

ODESSA NATIONAL MEDICAL UNIVERSITY


**Department of Radiation Diagnostics, Therapy, radiation medicine
and Oncology**

METHODICAL RECOMMENDATIONS FOR STUDYING THE TOPIC:

"Radiation research methods and radiation anatomy of the maxillofacial region.

Radiation signs of diseases of the teeth and jaws".

(for the 3th year students of the dentistry faculty)

Approved
at the methodical meeting of the department
"27" August 2021
Protocol №1
Head Department  Sokolov V.M.

ODESSA- 2021

"Radiation research methods and normal radiation anatomy of teeth» - 2 hours.

1. Actuality of theme.

Numerous etiological factors contribute to the violation of the harmonious development of the maxillofacial area, which leads to the formation of abnormalities of individual teeth, each of which requires appropriate and timely treatment. Radiation diagnostic methods allow you to fully and quickly assess the severity of pathological changes and provide timely assistance to the patient.

2. Objectives of the lesson:

2.1 General goals:

1. To study the basic and additional methods of X-ray examinations used in dentistry and their possibilities in solving diagnostic problems.

2. Assimilate the features of X-ray image of the facial skeleton in the norm and at different ages.

3. Learn to choose the most appropriate method to solve a particular clinical case.

2.2 Educational:

1. Deontological - to provide information for conversations of students (future doctors) with patients about the need for timely X-ray examination.

2. The guidelines of dentists are to optimize the methods of treatment and research of patients, reduce the impact of radiation and responsible allocation of health resources.

3. Legal representations - information on this topic allows the doctor to avoid unfounded accusations of complications during the disease after medical or diagnostic procedures.

2.3. Specific goals:

- know:

1. Features of methods of examination of patients in this group.

2. Be able to distinguish between "norm" and "pathology" in dental practice.

3. Indications and contraindications for the use of various methods of radiological examination.

2.4. Based on theoretical knowledge on the topic:

- master the techniques / be able /:

1. Be able to choose the appropriate method of radiological examination in their own dental practice in a specific clinical case.

2. Be able to justify the appointment in the patient's medical history and fill out referrals for examination.

3. Be able to interpret (evaluate) the results of the study.

4. Be able to explain to the patient the results of radiological examination.

3. Materials for classroom independent training (interdisciplinary integration).

Names of previous disciplines	Acquired knowledge and skills
1. Anatomy	1. Be able to describe the structure of the cerebral and facial parts of the skull. 2. Know the structure of the temporomandibular joint. 3. Identify the anatomical features of different groups of temporary and permanent teeth. 4. Draw a diagram of the group affiliation of temporary and permanent teeth.
2. Histology	Ability to draw a diagram of embryonic development of the maxillofacial area and histological structure of teeth.
3. Medical biology	Be able to schematically depict the mechanisms of inheritance of pathology of individual teeth.

4. Content of the topic (text or thesis), graph-logical structure of the lesson.

1. Features of the so-called dental X-ray diagnostic devices.
2. Technique of obtaining intraoral X-rays. Dental x-ray film.
3. The rule of isomerism in intraoral radiographs in the bite.
4. Interproximal radiography.
5. Bite radiography (occlusal).
6. Long-focus radiography.
7. Scheme of panoramic radiography.
8. Artifacts in violation of the rules of radiographs.
9. Scheme of X-ray image of the tooth.
10. Normal radiography of the maxillofacial region.
11. Scheme-algorithm of X-ray analysis.

3.1. Introduction.

Despite the emergence of new radiological diagnostic methods, classical radiography remains the main method of diagnosing diseases of the maxillofacial region. With the help of radiography it is possible to clarify the diagnosis of apical or marginal periodontal lesions, to differentiate chronic periodontitis (fibrous, granulomatous, granular), to detect osteomyelitis and other bone disorders, to diagnose periodontitis or periodontitis and its degree depending on the degree of Radiography facilitates the diagnosis of functional overload of individual teeth due to traumatic articulation or improper design of dentures. Radiography allows to determine the severity of the process in the case of periodontal disease, the degree and nature of resorption of cells (horizontal, vertical, funnel-shaped resorption, the presence of bone pockets), the need for surgical or orthopedic treatment, the design of the orthopedic apparatus (removable, non-removable) and abutment teeth. Modern dental X-ray machines allow you to produce both classic images using X-ray film and images using digital sensors.

3.2. Intraoral radiography is still the basis of X-ray examination in most dental and periodontal diseases. Currently, there are four methods of intraoral radiography, used to study the condition of the teeth, para- and periodontium:

1. Contact (in the "example") radiography according to the rule of isometry.
2. Interproximal radiography.
3. X-ray bite (occlusal).

