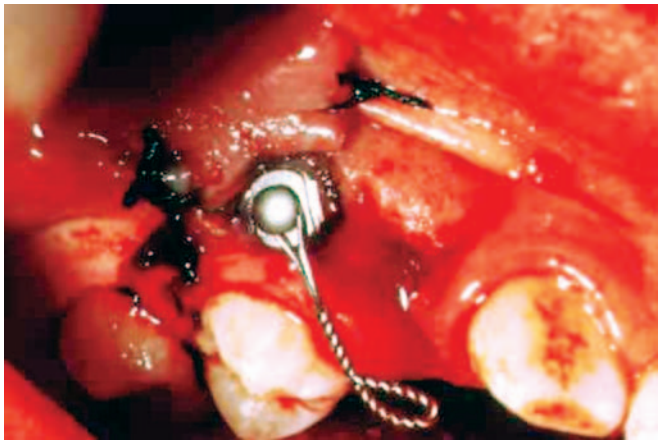


**Fig. 20.4:** Bonded button in place after surgical exposure with traction applied

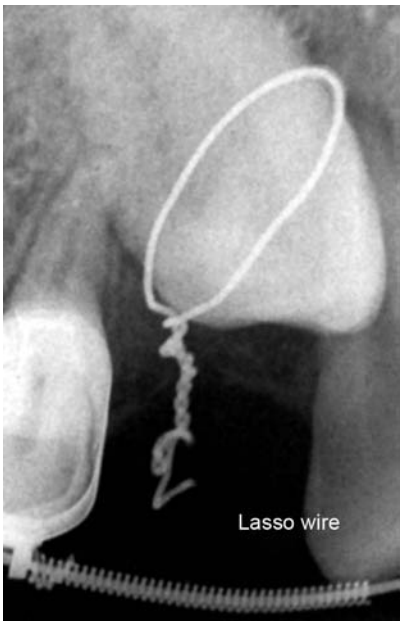



**Fig. 20.5:** Lasso wire wrapped around the cervical aspect of canine for traction

Twisted ligature wire tie could be made for bonding in closed eruption cases also.

**2. Lasso Wire**

In the years prior to 1960s a lasso wire (Fig. 20.5) twisted around the neck of the canine had been employed widely. The wire is engaged at the cemento enamel junction and this will result in irritation of the gingiva and prevent reattachment of the healing tissues in this vital area. Studies have shown that this method can result in external resorption and ankylosis (Shapira and Kuftinec, 1981)[6] of the impacted canine. Since many other good alternatives are available this method is seldom followed now.

**3. Stainless Steel Crowns**

Sometimes a stainless steel crown of appropriate size could be cemented to the crown especially to molars and premolars after surgical exposure. Orthodontic traction could be placed to the soldered attachments. This procedure can avoid bonding at the site of surgical exposure and immediate traction force could be placed.

**Various attachments for canine traction**

1. Bonded attachments
   a. traction chains
   b. brackets
   c. buttons
2. Lasso wire
3. Cemented crowns
4. Threaded pins
5. Orthodontic bands

**Fig. 20.6:** Treaded pin

## 4. Threaded Pins

Threaded pins (Fig. 20.6) that are usually used for retention of amalgam restoration can be threaded to the impacted tooth and traction force can be applied. (Becker and Zilberman, 1978).[7] The obvious disadvantage of this method is that it is a dentally invasive method which requires a restoration later. Also since the long axis of a tooth cannot be exactly determined during exposure, the pin can reach the pulp as the chamber is usually large in an impacted unerupted tooth.

## 5. Orthodontic Bands

Placement of preformed orthodontic bands to the crown is another option. This requires wide clearance of bone for the exact placement of band with out contamination with blood while cementing. With the introduction of acid etch bonding this method has become obsolete.

## 6. Through and Through Hole at the Tip of Canine

This is another approach in which a through and through hole is drilled close to the incisal edge and a ligature is passed through it for applying traction. The disadvantage is that it is dentally invasive and requires a restoration later. This could be tried in canines which are not accessible for bonding or in cases where there is repeated bond failure. Traction force application without fear could be applied at each visit for orthodontic positioning, since many clinicians have the fear of bonding breakage. Later the hole could be closed with composite resin. Once the tooth is accessible for bonding, orthodontic bracket should be bonded.

## Principles of Orthodontic Traction

Orthodontic canine traction is best treated with any of the fixed appliance systems. At the age at which an impacted canine is detected and treated, a full compliment of teeth with the exception of third molar is invariably present. Accordingly a fully multibracketed appliance should be normally placed and the initial process of leveling and alignment with bite correction should be performed. Sufficient space should be opened up for accommodating the impacted canines. Retained deciduous counterpart could be used as a good space maintainer until the surgical exposure. If it is removed early the bone gets hardened and affects the traction process adversely. Preadjusted edgewise appliance provides better three dimensional control of the teeth than a Begg's appliance.

Orthodontic extrusion is one of the tooth movements which require very light and continuous force. 35-60 grams (Proffit WR, 2000)[8] is the ideal force suggested for extrusion. A good guide will be one mm of extrusion per month. Force should be directed along the long axis of the tooth. A tooth with altered axial inclination should have the force directed accordingly to avoid damage to the roots of adjacent teeth. Force should be redirected later after the initial unlocking of the roots.

- Orthodontic extrusion requires very light and continuous force.
- 35-60 grams is the ideal force at the rate of one mm per month.
- Force is directed along the long axis of the tooth.

## Orthodontic Springs

An orthodontic spring could be designed for affecting the traction by the clinician himself. A number of designs are available in the literature. Ballista spring (Jacoby H, 1979)[9] is one example. Usually springs are made of

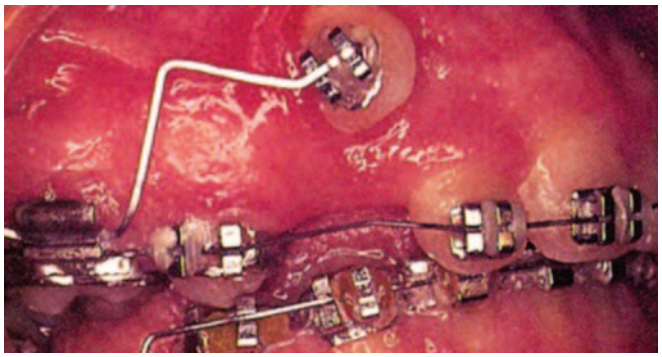
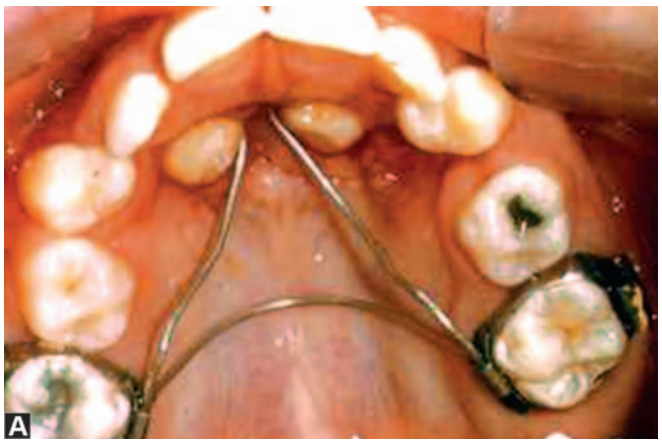
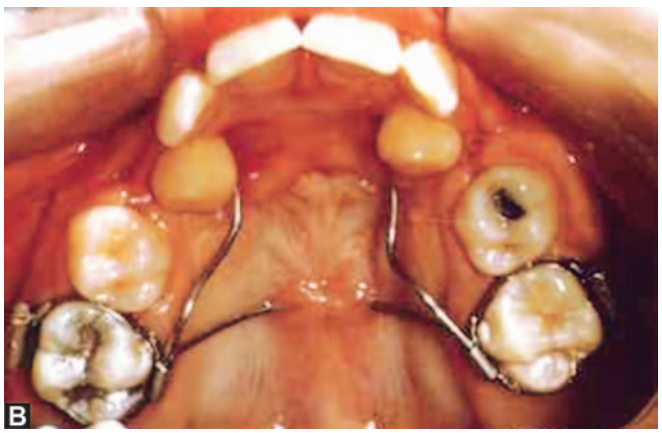


**Fig. 20.7:** Auxiliary wire spring for canine alignment




**Figs 20.8A and B:** Palatal spring for the canine alignment

accessory wire with good flexibility (Fig. 20.7) and are placed in concert with the main arch wire. Care should be taken so that the line of action of the spring should be in the desired direction. (Figs 20.8A and B).

**Orthodontic traction**

- Traction force applied at the same appointment itself is better.

**Traction can be done with:**

- Auxiliary springs made of flexible wire
- Niti closed coil springs
- Elastic threads and chains
- Magnets.

## Elastic Traction

After bonding of the attachment to the tooth, sufficient traction force could be generated by elastic ligation (Fig. 20.9) to the arch wire. Elastic threads are conventionally used to tie the end of the traction chain to the arch wire. Care should be taken to prevent loosening of the elastic after tying. Small segment of elastic chains also could be used as force generating unit. One disadvantage with elastic ligation is the rapid rate of force decay. Force level reduces considerably after two to three weeks (Lu TC et al, 1993)[10] and hence frequent reactivation is necessary.

Elastic threads, chain (Figs 20.10 to 20.12) or module with a flexible arch wire, when deflected with ligation provide good power source. Alternatively nickel titanium closed coil springs or flexible wire with incorporated loops may also be used to deliver force to the impacted canine.

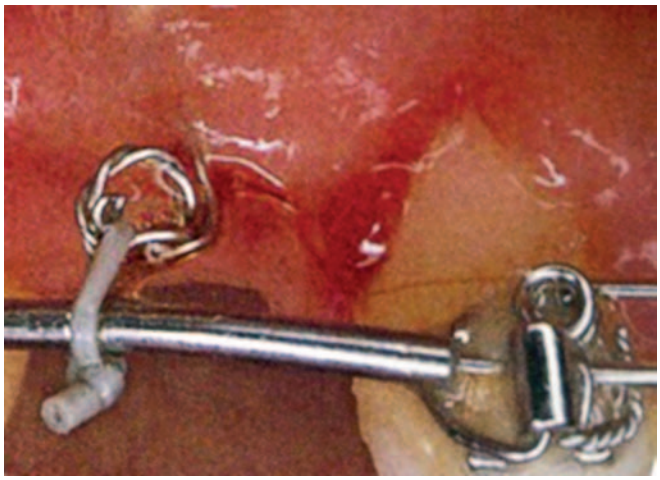


**Fig. 20.9:** Elastic traction in place

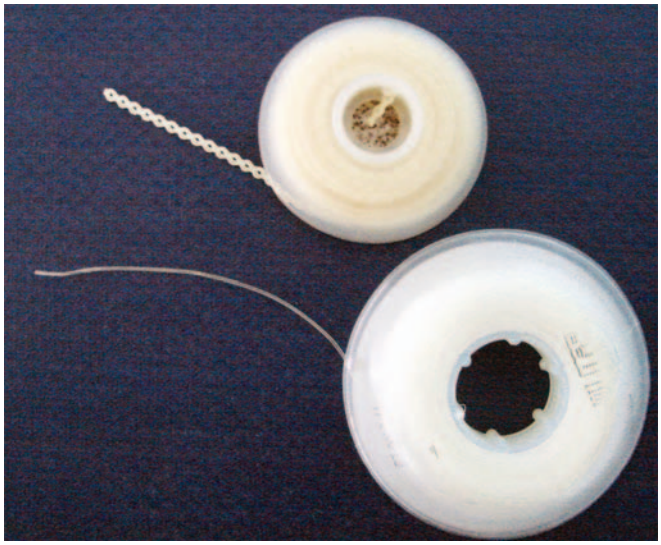


**Fig. 20.10:** Elastic chain and elastic thread

**Fig. 20.11:** Elastic chain applied for labial positioning of canine

## Anchorage

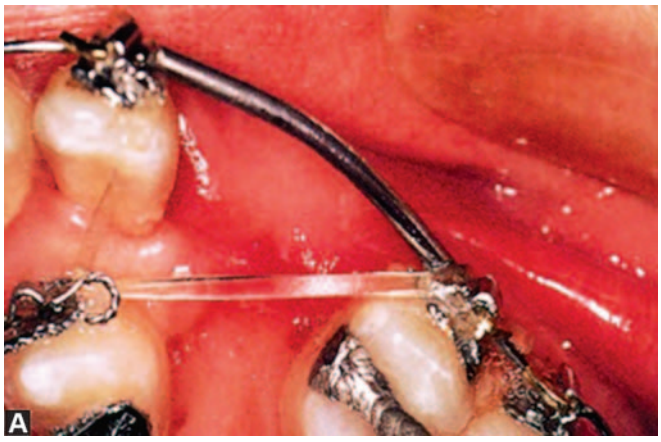
Orthodontic canine traction requires good anchorage and all means to reinforce anchorage like transpalatal arch, lingual arch and Nance palatal arch should be considered. Prior to application of traction force on canine the arch wire should be of thicker gauge to avoid undue tooth movement of the adjacent teeth. (Kokich and Mathews DP, 1993).[5] Usually when canine is extruded down, adjacent laterals and premolars will have an intrusive effect, which could be prevented by thick wire, especially full slot rectangular wires in straight wire technique. Teeth located on both sides of the space for future canine should be tied to the adjacent teeth with closed figure of eight ligature wire to prevent space closing. Open or closed coil spring could be placed accordingly to maintain or gain space between teeth for canine. Smaller gauge auxiliary Niti wire can be placed over the heavier wire to exert lighter force.

## Implants for Canine Traction

Cortically stabilized implants are now gaining popularity among orthodontists for various orthodontic needs. It can be utilized for effecting canine traction, especially a resistant canine with out compromising the anchorage. The use of osseointegrated implants in adult patient will provide absolute anchorage (Roberts et al, 1984).[11]

## Removable Orthodontic Appliance

Although fixed appliance is the appliance of choice for the orthodontic traction at times a removable appliance could be used in selected cases. If a removable appliance



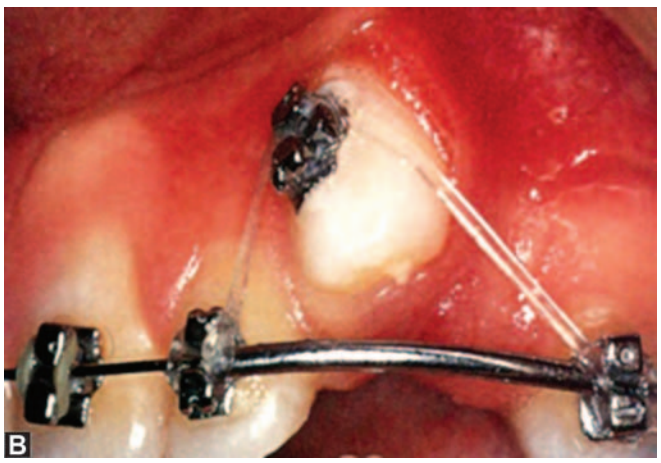




**Fig. 20.12:** Elastic thread applied for canine alignment

is found sufficient, it should have attachment hooks for the placement of elastics and a good number of clasps for retention. Stops should be placed for laterals and premolars to prevent drifting. Traction chains cannot be used with removable appliance. Always an open approach is preferred where the superficially impacted tooth is opened and a bracket with hook is bonded. The hook on the removable plate is positioned in such a way that the line of force is in the desirable direction and there is no occlusal disturbance. Care should be taken by the patient while placing and removing the elastics not to dislodge the attachment bonded to the tooth. The elastic should not impinge on the mucosa. Regular cleansing of the appliance and proper oral hygiene maintenance should be recommended.

## Magnets for Correction of Canine Impaction

The introduction of lanthanide alloys has provided the possibility of applying suitable force for the traction of impacted canines using magnets as described by Sandler et al (1989)[12] and also by Vardimon (1993)[13] (Fig. 20.13). The attracting force between two magnets is inversely proportional to the square of the distance between them. So the magnets should be positioned very close to each other for sufficient force. A grossly displaced tooth may require that the appliance magnet may be repositioned from time to time, in line with the progress of the tooth. The greatest disadvantage of using magnets is its corrosion as reported by Rygh (1993)[14] and Darendelier et al (1994).[15] It can be concluded that the use of magnets offers no better advantage over the conventional traction process.

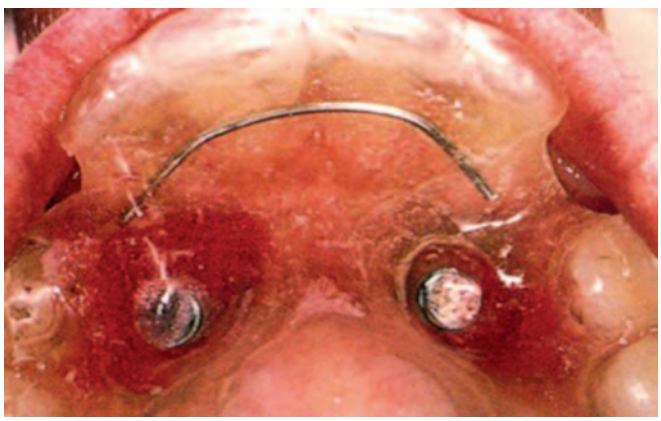


**Fig. 20.13:** Embedded magnet in removable appliance

## Prevention of Canine Impaction

Development of permanent canine begins at 4-5 months after birth. Crown is completed by 6-7 years. Eruption of the upper canine is at 11-13 years and lower canine at 10-12 years. This shows racial and sexual variations. Root formation is completed at 13-15 years for the upper and 12-14 years for the lower. It is the last tooth to erupt in the anterior segment of the arch. Clinically one should be watchful from the dental age of 8 or 9 years for the eruption of permanent canines especially in patients with a family history of small or peg-shaped laterals, congenitally missing laterals and impacted canines. Normally erupting canines should be palpable in the buccal sulcus as a firm bulge at about 12-18 months before eruption. At the age of 10 years if the canine prominence is not felt or if there is any asymmetry while palpating left and right side cuspid regions labially, appropriate radiograph should be taken to rule out the possibility of impaction.

**Prevention of canine impaction**

- Prevention is better than cure.
- Careful watching of the developing laterals and canines.
- Necessary radiographs especially in patients with family history of impacted canines, missing laterals, or with abnormal shape and size of lateral incisors.

Ericson and Kurol (1988)[1] in a landmark study had reported that extraction of primary cuspid can prevent palatal impaction of permanent canine provided normal space condition is present and there is no radiographic evidence of incisor root resorption. In cases of crowding, extraction of primary canine alone may not resolve the problem; rather additional arch expansion or other means of gaining space is required. A marked difference in the eruption of canine between the two sides, maxillary lateral incisor which is late in eruption and is unusually proclined are a few warning signs of maxillary canine impaction.

## Conclusion

This chapter has focused on the sequential management of impacted maxillary canine by surgical orthodontic approach. The principle of management of other

impacted teeth are also essentially the same with minor differences. A wise clinician should consider many factors before taking up a decision regarding the management of an impacted tooth. Patient perception should get appropriate consideration in the treatment plan. A team approach is essential in the ideal surgical orthodontic management of an impacted canine tooth.

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CHAPTER

# 21 Surgical Removal of Palatally Impacted Maxillary Canine

Impacted maxillary canines which are in an unfavorable position to bring into normal occlusion should be removed earlier rather than later as the difficulty for removal increases with age and also as the damage done by the tooth to the adjacent structures can be minimized.

## Indications for Removal

1. Change in position of adjacent teeth due to the impacted tooth in unfavorable position
2. Resorption of roots of adjacent teeth.
3. Associated pathology, like formation of a dentigerous cyst.
4. Teeth in the alveolar cleft in cleft palate patients, if the tooth cannot be aligned orthodontically after bone grafting.
5. Impacted tooth in edentulous patient.
6. Neurological symptoms like pain.
7. Prior to orthodontic treatment if it can hinder the movement of other teeth.
8. Lack of motivation of the patient or lack of facilities for orthodontic alignment.

In cases where the primary canine is left following extraction of the permanent successor it is not possible to predict how long the primary canine will remain intact. Little research has been carried out on this aspect. In the event of the primary canine becoming unsightly or being lost it could be replaced with fixed or removable prosthesis.

## Factors Complicating the Removal of Impacted Maxillary Canine

Due to the close proximity of impacted maxillary canine to the adjacent central incisor, lateral incisor and premolar there is a danger of injury to these teeth. Injury to the above teeth can occur either during bone removal, or during sectioning or during elevation of the impacted cuspid.

In the majority of cases the impacted canine is separated from the maxillary sinus and nasal cavity by a thin plate of bone (Fig. 21.1). Rarely this bone may be

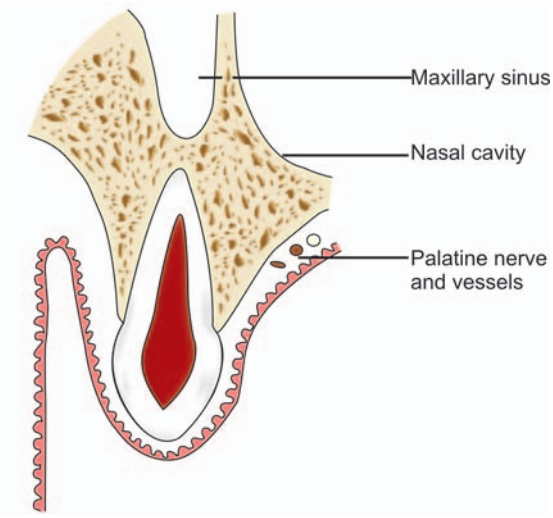



**Fig. 21.1:** Surgical anatomy of maxillary canine area. Note the close relationship of the root of the impacted canine to the floor of the maxillary sinus and nose

absent. Hence, in such cases there is a possibility of pushing the impacted tooth or the sectioned root into the maxillary sinus. It is also not uncommon to have the possibility of creating an oro antral communication and the resultant postoperative nasal bleeding even if the tooth has been removed successfully. Postoperative infection of the maxillary sinus can be avoided in such cases by following strict asepsis.

Most impacted maxillary canine roots have a pronounced curvature at the apical third of the root. Very often this is not visible in the radiographs. In cases where resistance is encountered in the removal of a tooth or a sectioned root which is otherwise adequately mobilized, the possibility of extreme root curvature should be thought of. Removal of a fractured apical third of the root is a difficult procedure.

As the age advances, the bone becomes more sclerosed and its removal especially that of the palatal bone becomes more difficult. This in turn prolongs the operative time as well as increases the possibility of development of complications both intra operatively and post operatively. Hence it is always ideal to remove impacted canine at a younger age when the bone is more elastic. Asymptomatic impacted canine in older individuals may be left as such with periodic review.

## Choice of Anesthesia

The surgery can be done under local or general anesthesia or under local anesthesia with intravenous sedation.

Like in any other surgical procedure, a proper history has to be taken. Clinical and radiographic examination is then done and the position of the tooth localized.

## Procedure

The patient should be in a reclining position with the head bend back, which helps in direct vision of the palate.

## Approaches

a. The usual approach is by using a mucoperiosteal flap reflected following an incision along the gingival sulci on the palatal side. The incision starts from the first premolar on the same side and extends up to the lateral incisor or up to the pre molar of the opposite side depending upon the position of the impacted tooth (Figs 21.2 A to F).

   If the cuspids are impacted bilaterally and are close to the midline, the incision should always extend from the first premolar on one side to the first premolar of the opposite side (Figs 21.3A to 21.4K). This is important because if a double flap is elevated to avoid injury to nasopalatine neurovascular bundle, the tissues left in the midline is easily traumatized and sloughs eventually. By elevating a single palatal flap sloughing is avoided and at the same time there is adequate visualization. The only problem encountered is brisk hemorrhage from the nasopalatine vessels which can be controlled by pressure pack or by electrocautery.

b. Instead of placing the incision in the gingival sulcus, an incision can be made above the attached gingiva, leaving at last 0.5 cm of it. This incision is not commonly employed.

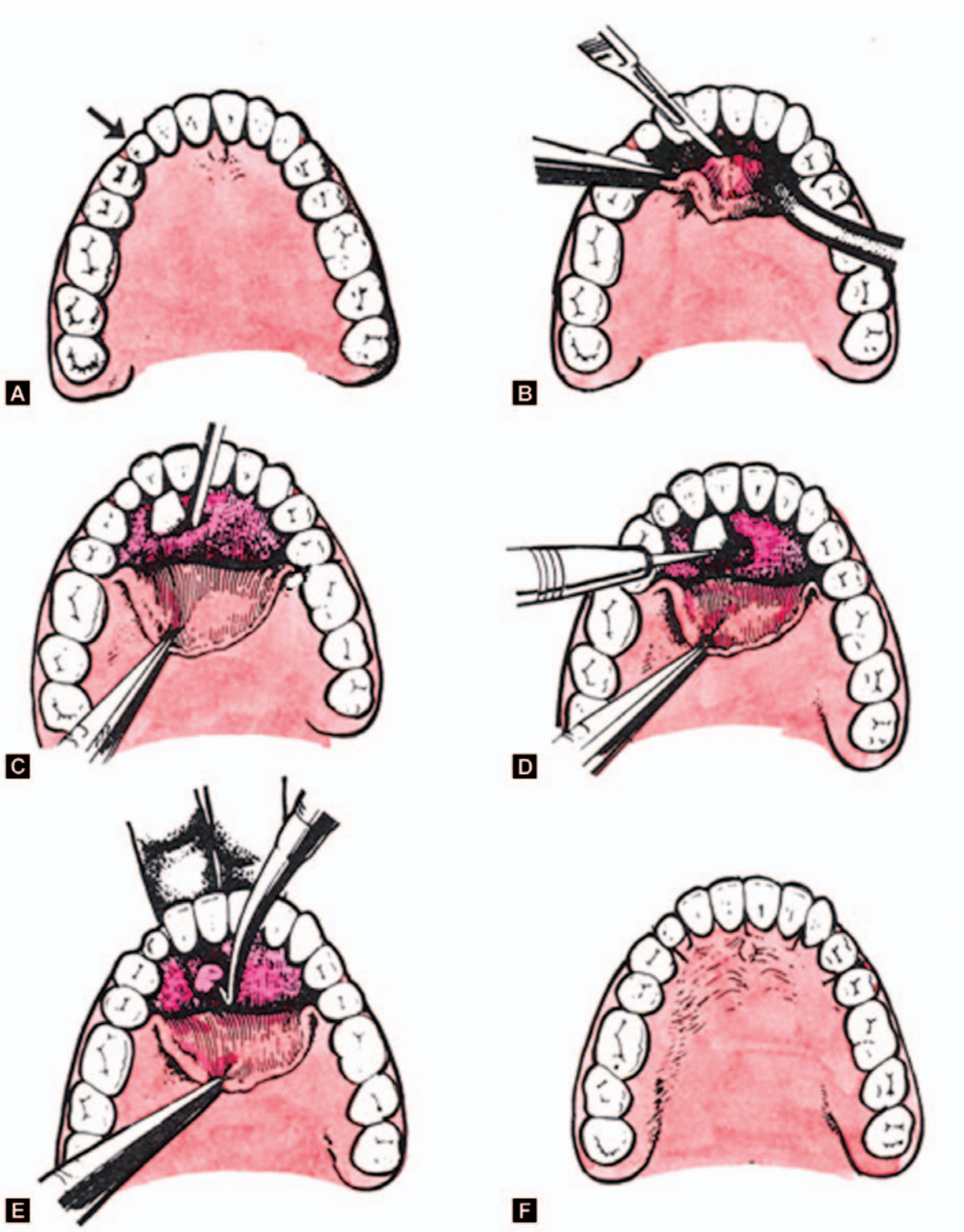
c. If the tooth is only on one side, instead of carrying the incision over to the opposite side, a vertical incision can be given in the mid palate (Figs 21.5A to 21.6N).

However in such cases suturing after the procedure may be difficult and the chance of traumatisation of the flap is more in the last two methods, especially for the beginners.

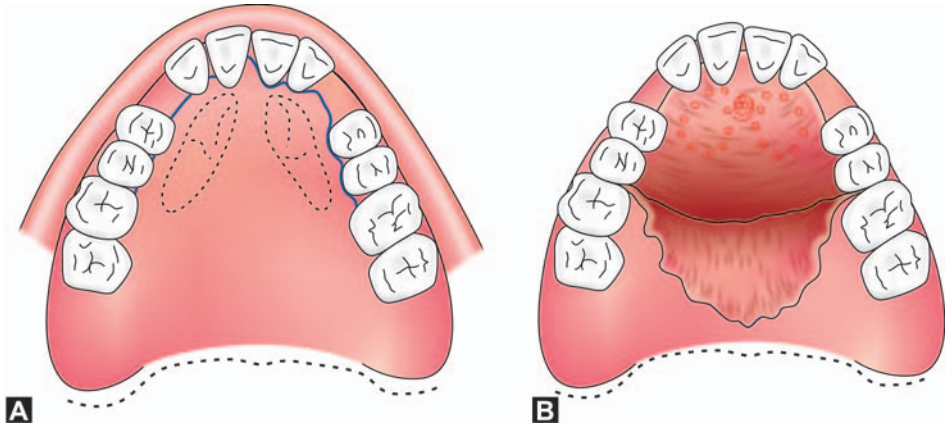
The mucoperiosteal flap is reflected to expose the palatal bone and the tooth. The nasopalatine vessels and nerve can be divided if needed for sufficient exposure and firm pressure is usually sufficient to stop the bleeding.

The crown of the tooth may sometimes be visible, or a bulge may be felt. Bone is removed around the area with a chisel or bur or using both, taking care not to damage the roots of the adjacent teeth. Once sufficient bone is removed, a groove is made on the mesial side. An elevator is introduced in the groove and the tooth is luxated. Once the crown moves out, it can be grasped with an upper anterior or premolar forceps and removed. A certain amount of torsion may be needed to disengage the apex of the root which is often curved.

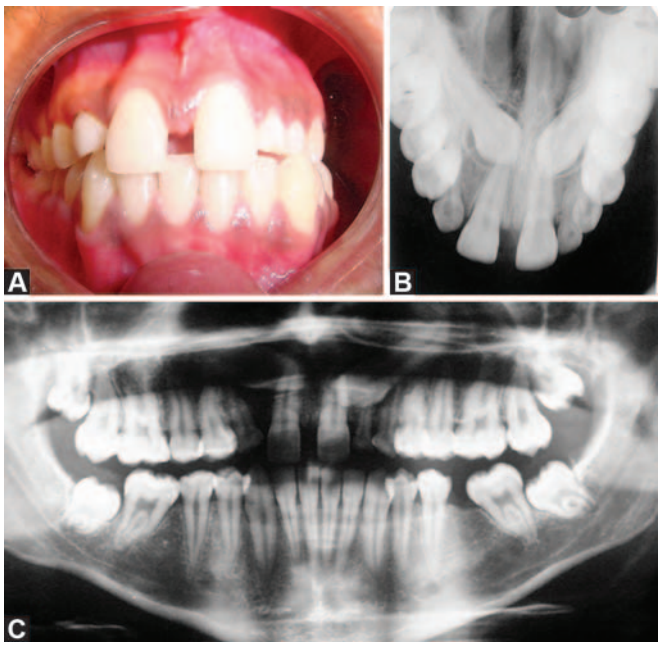
If the tooth is resistant to elevation, more bone is removed to enlarge the opening. If there is still obstruction to the movement of the crown, the tooth may need to be sectioned (odontotomy). This is accomplished with a straight fissure bur. The crown portion is first removed. Some amount of the remaining root should be visible and if not, bone is removed to expose the root. A bur hole is placed in the root close to the bony margin and the root is elevated into the space created by removal of the crown




**Figs 21.2 A to F:** Schematic diagram showing steps in the surgical removal of palatally positioned impacted maxillary canine (A) Incision, (B) Reflection of the flap, (C) Removal of bone to expose the crown, (D) Sectioning of the crown, (E) Removal of the root, (F) Suturing of the flap




**Figs 21.3 A and B:** Palatal flap elevation for exposure of bilaterally impacted palatally positioned canine. (A) Flap outlined from second premolar on one side to the second premolar of the opposite side, (B) After reflection of the mucoperiosteal flap multiple drill holes are placed in the bone overlying the crown. These drill holes are then connected together to remove the bone thereby exposing the crown




**Figs 21.4 A to C:** Steps in the surgical removal of palatally impacted canines (A) Intraoral view of the patient, (B) Occlusal X-ray of maxilla showing bilaterally impacted canines, (C) OPG of the patient showing bilaterally impacted canines

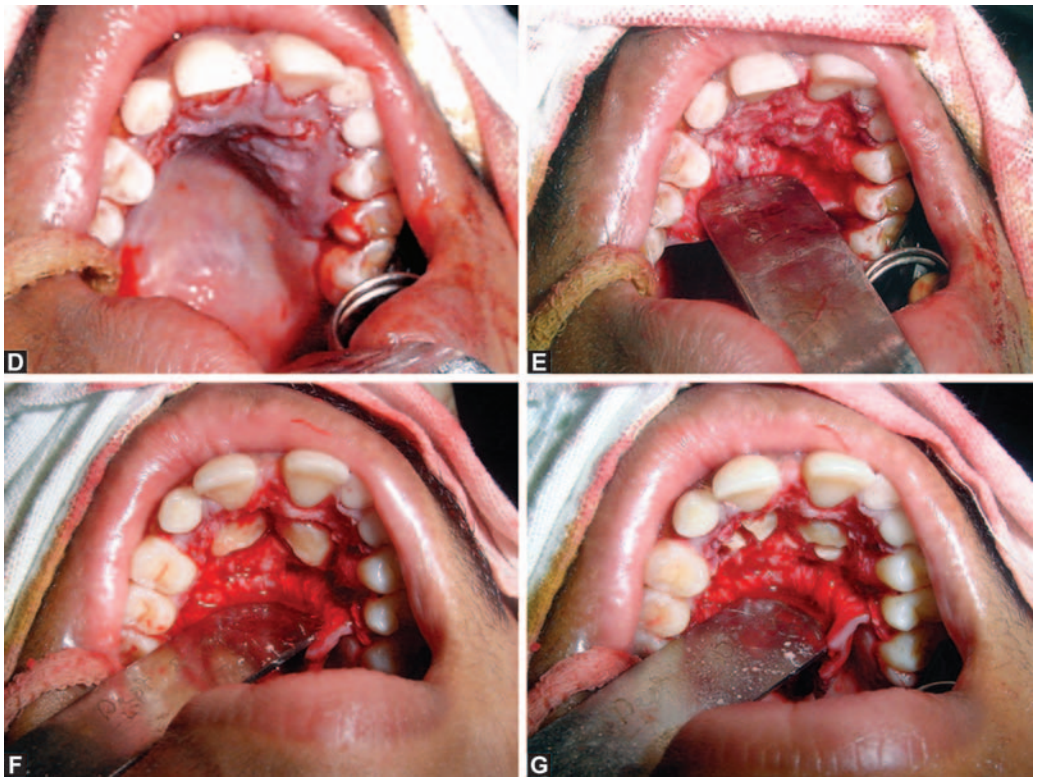
portion.

Thorough debridement is done taking care to remove the tooth follicle by curettage and to remove the bone debris with saline irrigation. The flap is replaced and sutured into position. Once the mucoperiosteum is sutured back, it is held in contact with the palatal bone by using a gauze pack for an hour or two. The gauze pack is held in position by the pressure from the dorsum of the tongue. Healing follows without any complications.

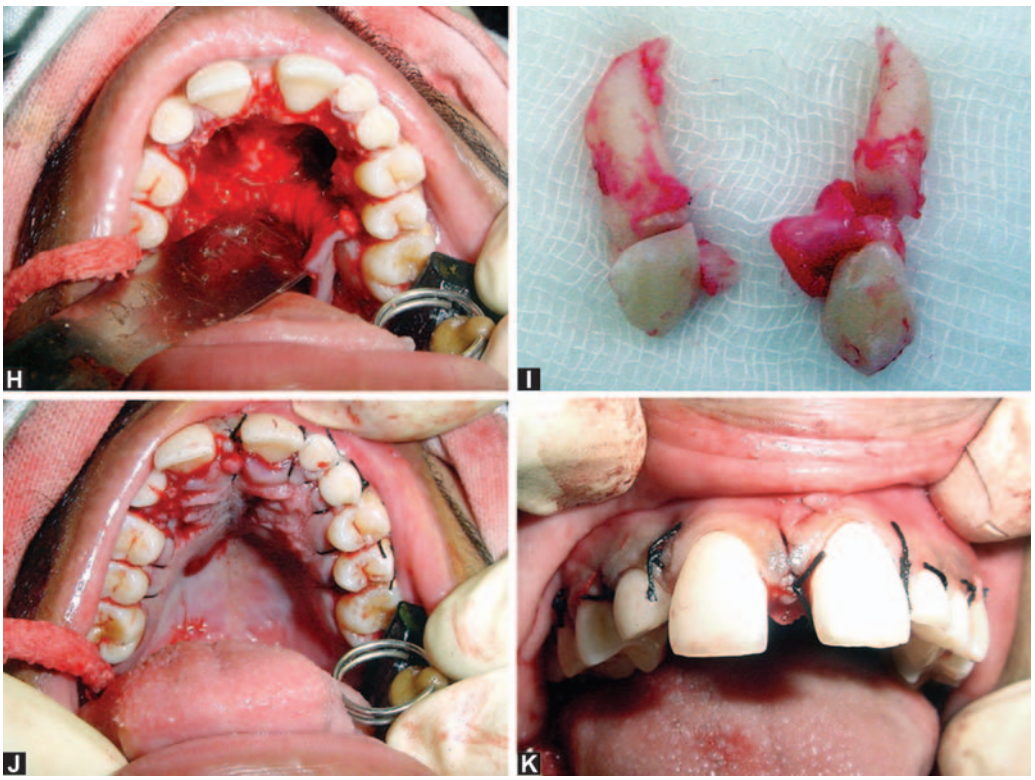
Use of a prefabricated clear acrylic plate covering the palate postoperatively may help to reduce the chance of hematoma formation.

Removal of bilateral palatally impacted canine by elevating a full palatal flap and tooth sectioning:

**Case report** (Figs 21.4 A to K): An 18-year-old boy reported with diastema between upper centrals and unerupted canine teeth (Fig. 21.4 A).Occlusal X-ray and OPG revealed bilaterally impacted canine in the maxilla with their crowns closely related to the roots of the central incisors (Figs 21. 4 B and C). Impacted teeth could not be palpated on the labial side. However, there was a mild swelling on the palatal aspect suggesting the presence of impacted teeth on the palatal aspect. Considering the position of impacted tooth in the palatal aspect, the procedure was planned under general anesthesia with endotracheal intubation. Incision was given along the palatal gingival margin from 16 to 26 (Fig. 21.4 D). Mucoperiosteum was reflected (Fig. 21.4 E). The bone overlying the impacted teeth was removed using bur along with profuse saline irrigation to expose the crown of the impacted tooth (Fig. 21.4 F). Care was taken not to injure the roots of the adjacent teeth. The crown was then sectioned (odontotomy) using a fissure bur and removed (Fig. 21.4 G). Using an elevator, the root was elevated into the space created by removal of the crown portion.




**Figs 21.4 D to G:** (D) Incision along the gingival margin in the palatal mucoperiosteum, (E) Mucoperiosteum reflected to expose the bone overlying the impacted canines, (F) Bone overlying the canines removed to expose the crown, (G) Sectioning of the crown



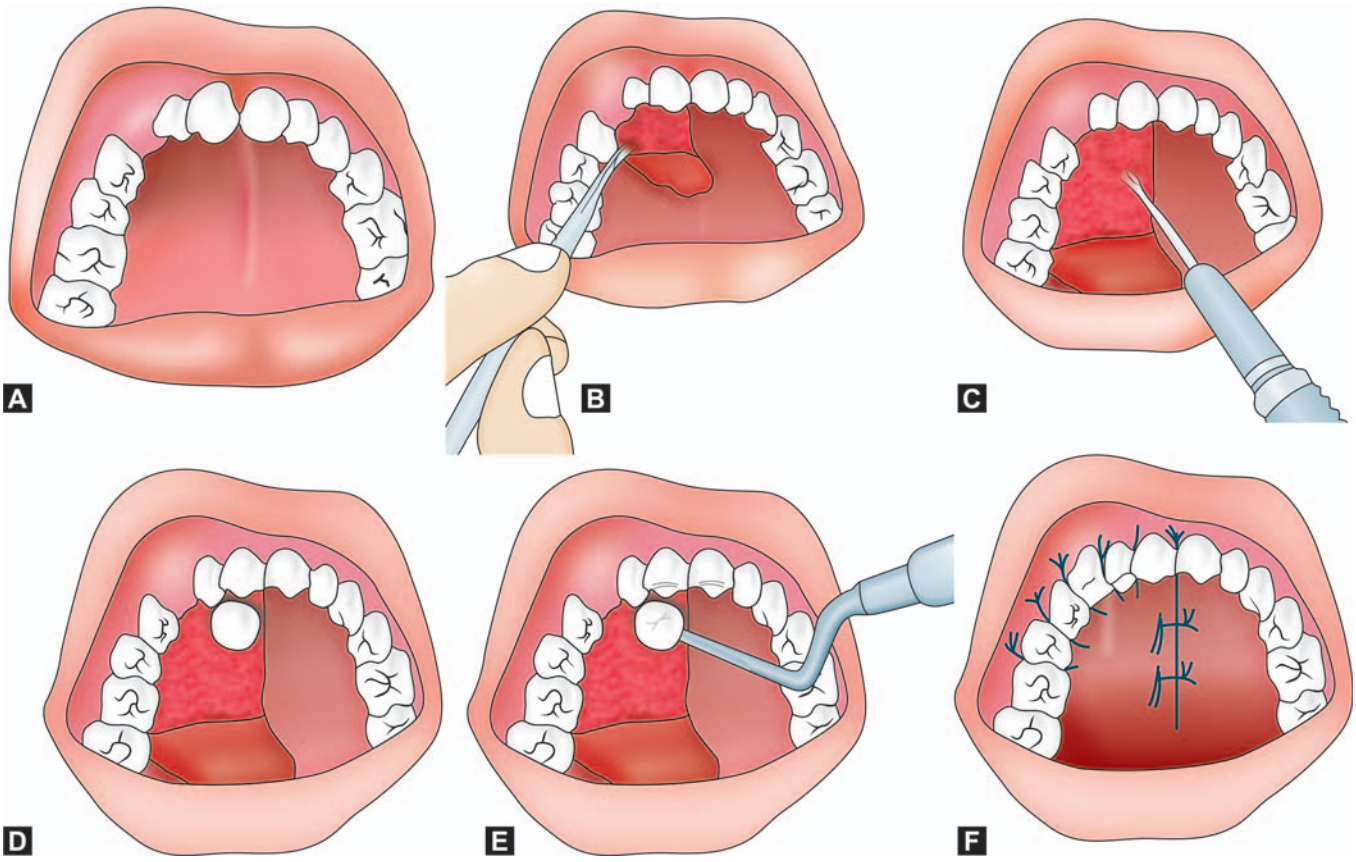

**Figs 21.4 H to K:** (H) Socket after the removal of impacted canines, (I) Excised canines, (J) Suturing complete-view from the palatal aspect, (K) View from the labial aspect

The root was then removed (Fig. 21.4 H). Both the teeth were removed in a similar fashion (Fig. 21.4 I). The wound was then debrided, irrigated and closed with 3-0 black silk interdental sutures (Figs 21.4 J and K).

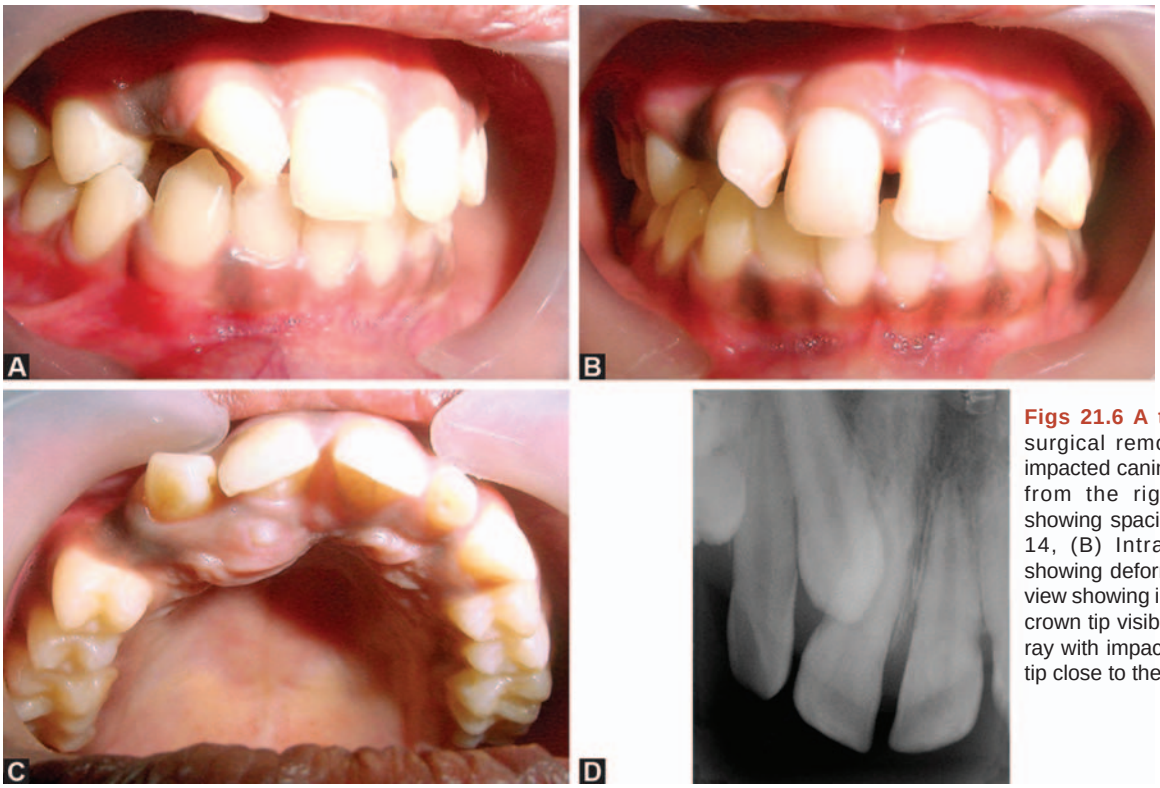
Removal of palatally impacted canine (unilateral) by elevating a palatal flap with vertical incision:

**Case report** (Figs 21.6A to N): A 14-year-old boy reported with complaints of deformed right upper lateral incisor and unerupted canine tooth (Figs 21.6A and B). There was projection of the impacted canine on the palatal side with the crown tip visible (Fig. 21.6 C). Periapical X-ray revealed impacted right maxillary canine with its crown closely related to the roots of the central incisor (Fig. 21.6 D). Orthodontic consultation was done to assess the feasibility of orthodontic guidance of the impacted tooth. Considering the unfavorable position of the impacted tooth for orthodontic positioning, surgical removal of the impacted tooth was advised by the orthodontist. The procedure was planned under local anesthesia. Incision was placed along the palatal gingival margin from 15 to 21 region with a vertical incision in the palate in the region of 21 (Fig. 21.6 E). Mucoperiosteum was reflected (Fig. 21.6 F) and it was held in position using a 'stay suture' (black arrow). The bone overlying the impacted tooth was removed using bur with profuse saline irrigation to expose the crown of the impacted tooth. Care was taken not to injure the roots of the adjacent teeth. A trough (black arrow) was made around the crown of the impacted tooth (Figs 21.6 G) for placement of an elevator and for mobilizing the tooth. The tooth was slowly luxated using an elevator(Figs 21.6 H and I) and removed in one piece (Fig. 21.6 J).The wound was then debrided and irrigated with normal saline(Fig. 21.6 K). Closure was done with 3-0 black silk interdental sutures and two sutures for vertical incision in the palate (Fig. 21.6 L).

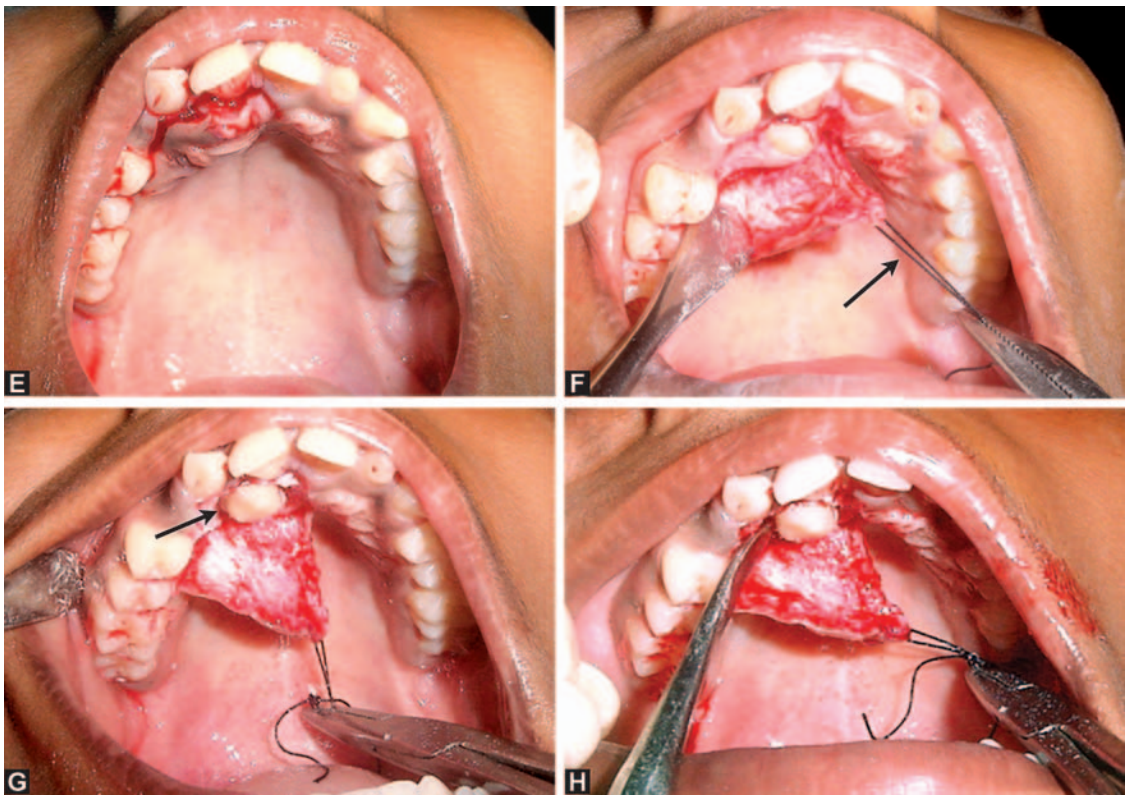
As discussed in Chapter 17, CT scans are extremely useful in the localization of maxillary canines and to decide the type of surgical approach to be employed to



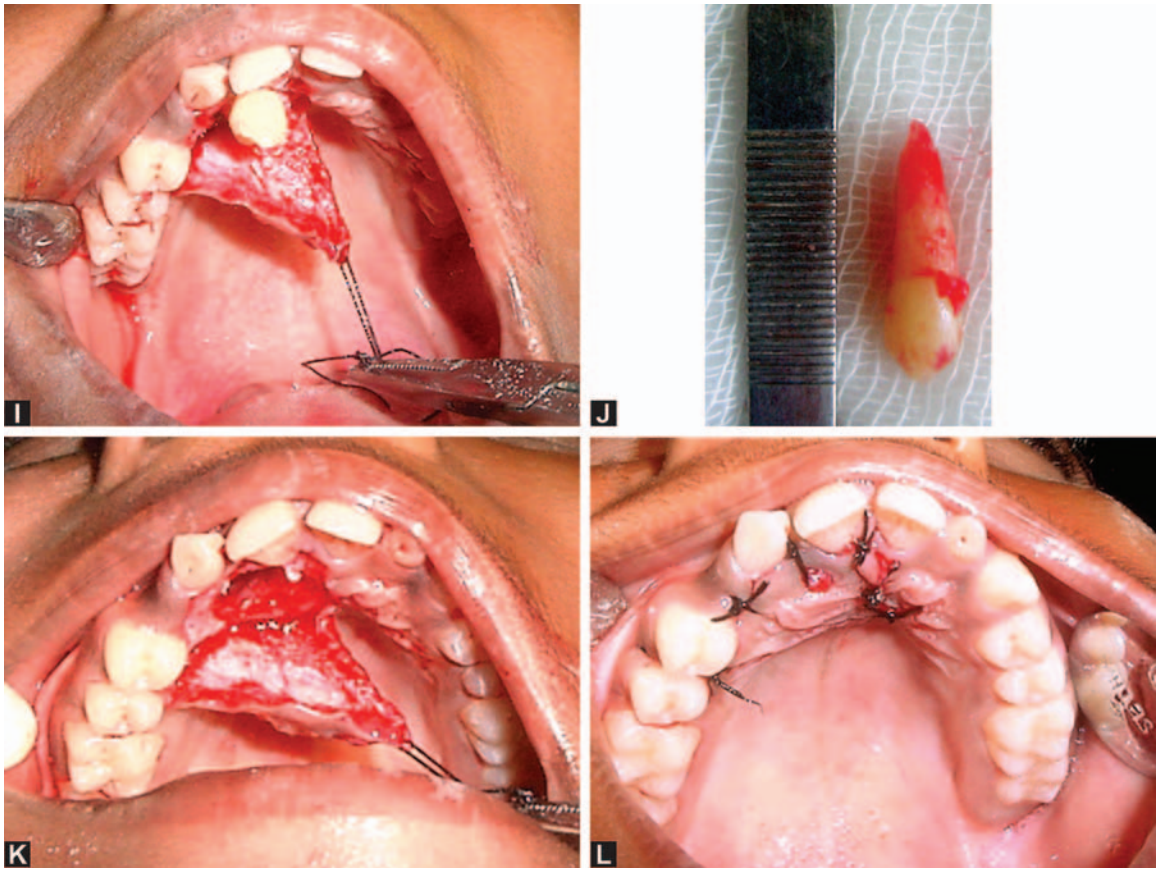

**Figs 21.5A to F:** Schematic diagram showing removal of palatally impacted canine by elevating a palatal flap with vertical incision. (A) Incision made around the neck of the teeth from the region of the second premolar to the midline followed by a midline incision in the palate, (B) Mucoperiosteum reflected, (C) Drill holes made around the crown of the impacted tooth, (D) Opening enlarged to fully expose the crown, (E) Tooth elevated using elevator, (F) Closure of the flap using interdental sutures and sutures in the midline of the palate




**Figs 21.6 A to D:** Steps in the surgical removal of a palatally impacted canine (A) Intraoral view from the right lateral aspect showing spacing between 12 and 14, (B) Intraoral frontal view showing deformed 12, (C) Palatal view showing impacted 13 with the crown tip visible, (D) Periapical X-ray with impacted 13 and its cusp tip close to the root of 11

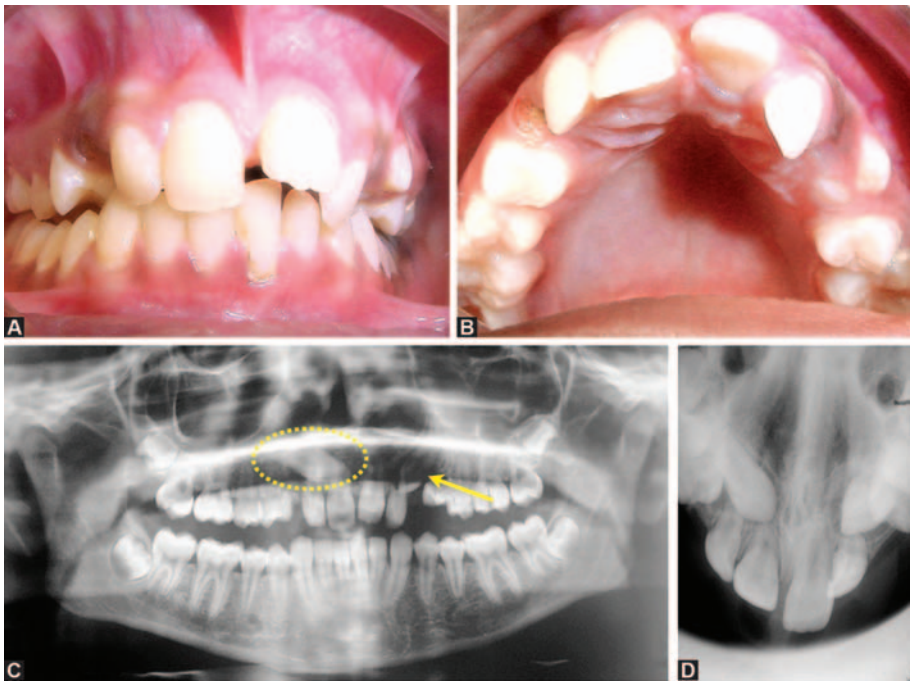



**Figs 21.6 E to H:** (E) Incision along the gingival margin from 15 to 21 with vertical incision in the palate, (F) Mucoperiosteum reflected and held in place using 'stay suture' (black arrow), (G) Bone overlying the crown removed to expose it and a trough created around the crown (black arrow), (H) Elevator placed in the trough to luxate the tooth

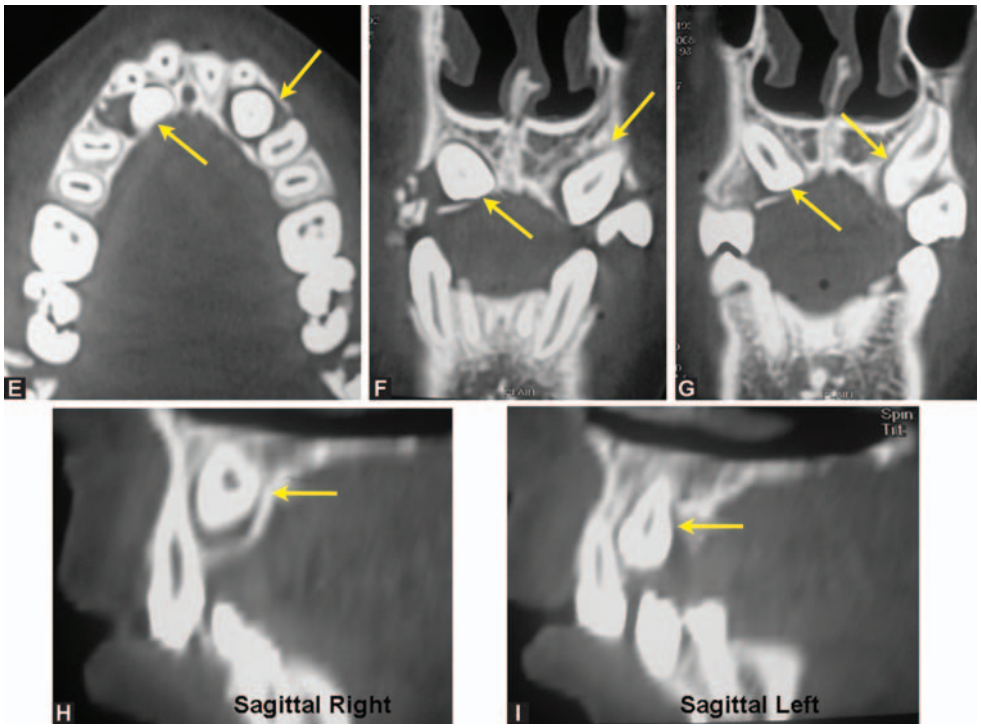



**Figs 21.6 I to L:** (I) Impacted tooth luxated out of the socket, (J) Tooth removed in one piece, (K) Debridement of the socket, (L) Suturing completed

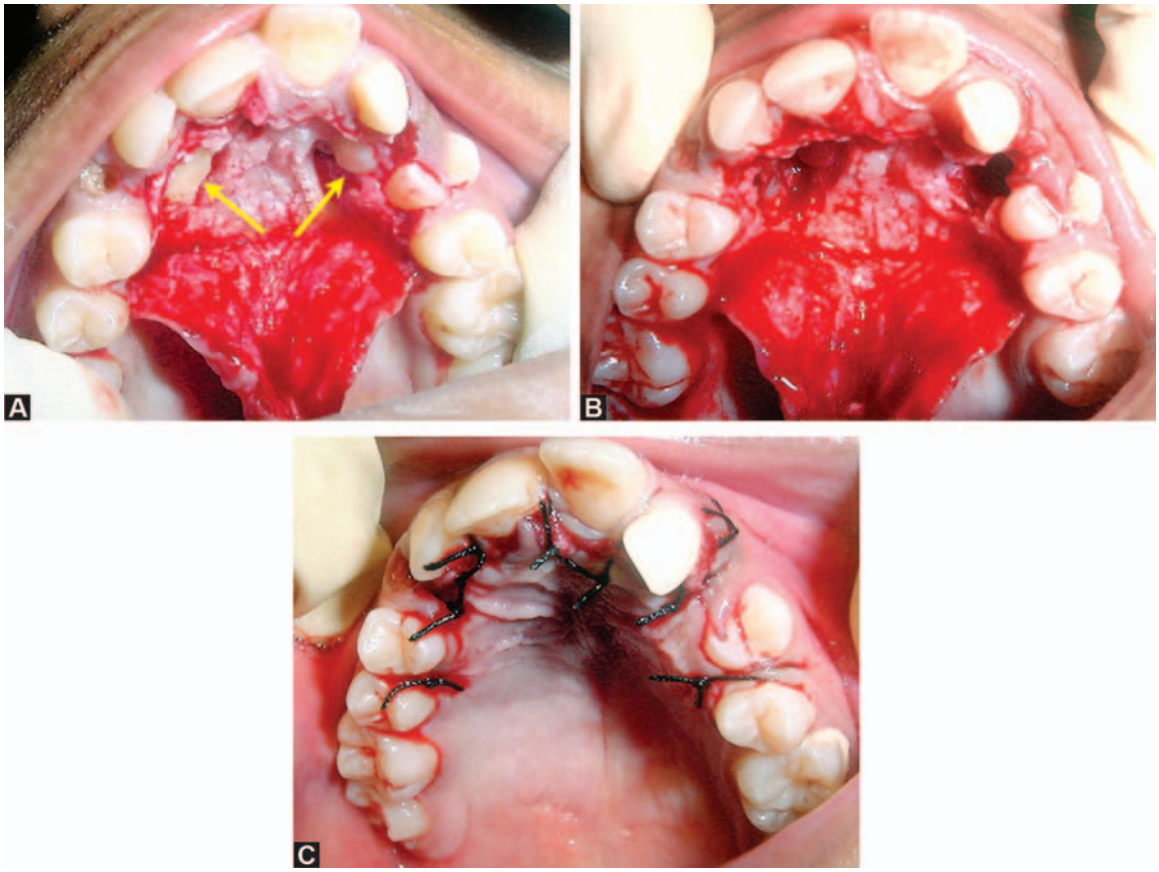

**Figs 21.6 M and N:** Postoperative appearance two weeks later. (M) Intraoral frontal view, (N) Palatal view. Note the well healed palatal wound




**Figs 21.7 A to D:** (A) Intraoral view showing spacing between the upper centrals and unerupted maxillary canines. There is no labial bulge indicating the position of impacted 13 and 23, (B) Palatal view showing unerupted canines and retained deciduous canine root on the right side. No palatal bulge can be seen indicating the location of the impacted teeth, (C) OPG demonstrating impacted canines (yellow circle and yellow arrow), (D) Occlusal view showing impacted 13 and 23




**Figs 21.7 E to I:** (E) Axial CT showing impacted 13 and 23 (yellow arrows). Note that the crowns of impacted canines are more palatally placed compared to the roots of the incisors, (F) Coronal CT scan at the level of normal position of the canines. Note that the impacted canines are obliquely placed, (G) Coronal CT scan at the level of premolars. Note the relationship of the roots of the canine to the nasal floor and the deficient palatal plate in the region of cusps of impacted canines, (H) Sagittal CT through the region of 13. Note the palatal position of impacted 13 in relation to the root of 12, (I) Sagittal CT through the region of 23. Note the palatal position of impacted 23 in relation to the root of 22




**Figs 21.7J to L:** (J) Mucoperiosteum reflected and the overlying bone removed to expose the crowns of impacted 13 and 14 (yellow arrows), (K) The impacted teeth were removed by sectioning and the surgical site before closure, (L) Suturing completed with interdental 3-0 sutures

remove the tooth i.e. the labial approach or the palatal approach when the bulge of the impacted tooth cannot be felt on either side. The following is the report of a case in which the CT scan was useful in confirming the palatal position of bilaterally impacted maxillary canines. The surgical removal of the impacted teeth was done under local anesthesia via palatal approach.

**Case report:** (Figs 21.7 A to L): A 16-year-old girl reported with complaints of unerupted permanent canines in the maxilla (Figs 21.7 A and B). Occlusal X-ray and OPG revealed bilaterally impacted canines in the maxilla with their crowns closely related to the roots of the central incisors(Figs 21.7 C and D). The impacted teeth could not be palpated on the labial side or on the palatal side. Hence a CT scan was taken to locate the position of impacted teeth in the axial, coronal and sagittal planes. The scans revealed that the canines were lying palatal to the upper incisors (Figs 21.7 E to I). Considering the position of the impacted tooth in the palatal aspect, the procedure was planned under local anesthesia. Incision was given along the palatal gingival margin from 16 to 26. Mucoperiosteum was reflected. The bone overlying the impacted tooth was removed using bur with profuse saline irrigation to expose the crown of the impacted tooth (Fig. 21.7 J). Care was taken not to injure the roots of the adjacent teeth. The crown was then sectioned (odontotomy) using a fissure bur and removed. Using an elevator, the root was elevated into the space created by the removal of the crown portion. The root was then removed (Fig. 21.7 K). Both the teeth were removed in a similar fashion. The wound was then debrided, irrigated and closed with 3-0 black silk interdental sutures (Fig. 21.7 L).

CHAPTER

# 22

# Removal of Labially Positioned Impacted Maxillary Canine

The patient is best placed in a sitting or semi-reclining position.

## Incision

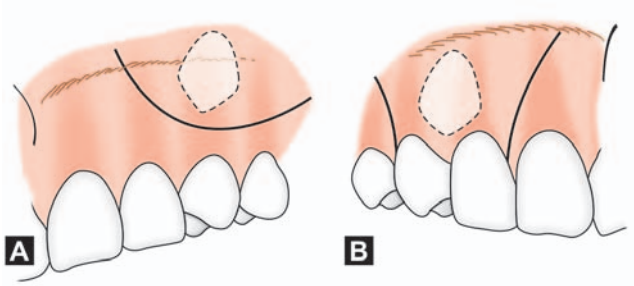
A semilunar incision (Fig. 22.1A) is sufficient for good exposure, but proper localization of the position of the tooth is important to make sure there will be sufficient bone to support the wound edges after the procedure. The lower part of the incision should not come closer than 0.5 cm from the gingival margin.

For the beginners, a standard triangular (2 sided) or trapezoidal (3 sided) flap with a broad base and incision along the gingival sulcus may be better for easy handling (Fig. 22.1B).

(A) Semi-lunar incision, (B) Trapezoidal (3 sided) incision

## Operative Procedure

The mucoperiosteum is reflected to expose the bone and the bulge of the tooth. A window is cut over the prominence of the crown with a chisel or bur or both (Fig. 22.2B). This is enlarged to expose the whole crown, taking care not to damage the roots of the adjacent teeth. An elevator can then be inserted to mobilize the tooth (Fig. 22.2C).




**Figs 22.1A and B:** Incisions for removal of labially placed canine

If there is resistance, expose the root of the tooth and then try to elevate. The elevator should not rest on the adjacent teeth; rather the cortical plate is used as the fulcrum.

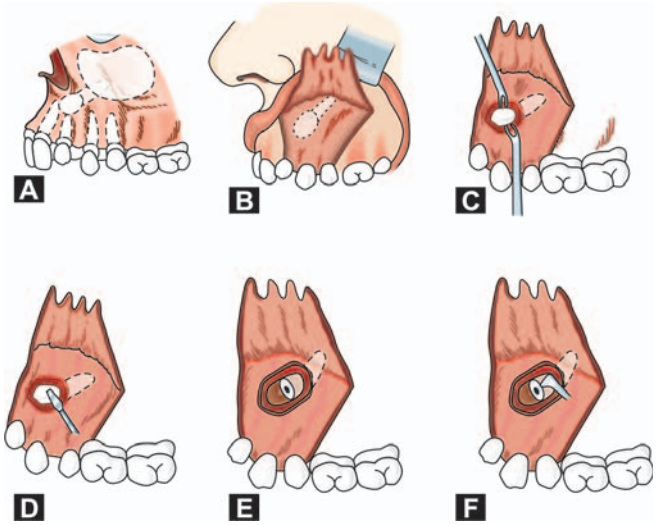
If there is still resistance, division of the tooth should be considered (Fig. 22.2D). Dividing the tooth into two or three parts will help in the easy removal of the fragments. The middle piece can be removed first, and the resultant space can be utilized for elevating the remaining two fragments.

The area is thoroughly debrided and follicle remaining if any is removed. The flap is repositioned and sutured into place.

## Removal of Maxillary Canine without Tooth Sectioning

In carefully selected cases, the impacted maxillary canine can be removed without tooth sectioning. The procedure can be performed much faster with minimum post operative morbidity. Cases with the following clinical and radiographic features may be considered for surgical removal without tooth sectioning:

1. The crown of the impacted canine can be appreciated by the presence of a swelling of the labial gingiva.
2. Crown of the impacted tooth can be easily palpated.




**Figs 22.2A to F:** Schematic diagram showing surgical removal of labially impacted maxillary canine. (A) Impacted left maxillary canine. Note the relationship of the cuspid to the roots of the adjacent teeth, nasal cavity and maxillary sinus. (B) Drill holes placed in the cortical plate overlying the crown so as to expose the crown, (C) After the full exposure of the crown elevator is applied beneath the crown to mobilize the tooth, (D) If the tooth is resistant to elevation, the crown is sectioned using bur and it is removed, (E) Cavity created following removal of crown, (F) The root is moved into the space created by the removal of the crown and it is then removed

3. Presence of a radiolucency around the crown of the impacted tooth suggestive of a large follicular sac.
4. Incompletely formed root of canine seen in the X-ray.
5. Vertical or semi-vertical position of the tooth.
6. Patient in the 12-15 years age group when the bone is more elastic.

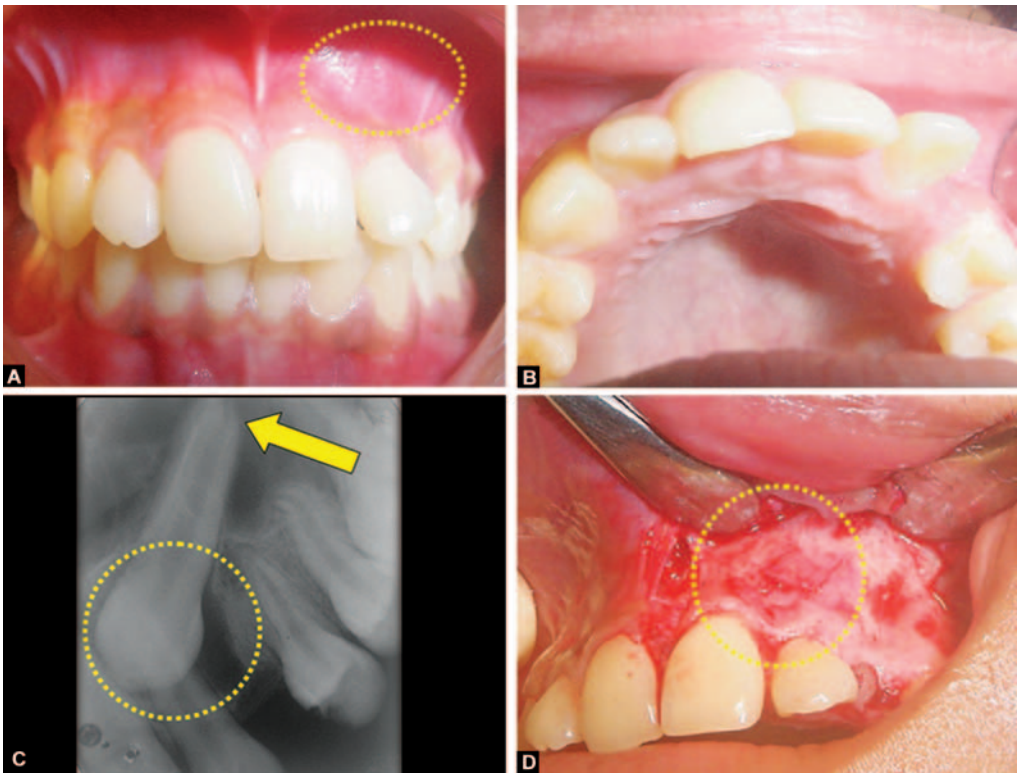
The following is the case report of a patient in which a labially positioned impacted maxillary canine was removed without tooth sectioning (Figs 22.3A to L).

**Case report** (Figs 22.3A to L): A 14-year-old girl reported to her dental practitioner with complaints of proclination of left upper lateral incisor and unerupted upper canine. On examination there was proclination of 22 and 23 was impacted (Figs 22.3A and B). The swelling of the crown of impacted 23 was visible as well as it could be palpated (Fig. 22.3 A- yellow oval) on the labial side near the region of the root of 22. Intraoral periapical X-ray showed impacted 23 in a semi vertical position. The root was incompletely formed (Fig. 22.3 C- yellow arrow)) and there was a radiolucency (Fig. 22.3 C -yellow circle) surrounding the crown suggestive of a follicular sac. Since there was no adequate space for orthodontic eruption of impacted 23, its surgical removal was planned. The procedure was performed under local anesthesia. A trapezoidal mucoperiosteal flap was raised on the labial side. Bone covering the crown of the impacted tooth was found to be very thin (Fig. 22.3 D-yellow circle). It was removed using the sharp tip of a #9 Molt periosteal elevator (Fig. 22.3E). (Alternatively, the overlying bone can be removed using bur also). After adequate exposure of the crown, the tooth was elevated out of the socket with the sharp tip of an elevator using the labial cortical plate as the fulcrum (Figs 22.3F and G). The follicle surrounding the crown of the impacted canine was also removed. Following thorough debridement (Fig. 22.3 H), the flap was replaced back and sutured (Figs 22.3I and J). Figure 22.3 K shows the impacted canine and the follicle. The postoperative period was uneventful and sutures were removed on the seventh postoperative day (Fig. 22.3L).

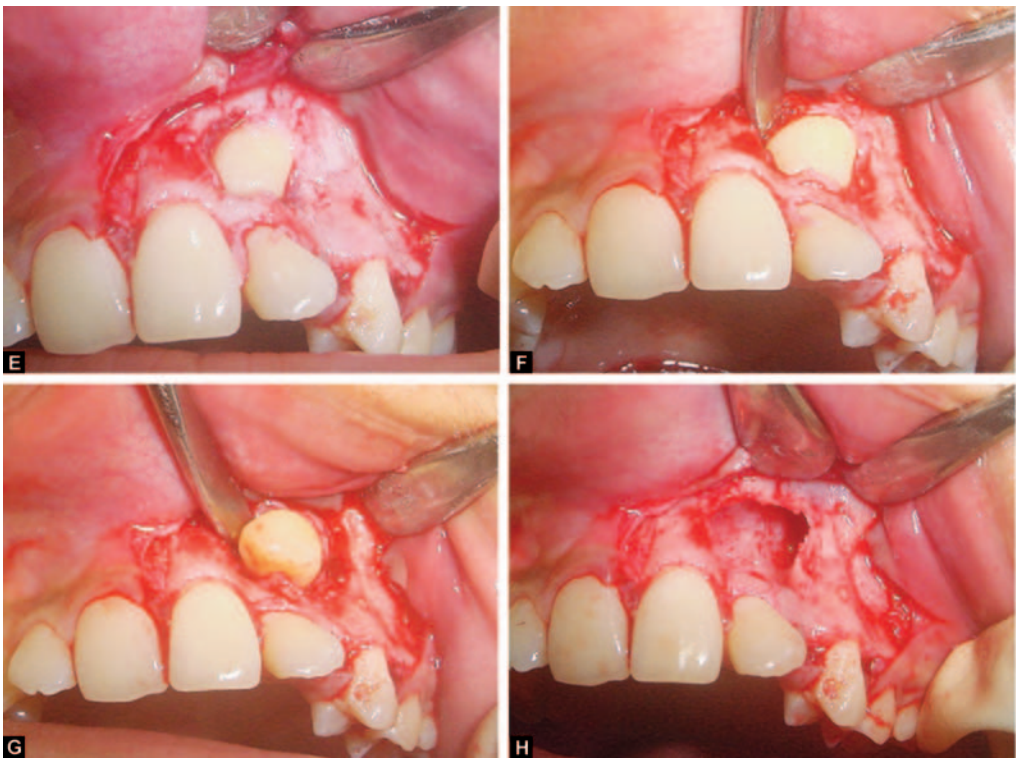
However in majority of cases, when the tooth is deeply impacted, sectioning of the impacted tooth into two or three pieces may have to be done to facilitate its removal as shown in the subsequent case reports.

**Step by step procedure for the removal of labially impacted canine by tooth sectioning (Incision in the sulcus):**

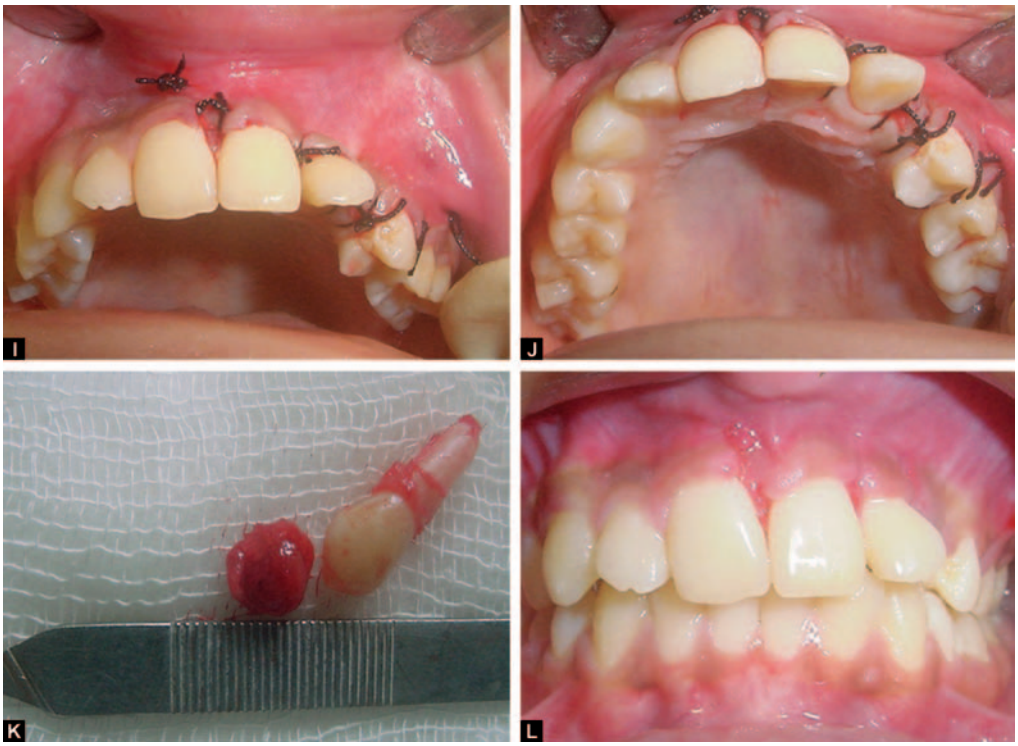
**Case report** (Figs 22.4A to H): A 52-year-old man reported with complaints of recurrent pain in right upper buccal sulcus. On clinical examination, the left upper quadrant was found to be edentulous and there was a bridge on the right upper quadrant. An OPG (Fig. 22.4A) revealed an impacted right upper canine high up in the alveolus (yellow oval) above the roots of the right upper central and lateral incisors. The tip of the root was found to be curved and in close approximation to the right maxillary sinus. After relevant investigation and discussion with the patient the procedure was planned under local anesthesia. Considering the high position of the impacted tooth, an incision was given in the sulcus, from 15 to 21 region (some what similar to the incision given for Caldwell Luc operation). This is because a semi-lunar incision or the reflection of a trapezoidal flap will necessitate a significant amount of flap reflection to reach the vicinity of the impacted canine. The mucoperiosteal flap was then elevated to expose the bone overlying the impacted tooth. The bone overlying the impacted tooth was removed using bur with profuse saline irrigation to expose the crown of the impacted tooth (Fig. 22.4B). Care was taken not to injure the roots of the adjacent teeth. The crown was then sectioned (odontotomy) using a fissure bur (Fig. 22.4C). The sectioned crown was



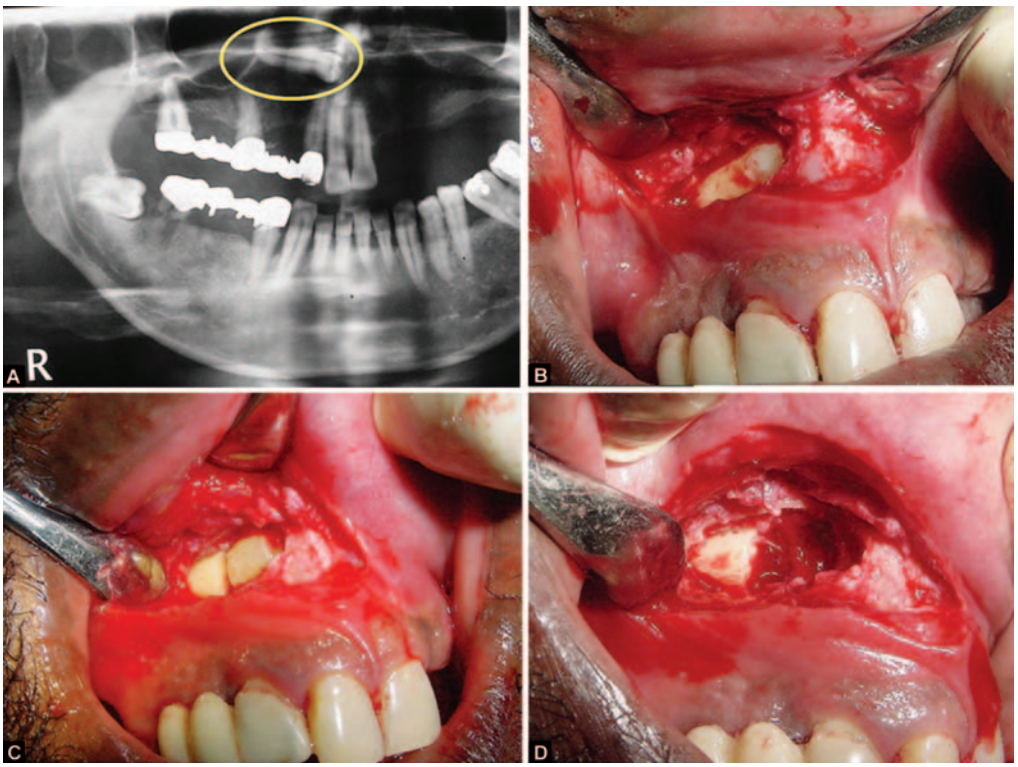

**Figs 22.3A to D:** Steps in the surgical removal of a labially positioned impacted maxillary canine without tooth division- (A) Intraoral view of the patient showing proclination of 22 and missing 23. Bulge in the mucosa indicating the crown of impacted 23 is marked as yellow oval, (B) Palatal view showing slight proclination of 22 due to the pressure effect of impacted 23, (C) Periapical X-ray showing impacted 23. Note the incompletely formed root of 23 (yellow arrow) and the follicular sac surrounding the crown (yellow circle), (D) A trapezoidal mucoperio-steal flap elevated. Note the thin bone covering the crown of the impacted canine (yellow circle)



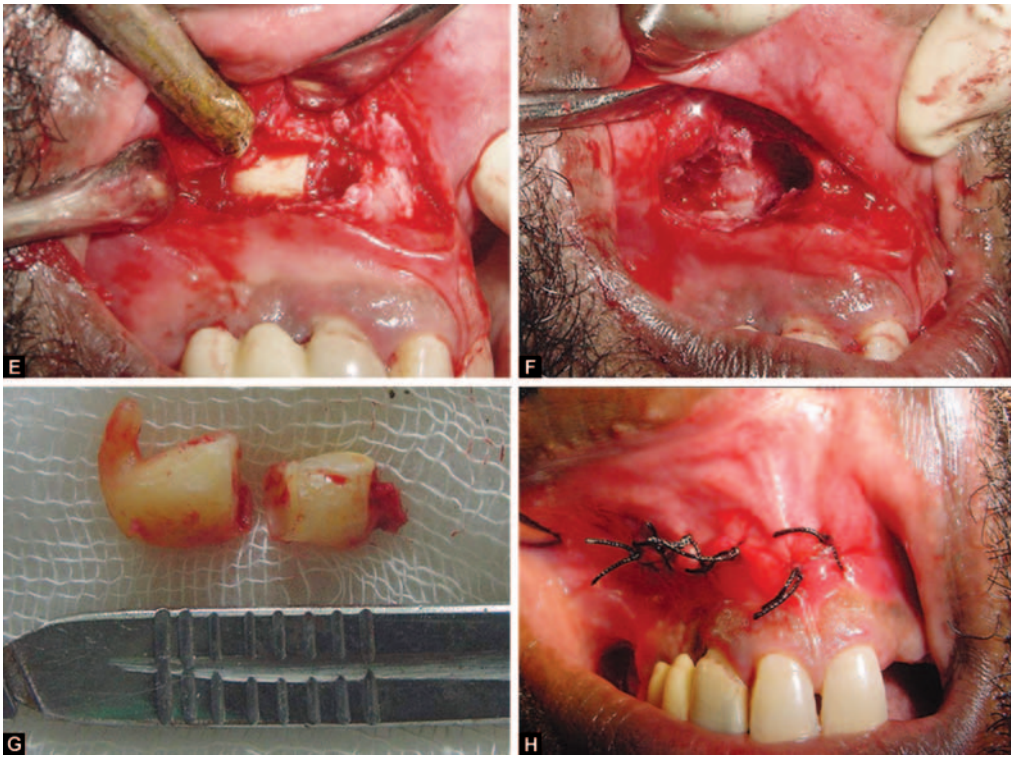

**Figs 22.3E to H:** (E) Exposure of the crown by the removal of overlying bone, (F) Tooth elevated using an elevator, (G) Use of buccal cortical plate as the fulcrum for the elevator, (H) Socket after debridement




**Figs 22.3I to L:** (I) Suturing completed - view from the labial aspect, (J) View from the palatal aspect, (K) Specimen of the tooth and attached follicle. Note the incompletely formed apex of the tooth, (L) Intra oral view on the seventh post operative day after suture removal




**Figs 22.4A to D:** Steps in the surgical removal of labially impacted maxillary canine- (A) OPG showing impacted right upper canine (yellow oval), (B) Overlying bone removed to expose the crown, (C) Crown sectioned, (D) Sectioned crown removed




**Figs 22.4E to H:** (E) Root pushed into the space occupied by the crown, (F) Socket after removal of the root, (G) Specimen after removal. Note the curvature of the root tip. (H) Suturing completed

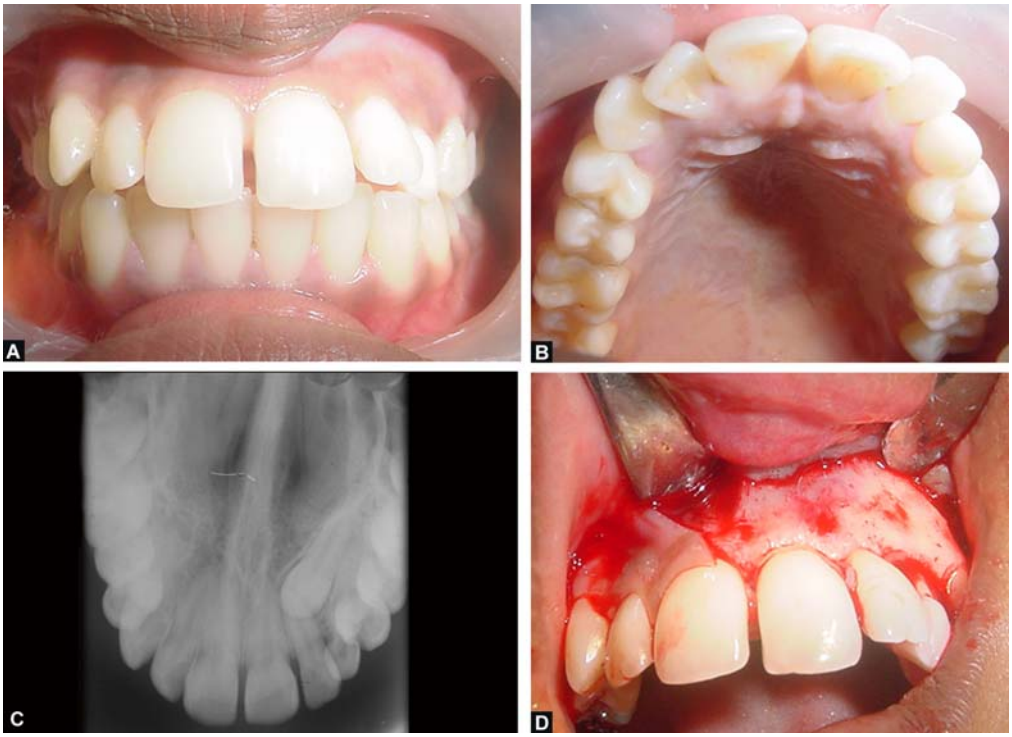
removed (Fig. 22.4D). Using an elevator, the root was elevated into the space created by the removal of the crown portion (Fig. 22.4E). The root was then removed (Fig. 22.4F). The root was found be sharply curved at the apex (Fig. 22.4G) as noted in the OPG. Involvement of the maxillary sinus and the possibility for the development of an oro-antral communication was evaluated by asking the patient to blow the nose. No bubbling of air was found in the wound. More over, there was no associated nasal bleeding. The wound was then debrided, irrigated and closed with 3-0 black silk sutures (Fig. 22.4H).

**Step by step procedure for the removal of labially impacted canine by tooth sectioning (Trapezoidal incision)**

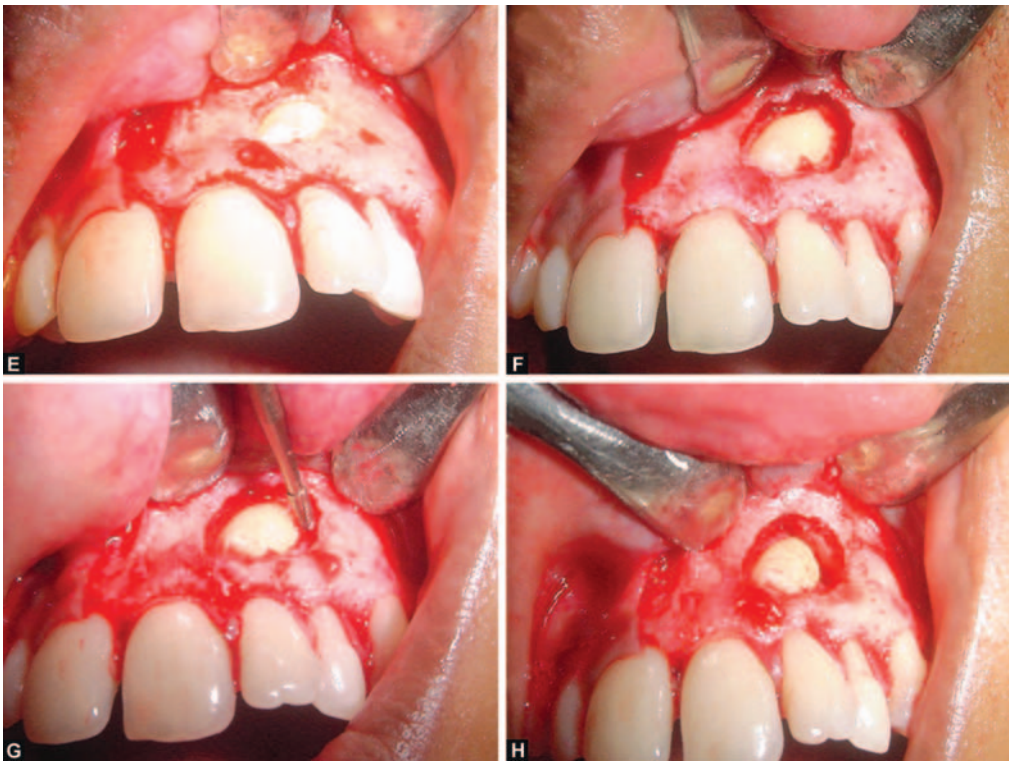
**Case report** (Figs 22.5A to M)- A 15-year-old girl reported with complaints of retained deciduous left upper canine and spacing of upper anterior teeth (Figs 22.5A and B). Maxillary occlusal X-ray (Fig. 22.5 C) revealed an impacted left upper canine. After relevant investigation the procedure was planned under local anesthesia. A trapezoidal incision was given and a mucoperiosteal flap was then elevated to expose the bone overlying the impacted tooth (Fig. 22.5D). The bone overlying the impacted tooth was removed using bur with profuse saline irrigation to expose the crown of the tooth (Figs 22.5E and F). Care was taken not to injure the roots of the adjacent teeth. The crown was then sectioned (odontotomy) using a # 703 fissure bur (Figs 22.5G and H). The sectioned crown was removed (Fig. 22.5 I). Using an elevator, the root was pushed into the space created by the removal of the crown (Fig. 22.5 J). The root was then removed. The wound was then debrided, irrigated with normal saline (Fig. 22.5K) and closed with 3-0 black silk interdental sutures (Fig. 22.5L). A pressure bandage was applied using adhesive plaster to reduce the post operative edema (Fig. 22.5M).

## Removal of Maxillary Canine in an Intermediate Position

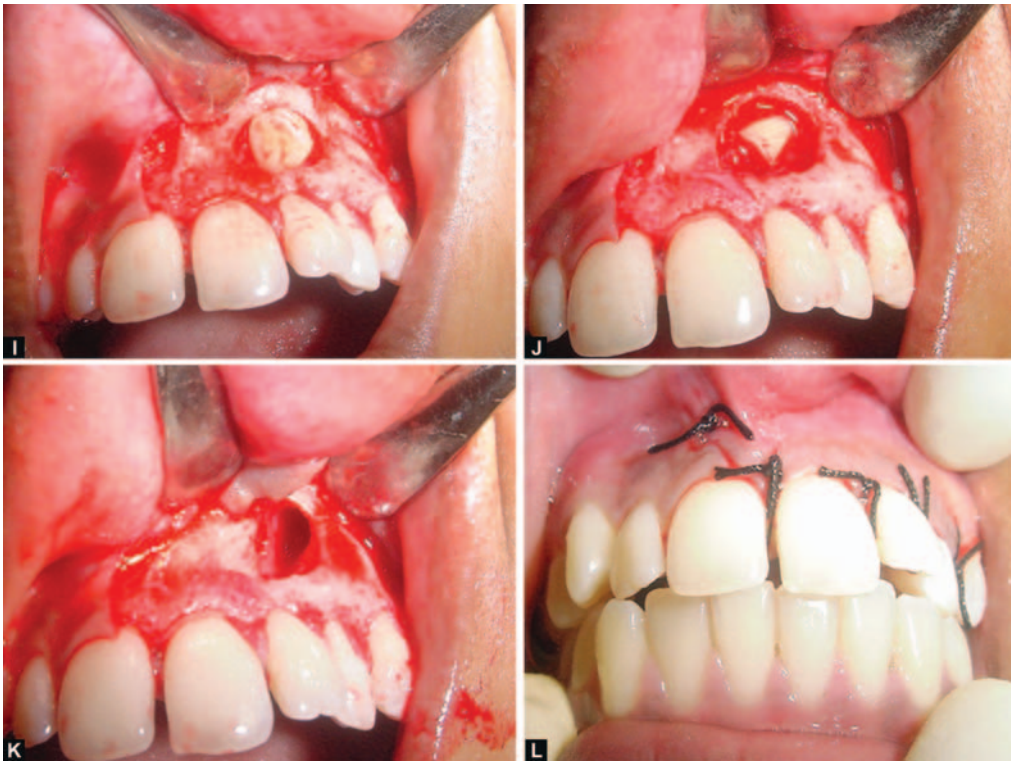
This may require reflection of flap both labially and palatally and the incisions are designed based on the location of the tooth. If the canine is wedged between the adjacent teeth, it may need to be sectioned. When there is bone overlying the crown, it is first removed on the




**Figs 7.5A to D:** Steps in the surgical removal of labially impacted maxillary canine- (A) Intraoral view of the patient showing retained deciduous left upper canine, (B) Palatal view showing slight proclination of 22 due to pressure effect of impacted 23, (C) Occlusal X-ray showing impacted 23, (D) Mucoperiosteal flap elevated




**Figs 22.5E to H:** (E) Removal of bone overlying the impacted tooth started, (F) Crown fully exposed, (G) Crown sectioned using # 703 fissure bur, (H) Crown fully sectioned




**Figs 22.5 I to L:** (I) Sectioned crown being removed, (J) Root being pushed into the space created by the removal of the crown portion, (K) Socket following removal of the root and after debridement, (L) Suturing completed


**Fig. 22.5 M:** Pressure dressing applied using adhesive plaster

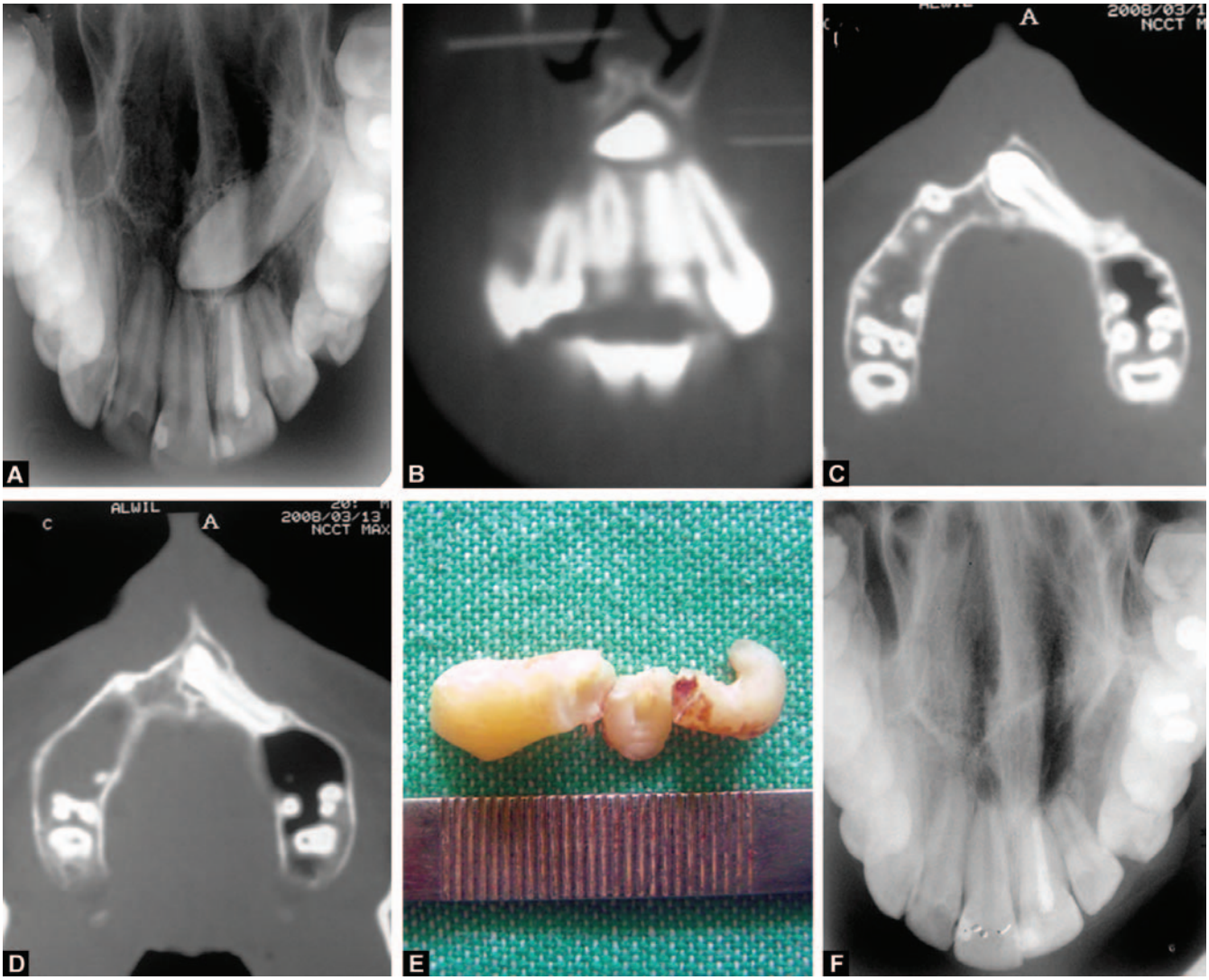
side towards which the tooth is pointing. Bone removal may be required on the opposite side also. Use of CT scan or Cone beam CT (CBCT) is extremely helpful in managing such cases. Figures 22.6A to F show the usefulness of CT in locating the position of canine.

## Impacted Maxillary Canine with Root on the Labial Side and Crown on the Palatal Side

The impacted maxillary canine can assume unusual position with the root on the labial side and the crown on the palatal side or vice versa. The removal of such impactions are more difficult and time consuming since the tooth has to be approached from both the labial and palatal sides. More over there is a higher possibility of causing injury to the adjacent teeth during the procedure. CBCT or CT scan is extremely useful in such cases to localize the impacted tooth. Figures 22.7 A to H show the steps schematically in the surgical removal of an impacted canine with the root on the labial side and crown on the palatal aspect.

## Teeth in Abnormal Positions

Maxillary canines can sometimes be present in abnormal positions like infra orbital rim, maxillary antral wall or nasal wall. The incision and procedure for their removal vary depending on the exact position of the tooth.



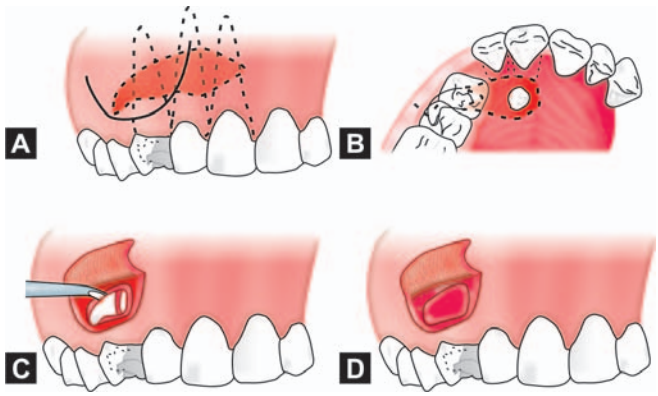

**Figs 22.6 A to F:** Usefulness of CT in locating the intermediate position of impacted maxillary canine. (A) Occlusal X-ray of an 18-year-old young man who reported with unerupted 23. The patient gave a history of endodontic treatment of 21 an year back. Impacted 23 could not be palpated on the buccal or palatal aspect. (B) Coronal CT scan image showing the crown of the impacted canine above the roots of central incisor teeth, (C) Axial CT scan image showing crown tip of impacted canine crossing the midline and lying just below the level of anterior nasal spine. The position of the impacted tooth is at the mid alveolar region rather than either to the buccal or palatal side. (D) Axial CT scan image showing slight curvature of the root tip. The impacted canine was removed through a labial approach under local anesthesia by sectioning of the crown. (E) Removed tooth showing extreme curvature of the root which was not evident in the occlusal X-ray, but visible to some extent in the CT scan. (F) Postoperative occlusal X-ray showing no damage to the roots of the adjacent teeth

Whatever may be the position of the tooth, if there is any cyst associated with the tooth, the cyst lining has to be completely removed along with the tooth and subjected to histopathological examination.

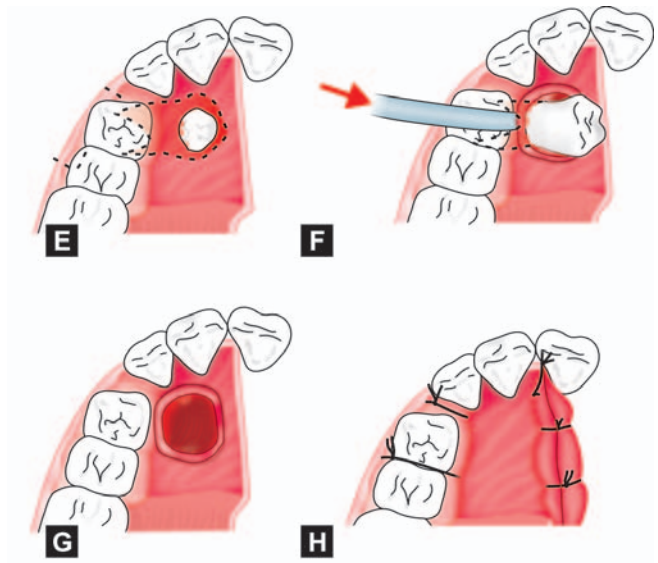
## Complications of Removal of Maxillary Canines

All possible complications with regard to the surgical removal of teeth can also occur following the removal of maxillary canines. The following are the specific complications:

a. **Nasal or antral perforation:** This can be avoided with proper care during reflection of the flap, bone removal and application of elevators. Even if small perforations occur, they are covered by the flap when it is replaced, and heal without any problem. But strict aseptic technique should be followed; otherwise infection may be introduced into the maxillary sinus.




**Figs 22.7 A to D:** Schematic diagram showing the steps in the in the surgical removal of impacted maxillary canine with root on the labial side and crown on the palatal side. (A) Outline of the impacted canine and its relation to the roots of the adjacent tooth. Note the semilunar incision marked, (B) Outline of the crown of the impacted canine on the palatal aspect, (C) Mucoperiosteum reflected on the buccal side overlying the bone to be removed and the root of the impacted tooth sectioned. An elevator is being used to dislodge the root, (D) Empty socket after removal of the root




**Figs 22.7 E to H:** (E) Palatal flap is outlined and reflected. Bone covering the crown of the impacted tooth is removed using bur. (F) Using a blunt instrument placed in the socket of the tooth on the buccal side, pressure is exerted on the cut end of the crown (see black arrow) to push the crown palatally, (G) Empty socket on the palatal side after removal of the crown, (H) Flap is replaced back and suturing completed

A nasal perforation may occur in those cases where the apex is positioned close to the lateral wall or floor of the nasal cavity. This results in nasal bleeding, which usually stops after a few minutes. Apart from tight suturing no other precaution is usually necessary. Patient should be cautioned against possible nasal bleeding in the post operative period. Should this occur, there is no reason to alarm and no attempt is made to blow the nose. Rather the blood may be gently wiped away and lie down with the head raised over a pillow. In case of persistent hemorrhage, the doctor may be contacted.

**b. Displacement of canine/ root into the antrum:** Care should be taken during elevating the impacted canine or its root to avoid pushing it into the antrum. Should this occur the removal of the displaced tooth/root may have to be done by a Caldwell Luc approach.

**c. Hemorrhage:** Troublesome hemorrhage can occur if greater palatine or nasopalatine vessels are severed. Firm pressure is usually sufficient to stop the bleeding, but cautery or ligation may be required if this does not help.

**d. Damage to adjacent teeth:** Exact position of the impacted tooth in relation to the adjacent teeth should be confirmed prior to surgery and care should be taken while removing the bone, not to damage the roots of the adjacent teeth. While applying elevators, fingers should be kept on the labial surface of the adjacent teeth to assess their mobility and to prevent their subluxation or avulsion. There may be mild mobility of the adjacent teeth after the procedures, which will usually become firm in a short while. However if there is marked mobility, such teeth should be splinted and later evaluated for viatality.

**e. Fracture of apical third of the impacted tooth:** If the canine develops with its apex close to the antral or nasal floor, a 90° deflection of the apex or a sharp curvature of the apex may occur. This curvature will result in resistance against tooth removal. In such an instance any one of the following two approaches can be used:

1. Deliberately fracture the apical portion from the reminder of the tooth and then retrieve it. This is done using a thin elevator, excavator or a root canal file. If the attempt to remove the apical portion is futile, it may be left *in situ* rather than inadvertently push it into the maxillary antrum
2. Uncover the major part of the root. Here the root is removed in one piece. This may be a better choice than the former one.

CHAPTER

# 23 Management of Impacted Mandibular Canine

Mandibular canines are much less frequently impacted than the maxillary canines.

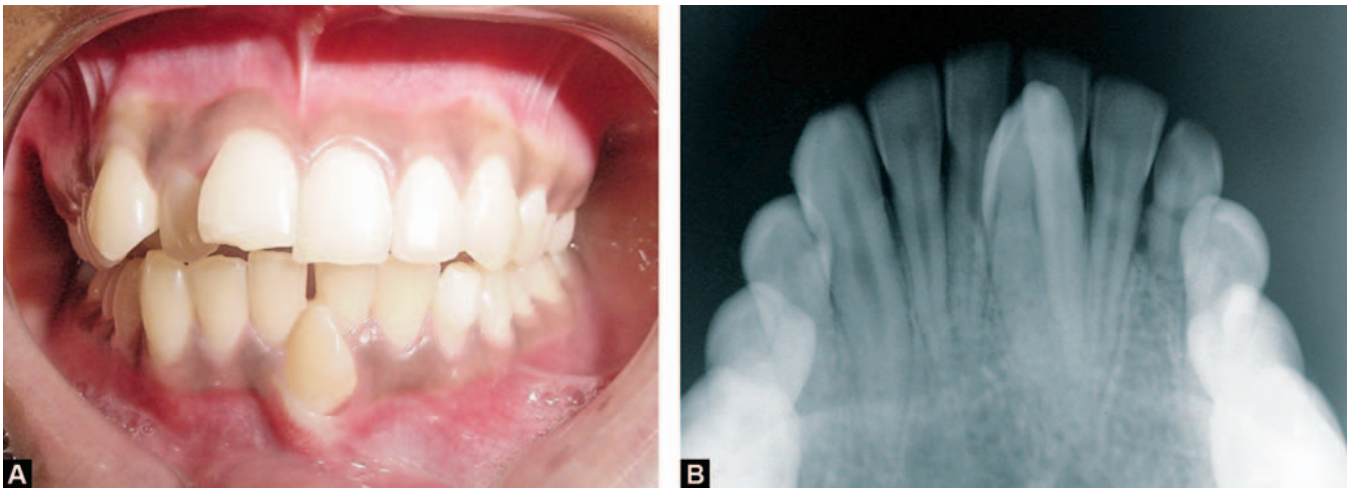
Most mandibular canines are found in a labial position. But sometimes they can be in the mental protuberance area or lying transversely at the lower border of mandible. They can migrate to the opposite side of the mandible, i.e. transposition of canine (Figs 23.1A and B, 23.2A and B). Such teeth maintain their original innervation and this fact has to be considered when removing them under local anesthesia.

Patients with impacted mandibular canine also presents with symptoms comparable to that of impacted maxillary canine like retained deciduous teeth, proclination/displacement of adjacent incisors (Figs 23.3A and B) or clinical features associated with cyst formation (Figs 23.4A and B). Impacted canines may remain symptom free and are then discovered accidentally in a routine radiograph or while investigating for other diseases (Figs 23.5). It may sometimes lead to recurrent pain and infection (Figs 23.6A and B).

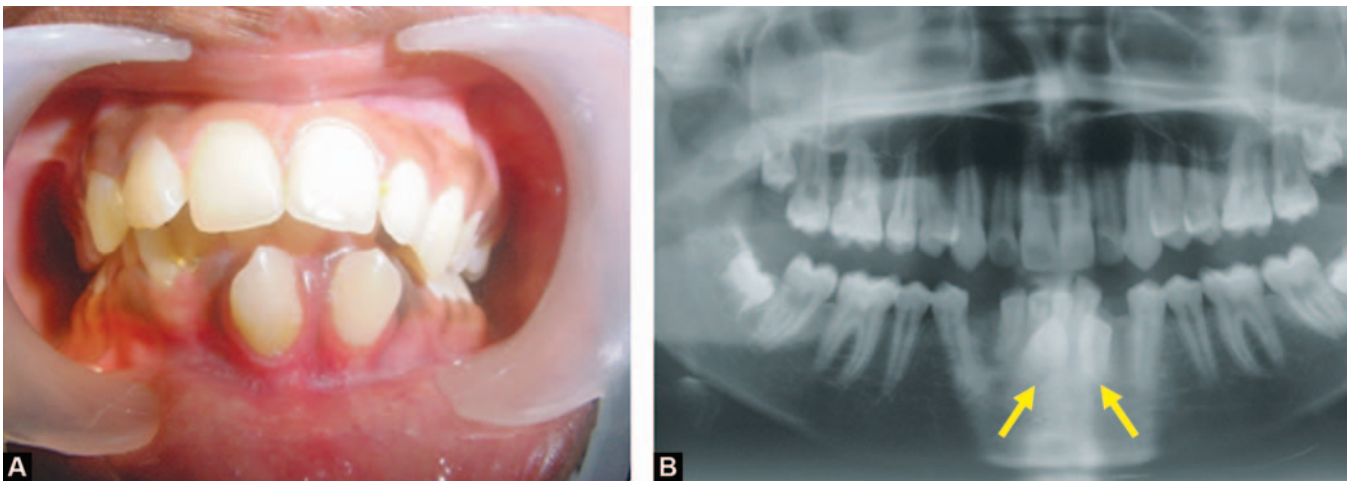
## Treatment

The following treatment options should be considered in the management of impacted mandibular canine:

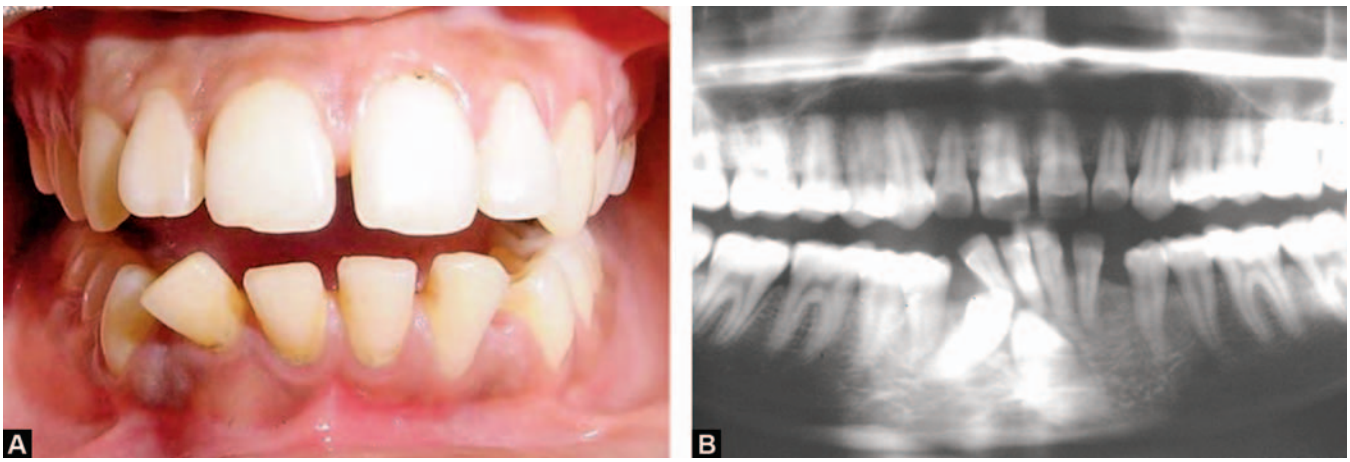
1. *Observation:* In many cases this modality is acceptable if indications for removal do not exist like impingement on adjacent tooth, development of follicular cyst or as a part of the planned orthodontic treatment. The retained primary may be permitted to continue for an extended period. However, the impacted tooth should be periodically reviewed to assess the development of pathologic changes.
2. *Exposure and orthodontic repositioning:* This can be considered if there is adequate space for the accommodation of the tooth in the arch and if the angulation of the tooth is favorable, i.e. deviation of the long axis of the tooth is not excessive. The treatment is carried out in the same manner as for the maxillary canine.
3. *Surgical repositioning:* This may be considered as an alternative treatment option if exposure and orthodontic repositioning is not possible. The optimal time for surgical repositioning appears to be before the root formation is complete, i.e. when the apical foramen is still wide open. In such cases pulpal revascularization and periodontal healing are very predictable. With further root development, the tooth may require endodontic treatment.
4. *Surgical removal of the tooth:* The following are the indications for the removal of impacted mandibular canine:
   a. Evidence of pathology around the tooth, e.g. follicular cyst, tumor.
   b. Close proximity of the follicle to the marginal periodontium of the adjacent tooth.
   c. Orthodontic need to move adjacent tooth into the area.



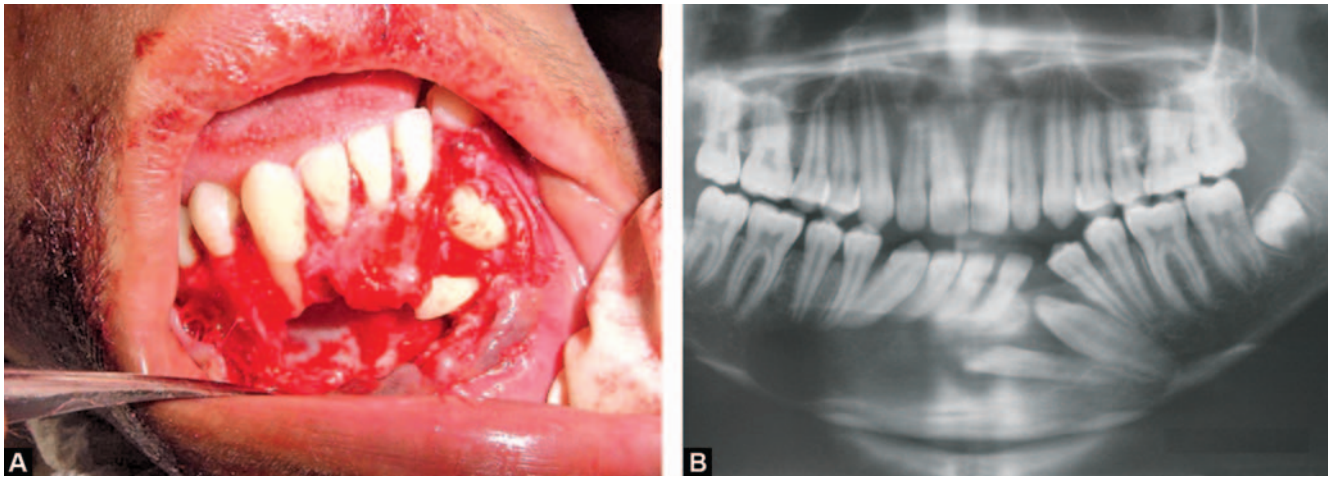

**Figs 23.1A and B:** Transposition of 33 to the midline. (A) Intraoral view, (B) Occlusal X-ray of the patient




**Figs 23.2A and B:** Transposition of both lower canines. (A) Clinical appearance of the patient, (B) OPG of the patient showing transposed canines (yellow arrows)




**Figs 23.3A and B:** Impacted canines causing displacement of lower anterior teeth. (A) Proclination of lower incisor teeth, (B) OPG of the patient showing both lower canines impacted




**Figs 23.4A and B:** Impacted canine associated with dentigerous cyst of mandible (A) Operative appearance showing impacted canine and incisor associated with cyst, (B) OPG of the same patient showing impacted canine and lateral incisor with radiolucent lesion of mandible

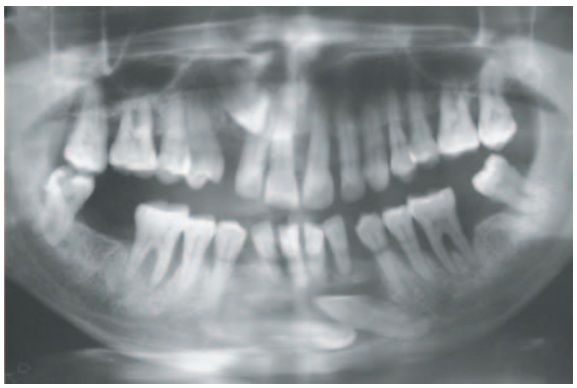
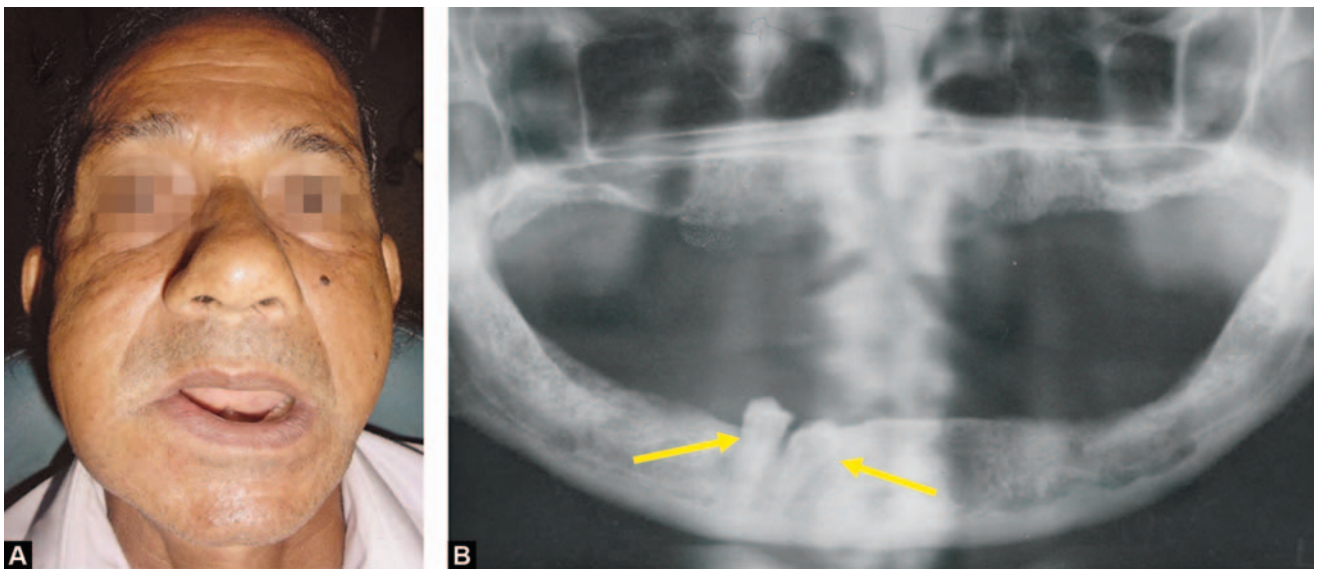


**Fig. 23.5:** Impacted mandibular canines (bilateral) and impacted right maxillary canine in a 52-year-old man. The impacted teeth had remained symptom-free during these years when it was discovered accidentally while investigating for chronic periodontitis




**Figs 23.6A and B:** (A) Patient aged 73 years reported with swelling of the right side of the face. He was using complete denture for the last 15 years, (B) OPG of the patient showing impacted 43 and 44 (yellow arrows). Both the teeth were surgically removed

## Surgical Anatomy (Fig. 23.7)

Compared to maxillary canine the bone encasing the mandibular canine is thick. The lingual cortical bone in the mandibular canine region is very thick, whereas the buccal bone is rather thin. The impacted mandibular canines are often located mesial or distal to the canine region. Surgical access to the tooth is obtained by raising a buccal flap. A lingual flap is seldom raised due to insufficient access and marked postoperative morbidity associated with it. While raising the buccal flap, the insertion of mentalis and incisive muscle is severed. The incisive muscle is inserted at the height of the canine alveolus while the mentalis arises from the mental fossa.

## Removal of Mandibular Canine (Figs 23.8 A to H)

A standard trapezoidal (3 sided) flap or a horizontal incision below the attached gingiva can be used to expose the tooth. A tooth close to the lower border of mandible may require an extraoral incision and dissection for proper exposure. Bone removal is done with burs and chisel and the tooth can be removed by simple elevation or after sectioning.

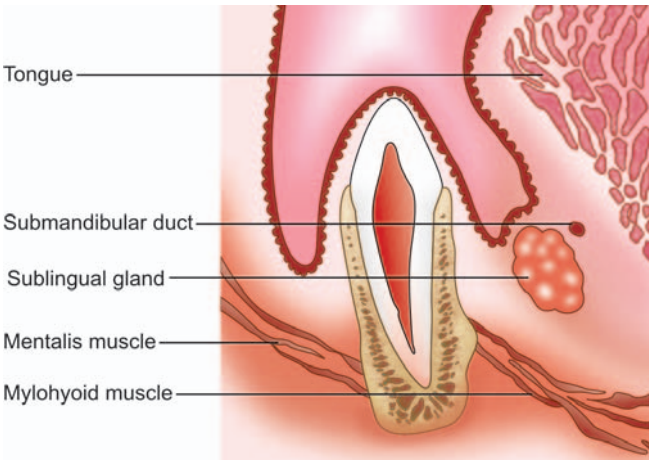
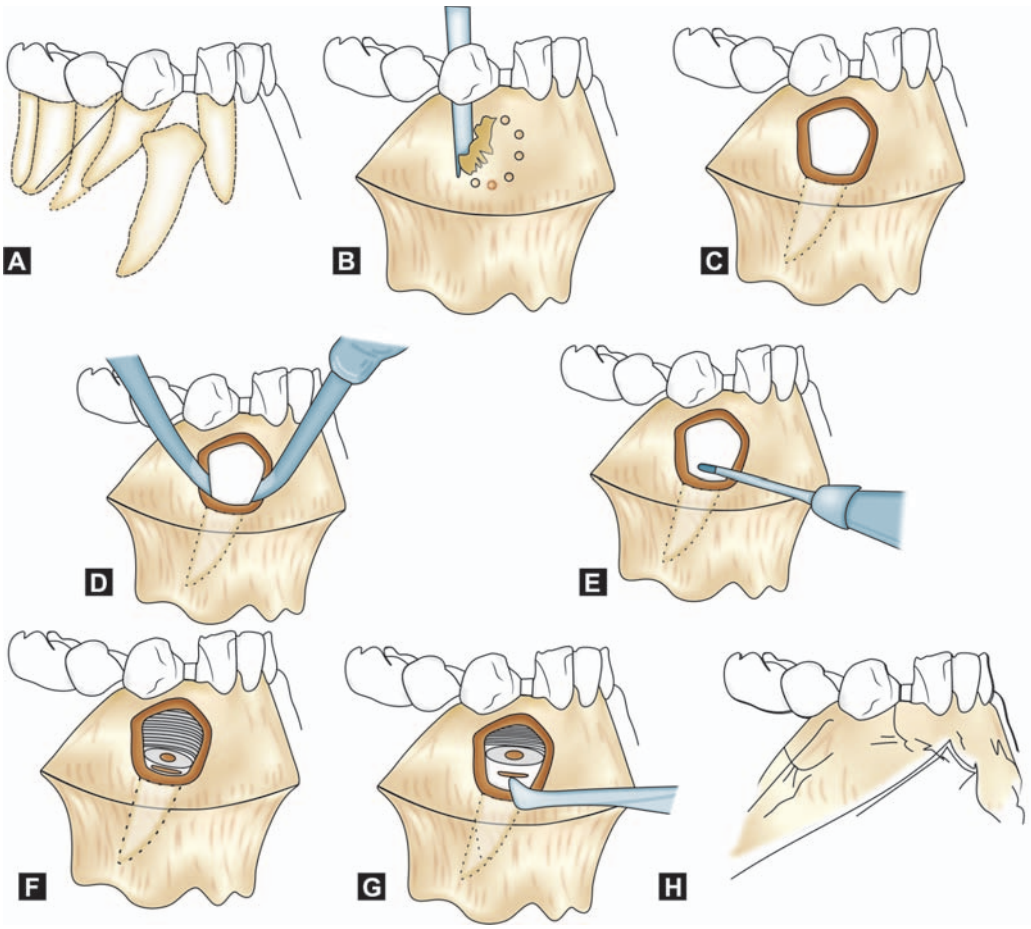



**Fig. 23.7:** Surgical anatomy of mandibular canine area




**Figs 23.8A to H:** Schematic diagram showing steps in the surgical removal of impacted mandibular canine. (A) Incision to raise a trapezoidal flap, (B) Mucoperiosteal flap reflected and the bone overlying the crown removed using bur and chisel, (C).Crown of impacted canine exposed, (D). Elevators applied in an attempt to luxate the tooth. If unsuccessful, (E) Tooth division is performed using bur, (F) Crown removed and more of the root exposed to create a purchase point on the root using bur, (G) Root removed using an elevator applied at the purchase point, (H) Closure of the incision

**Case report** A 16-year-old girl was advised surgical removal of impacted 33 before starting orthodontic treatment. The following is the surgical steps (Figs 23.9 A to L):

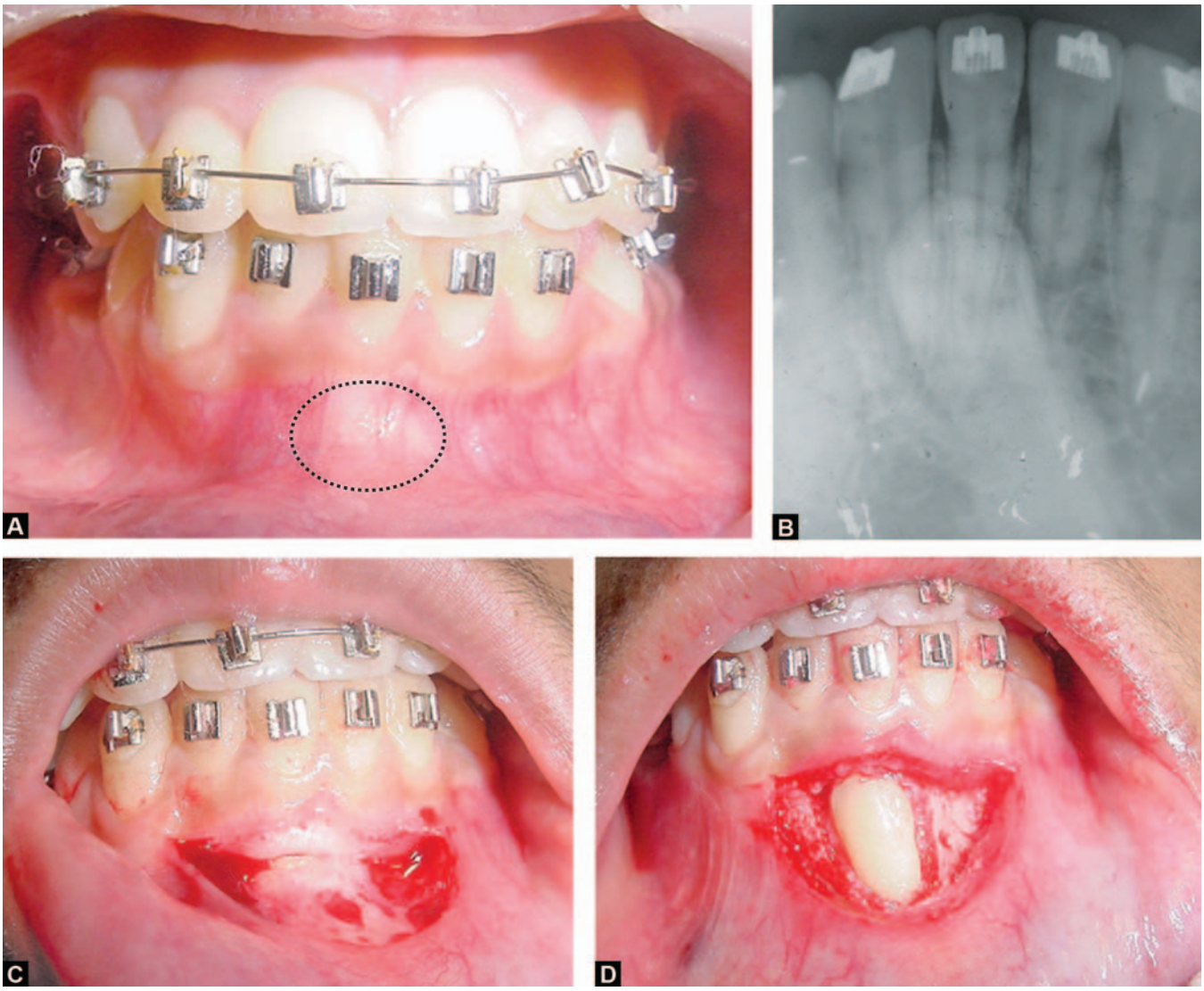
## Complications of Surgical Removal

The following complications may occur during the procedure:

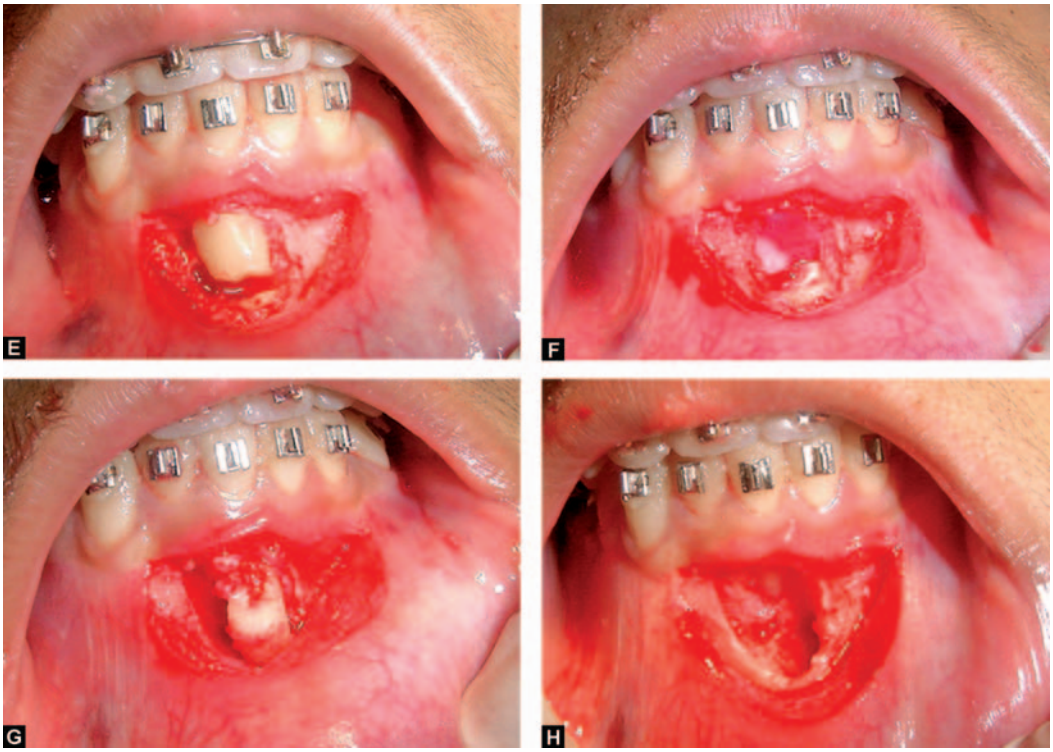
1. Accidental injury to adjacent tooth—During bone removal to expose the impacted canine damage to the supporting bone of the lateral incisor may occur leading to loosening of the tooth. If this happens, the involved tooth should be splinted to the adjacent tooth.
2. Mental nerve injury—This can happen if the distal vertical incision is carried too far backwards and inferiorly.

## Removal of Impacted Mandibular Canine in an Edentulous Patient

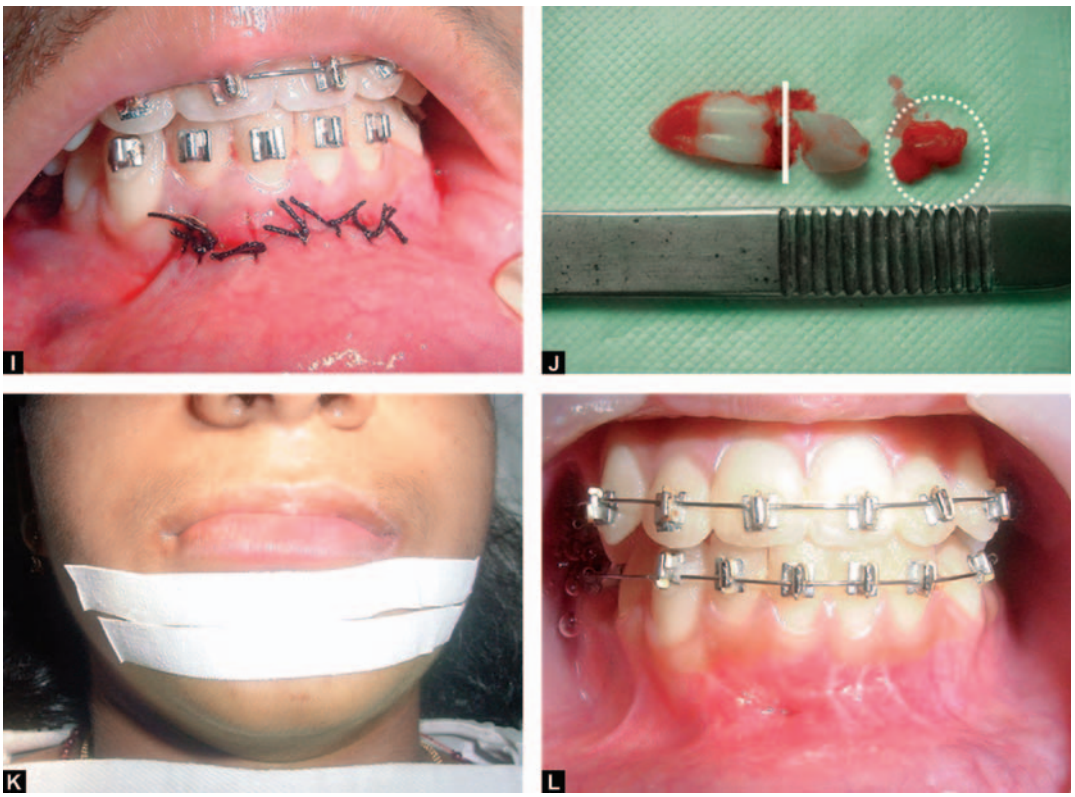
The technique of removal is essentially the same with some modifications and additional precautions. The incision is often given on the crest of the alveolar ridge if the tooth is closer to the ridge. If it is closer to the inferior



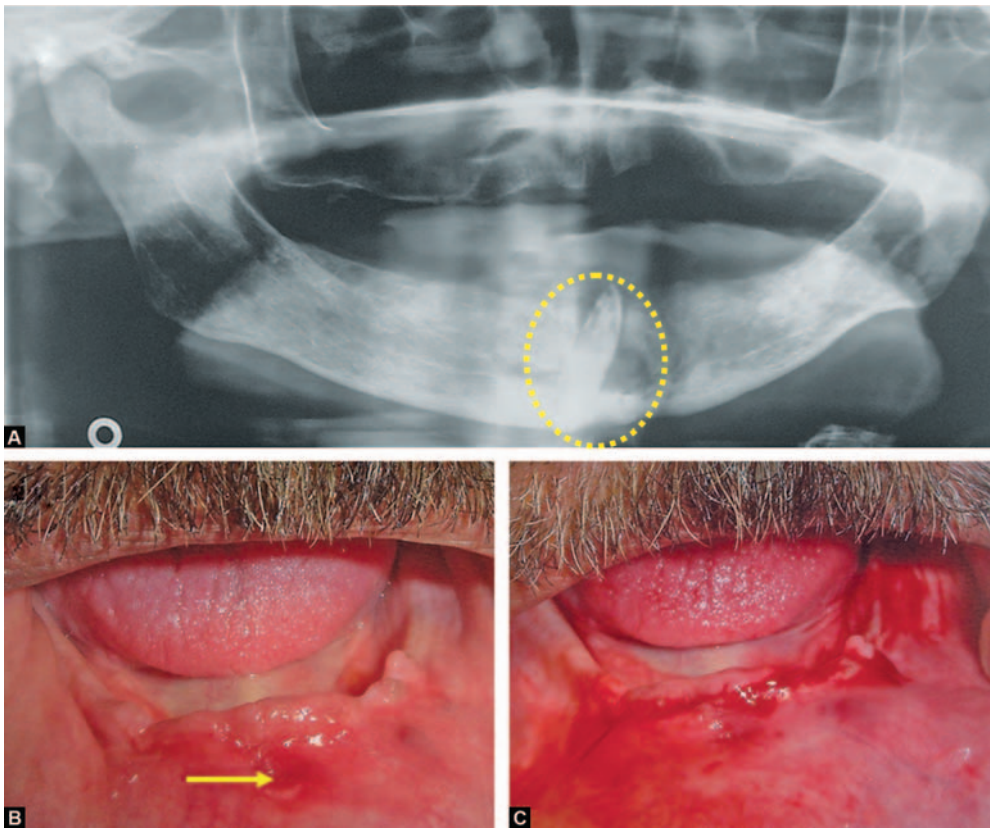

**Figs 23.9 A to D:** Steps in the surgical removal of impacted left mandibular canine- (A) Impacted 33 transposed to midline. Projection of impacted canine marked by dotted black oval, (B) Periapical X-ray showing impacted left lower canine transposed to region of 41 and 31, (C) Incision given and mucoperiosteum reflected, (D) Bone overlying the crown removed to expose the crown



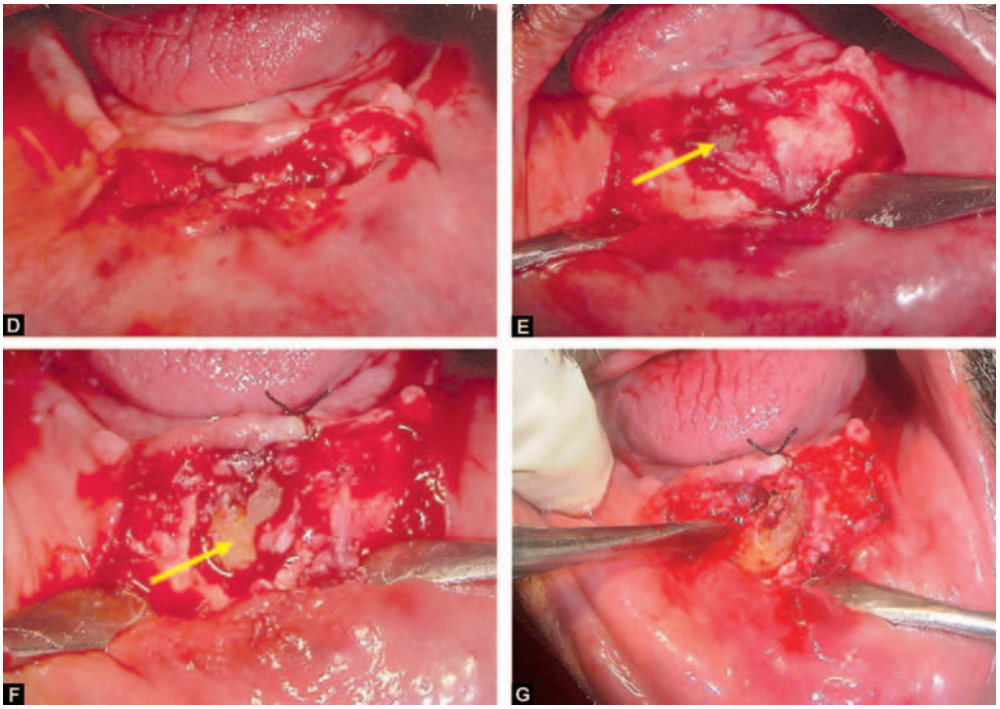

**Figs 23.9E to H:** (E) Crown sectioned, (F) Sectioned crown removed, (G) Root moved into the space previously occupied by the crown, (H) Root removed. Socket debrided and saline irrigation done



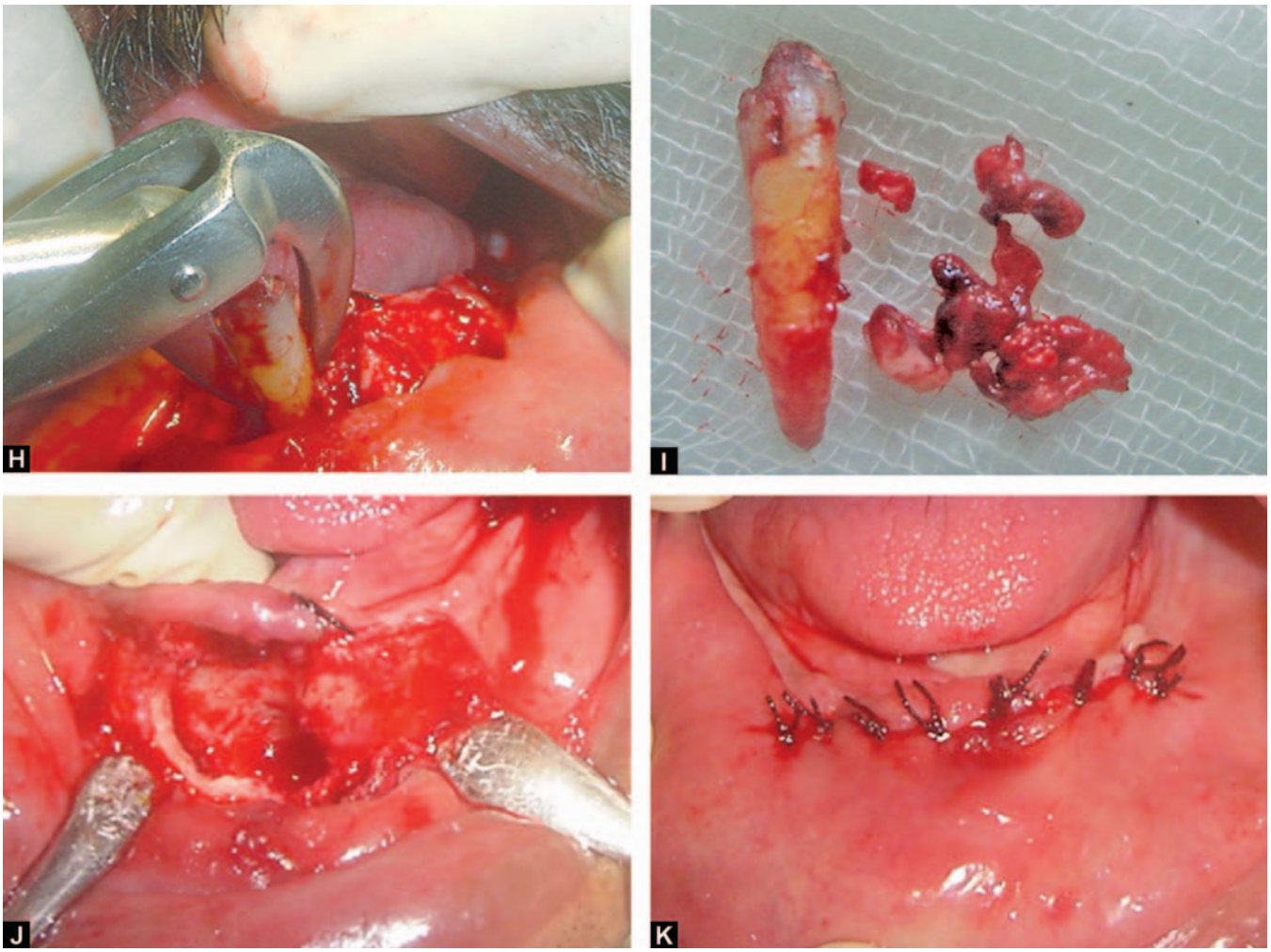

**Figs 23.9I to L:** (I) Suturing completed, (J) Specimen of the tooth (note sectioned area marked with yellow line and follicle with yellow oval), (K) Pressure bandage applied using adhesive plaster to reduce the edema, (L) Postoperative appearance two weeks later with lower arch wire placed




**Figs 23.10A to C:** Steps in the surgical removal of impacted left mandibular canine. (A) OPG showing impacted 33 transposed to the midline with associated radiolucency (yellow oval), (B) Intraoral view showing a sinus opening in the lower labial sulcus (yellow arrow), (C) Incision marked




**Figs 23.10D to G:** (D) Incision deepened and reflection of mucoperiosteum started, (E) Mucoperiosteum reflected to expose the crown tip of impacted 33 (yellow arrow), (F) Bone around the crown removed using bur to expose the crown fully (yellow arrow), (G) Crown mobilized using an elevator




**Figs 23.10H to K:** (H) Removal of the tooth using forceps. This was followed by the curettage of associated granulation tissue, (I) Specimen of the tooth with the soft tissue removed by curettage. The soft tissue was sent for histopathological examination, (J) Socket following debridement, (K) Suturing completed

border, an incision in the sulcus should be considered. As in the case of impacted mandibular third molar due to the extreme resorption of the alveolar ridge and sclerosis of bone in the old age, use of excessive force should be avoided to prevent fracture of mandible. Moreover, there may be pathology associated with the impacted canine which also has to be looked into which further weakens the mandible. Any associated systemic disease contraindicating the surgery has to be considered during the planning stage.

The following is the case report of surgical removal of impacted left mandibular canine transposed to midline in a 56-year-old man (Figs 23.10A to K). The patient reported with recurrent swelling of the sub mental region of two years duration associated with occasional intraoral pus discharge. He was wearing complete denture for the last seven years. He gave a history of treatment for hypertension for the last three years and the disease was well controlled with medication.

CHAPTER

# 24

# Surgical Repositioning/ Autotransplantation

Impacted or malpositioned canines with a favorable root pattern (without hooks or sharp curves) can be tried for transplantation in the dental arch. This is done utilizing the socket of deciduous canine or first premolar, depending on the space available.

The prognosis for auto transplantation of impacted canines in adults is poor (Moos,1974). Periodontal healing without any root resorption varied between authors from 25 to 85 percent. At a later stage of development the root is fully completed and the chance for pulpal and periodontal healing is reduced. The optimal development stage for autotransplantation is when the root is 50-75 percent formed. In light of good prognosis for autotransplantation of premolars documented by Andreasen (1992)[1] canine transplantation should be planned as early as possible.

## Autotransplantation could be Recommended When

Interceptive measures are inappropriate or have failed.

The degree of malposition is too great to make orthodontic alignment feasible.

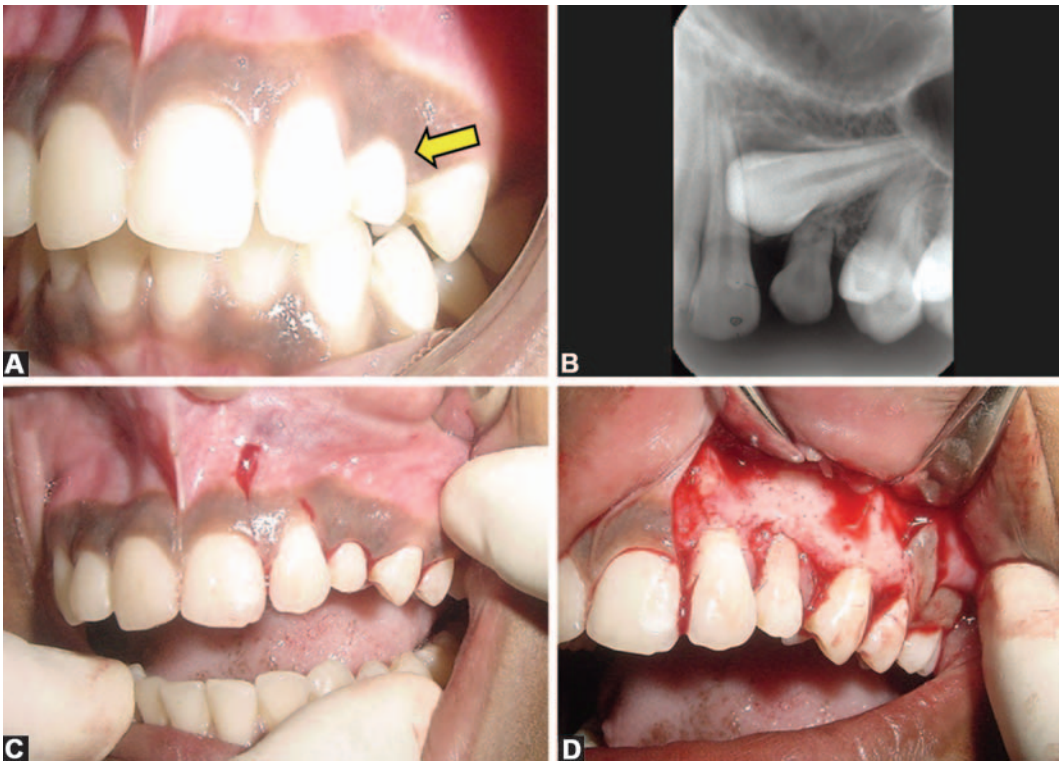
Adequate space is available for canine.

The prognosis is good for the tooth to be transplanted and it can be removed atraumatically.

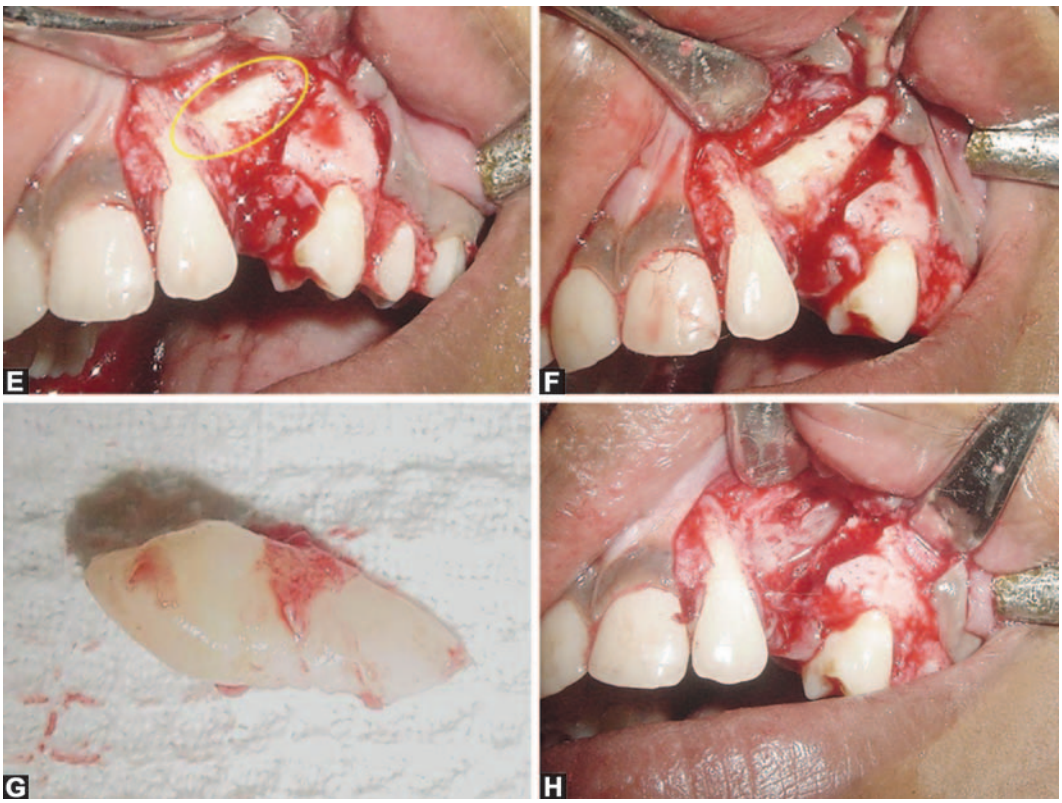
There is no evidence of ankylosis of canine.

However even in experienced hands, it can fail and there could be rejection, resorption, or ankylosis of the transplanted tooth. The procedure of transplantation is described in the following case report.

**Case report:** An 18-year-old girl reported with complaints of retained left upper deciduous canine and unerupted permanent canine (Fig. 24.1A). Intraoral periapical X-ray showed retained left maxillary canine and impacted 23 (Fig. 24.1B). Surgical removal of 23 was planned under local anesthesia. The patient was informed regarding the option of reimplantation of 23 following its removal. The patient readily agreed for the procedure. After raising a mucoperiosteal flap (Figs 24.1C and D) the retained deciduous canine was removed. The impacted 23 was exposed by removing the overlying bone (Fig. 24.1E). The impacted tooth was mobilized and then removed (Figs 24.1F and G). The socket of deciduous canine and permanent canine was debrided and 23 was tried for fit (Figs 24.1H and I ). To fill the area of bone loss artificial bone substitute ('Periobone- G') was considered (Fig. 24.1J). The bone defect was slowly filled using the bone substitute as per the manufacturer's direction (Figs 24.1K and L). Suturing was completed (Fig. 24.1M) and a previously fabricated splint was cemented to immobilize the reimplanted tooth and to relieve it from occlusal forces (Fig. 24.1N). Healing was normal and the sutures were removed on the tenth postoperative day. Postoperative X -ray was taken (Fig. 24.1O). It was an interesting finding in the postoperative X-ray of an additional impacted tooth in the same region (marked as yellow oval) which was not visible in the preoperative radiograph. Root canal treatment was then completed for the transplanted tooth on the 14th day (Fig 24.1P). The patient was regularly followed up. The splint was removed eight weeks later. Figure 24.1Q shows the reimplanted tooth in good functional occlusion.




**Figs 24.1A to D:** Steps in the surgical reimplantation of impacted maxillary canine tooth: (A) Intraoral photograph of the patient showing retained left upper deciduous canine (yellow arrow), (B) Periapical X-ray showing impacted 23, (C) Incision marked, (D) Mucoperiosteal flap reflected and retracted




**Figs 24.1E to H:** (E) Retained deciduous canine extracted and overlying bone removed to expose impacted 23 (yellow oval), (F) Adequate bone removed to mobilize 23, (G) Impacted 23 removed, (H) Socket after removal of 23


**Figs 24.1I to L:** (I) Canine tried for fit in the socket, (J) Packing of artificial bone substitute 'Periobone -G' used, (K) 'Periobone -G' placed in the socket, (L) Canine tooth reimplanted and additional amount of 'Periobone -G'placed


**Figs 24.1M to Q:** (M) Suturing completed, (N) Splint cemented to immobilize the reimplanted tooth and to relieve it from occlusal forces, (O) Postoperative X-ray taken on the 10th day. It was an interesting finding in the postoperative X-ray of an additional impacted tooth in the same region (yellow oval) which was not visible in the preoperative radiograph, (P) Radiograph showing root canal treatment of reimplanted 23 completed, (Q) Reimplanted tooth in good functional occlusion 8 weeks later (yellow arrow) after removal of the splint

## REFERENCE

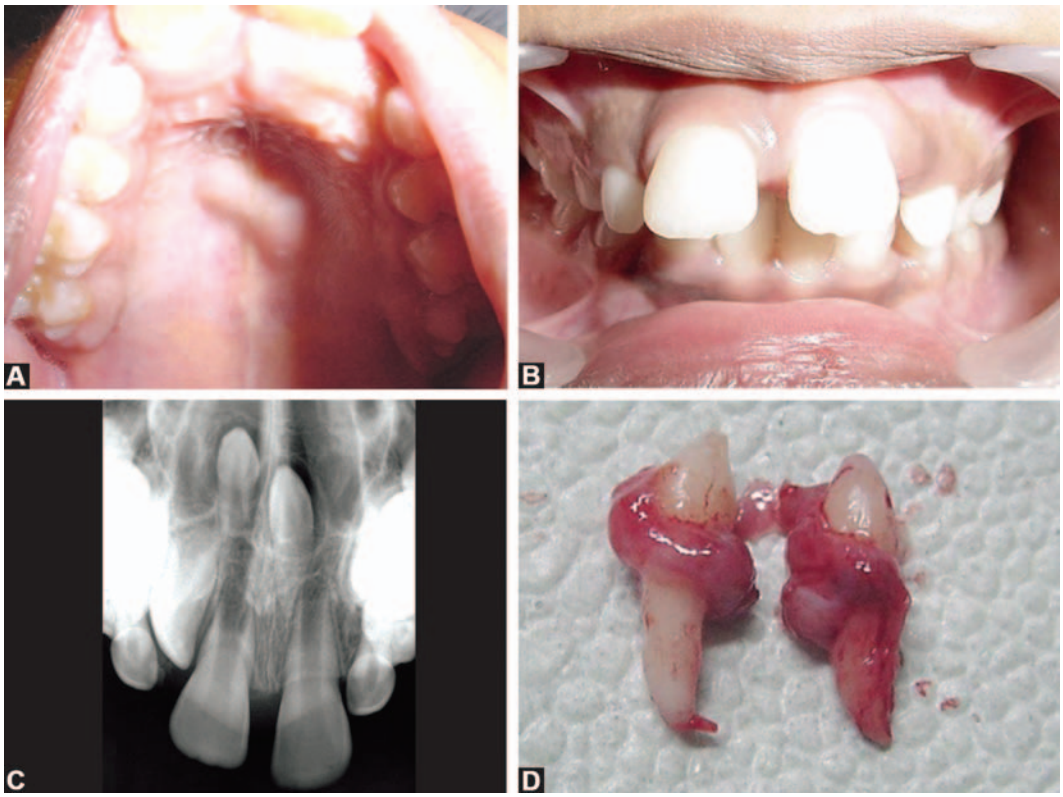
1. Andreasen JO. Atlas of Replantation and Transplantation of Teeth. Mediglobe SA, Fribourg 1992.

CHAPTER

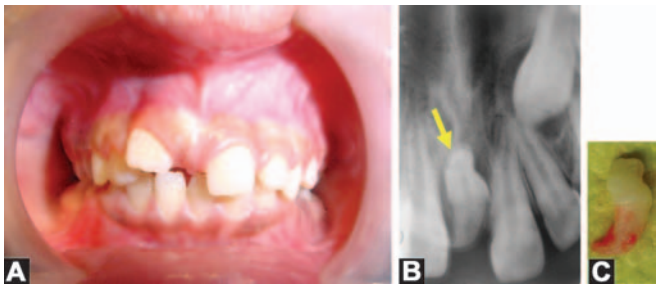
# 25 Unerupted and Impacted Supernumerary Teeth

Supernumerary teeth, especially mesiodens may be indicated for extraction as they can prevent the eruption of normal dentition, or cause malposition of teeth (Figs 25.1A to D), produce diastema (Figs 25.2A to C), or obstruct orthodontic tooth movement or may be associated with cyst formation.

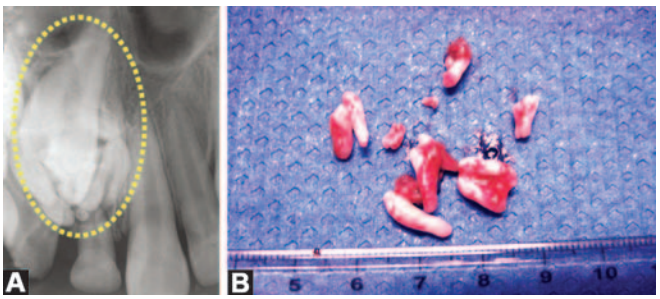
Multiple supernumerary teeth may be associated with odontome (Figs 25.3A and B).



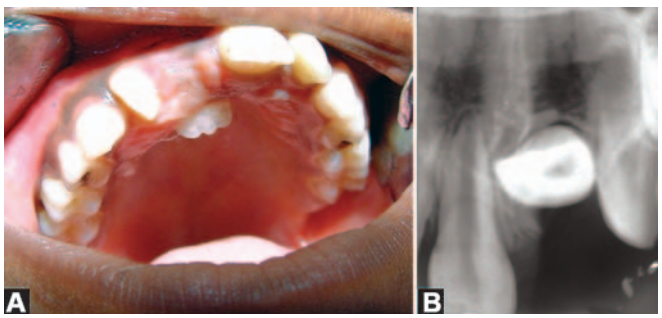

**Figs 25.1A to D:** Supernumerary teeth in the palate in a nine year old boy (A) Hard selling in the palate, (B) Intraoral view showing that 11 and 21 have erupted, but 12 and 22 are unerupted, (C) Occlusal X-ray showing two impacted supernumerary teeth in the palate, (D) Impacted supernumeraries removed surgically



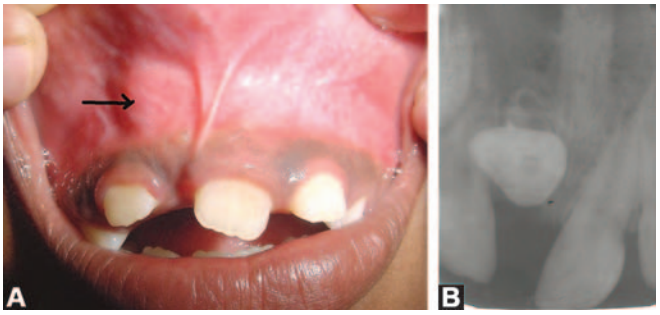

**Figs 25.2A to C:** Mesiodens causing diastema in a 10-year-old girl (A) Partial eruption of 11 and diastema, (B) Periapical X-ray of the same patient showing impacted mesiodens in inverted position (yellow arrow) and erupting 23. Removal of mesiodens was necessary to facilitate space closure between the centrals and to promote eruption of 23, (C) Mesiodens surgically removed




**Figs 25.3A and B:** Impacted supernumerary teeth associated with odontome (A) IOPA X-ray showing multiple impacted supernumerary teeth associated with odontome in the upper incisor region, (B) Supernumerary teeth removed at the time of surgery




**Figs 25.4A and B:** (A) Dilacerted 11 in a 10 years boy erupting palatally, (B) Periapical X-ray of the above patient showing dilacerated 11




**Figs 25.5A and B:** (A) Impacted 11 erupting labially (black arrow indicating the bulge), (B) Periapical X-ray of the patient showing dilacerated 11

## Operative Procedure

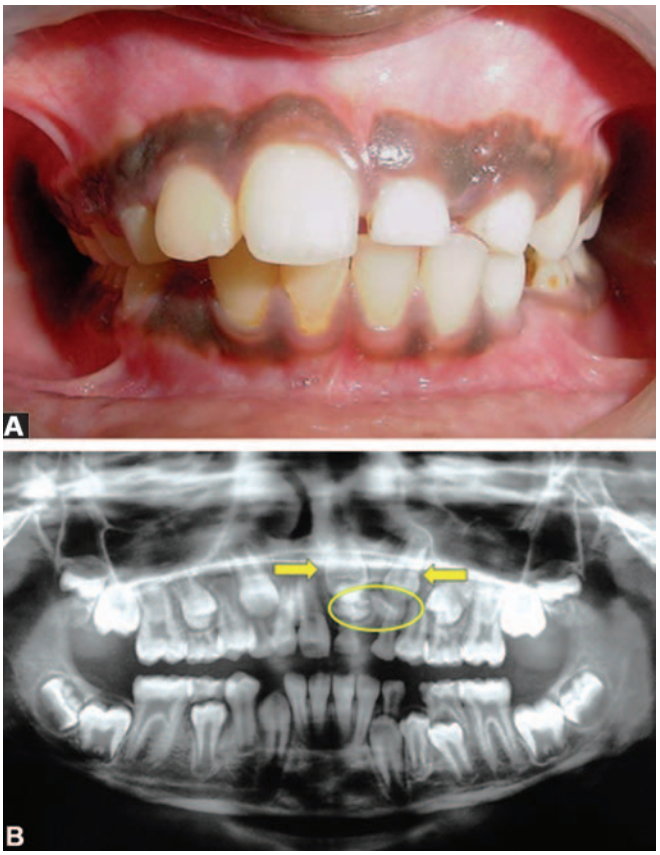
Localization and the surgical removal of impacted supernumerary is similar to that of maxillary canine. As for the maxillary canine tooth, the position of the supernumerary tooth is first localized clinically and radiographically. A mucoperiosteal flap is then designed and elevated, bone removal is done with burs and the tooth is then exposed and removed.

Other teeth in the dental arch like the incisors (Figs 25.4 to 25.6) or premolars (Fig. 25.7) can also get impacted either due to systemic or local factors. The flap design for their removal depends on the position of the teeth. But the basic principles of removal remain the same. Impacted upper central incisors are frequently dilacerated, which makes their removal difficult (Figs 25.4 and 25.5).

Impacted incisors will also prevent the eruption of adjacent teeth (Figs 25.6A and B).

## SUMMARY

The management of impacted supernumerary teeth requires good clinical skills and observation from the part of the dental surgeon. Any tooth missing in the dental arch even after its normal time of eruption should compel




**Figs 25.6A and B:** (A) Unerupted 21, 22 and 23 in an 11-year-old boy, (B) OPG of the patient showing supernumerary (yellow oval) preventing eruption of 21 and 23 (yellow arrows). 22 is missing

**Fig. 25.7:** Impacted lower premolar, the root of which is reaching up to the inferior border of mandible. Possible fracture of the mandible should be anticipated if excessive bone removal is done

the dental surgeon to investigate. Management of impacted teeth is not difficult and the basic principles of surgery followed are the same for all the teeth. Time should be spent to evaluate the case, arrive at a proper diagnosis and those which need expert management should be referred. In formulating a treatment plan close association of the general dental surgeon with the oral and maxillofacial surgeon, orthodontist and pedodontist is required.

# Index

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