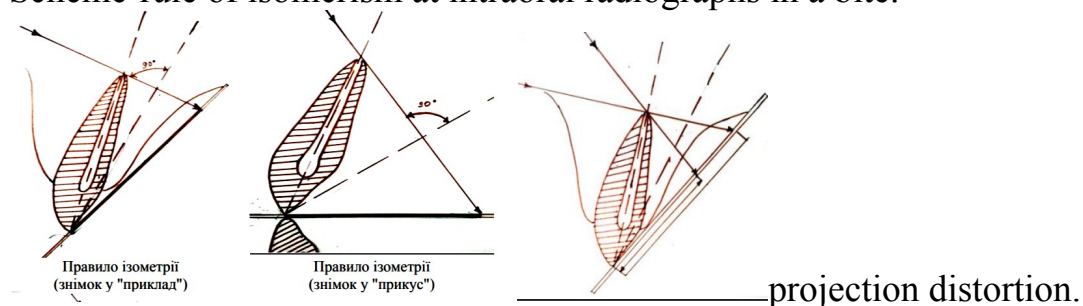
4. Radiography with increasing focal length by a parallel beam of rays (long-focus radiography).

Contact images give a clearer image, but unlike "bite" images do not always allow you to get an image near the alveolar area. At the same time, the method of isometric survey has a significant disadvantage, it does not allow to assess the condition of the marginal sections of the interalveolar ridges, as the latter are removed by a beveled beam, which leads to a shortening of their image.

That is why in the diagnosis of periodontal disease it should be abandoned.

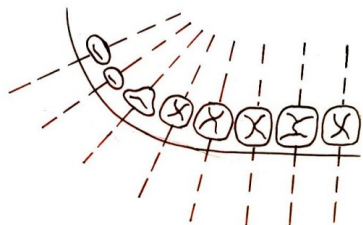
However, strict adherence to the rule of isometry, unfortunately, is impossible, because it is difficult for each patient to accurately determine the bisectors of the angle formed by the axis of the tooth and the plane of the film. Therefore, use the angles of inclination of the tube, calculated empirically for certain groups of teeth. Thus, for images of molars, the angle of inclination of the X-ray tube to the horizontal plane is 25-30 °, for premolars - 35 °, canines - 45 °, incisors - 55 °.

Scheme-rule of isomerism at intraoral radiographs in a bite.



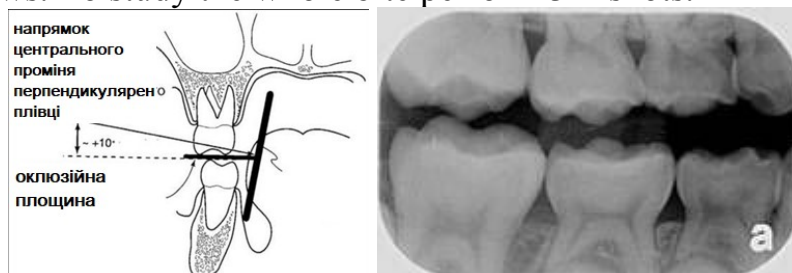
3.3. The orthoradiality rule is used to obtain a separate image of the teeth. The central beam is directed perpendicular to the tangent drawn to the dental arch in the area of the examined tooth.

Scheme of panoramic radiography

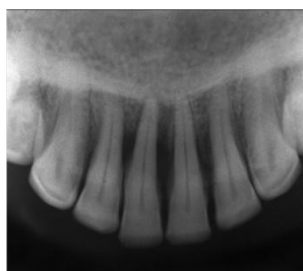


3.4. *Interproximal radiography (Bitewings)*. It is used to obtain a clear undistorted image of the marginal parts of the alveolar processes of the jaws. The method allows you to objectively assess the degree of resorption of bone tissue in the dynamics and is the best way to detect proximal and cervical caries.

To fix the film, you can use a piece of thick paper attached to the wrapper of the film and clamped between closed teeth. The central beam is directed perpendicular to the crowns and the film. The radiographs show the crowns of the teeth and the marginal parts of the alveolar processes of the upper and lower jaws. To study the whole bite perform 3-4 shots.



3.5. Bite radiography (occlusal). Snapshots are performed when necessary to study large areas of the alveolar process - 4 or more teeth, in search of retained and dystopian teeth. Bite radiography is used in the examination of children, as well as in cases where intraoral contact images are not possible (with damage to the jaws, stiffness of the TMJ, increased gag reflex).



Radiograph of the arch of the oral cavity ("bite")

Allows you to study the structure of the bony palate and front teeth of the upper jaw. The structure of the bony palate, the anterior part of the alveolar process of the upper jaws and the incisors are well visualized.

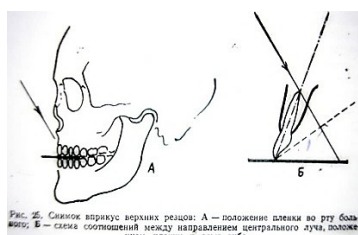
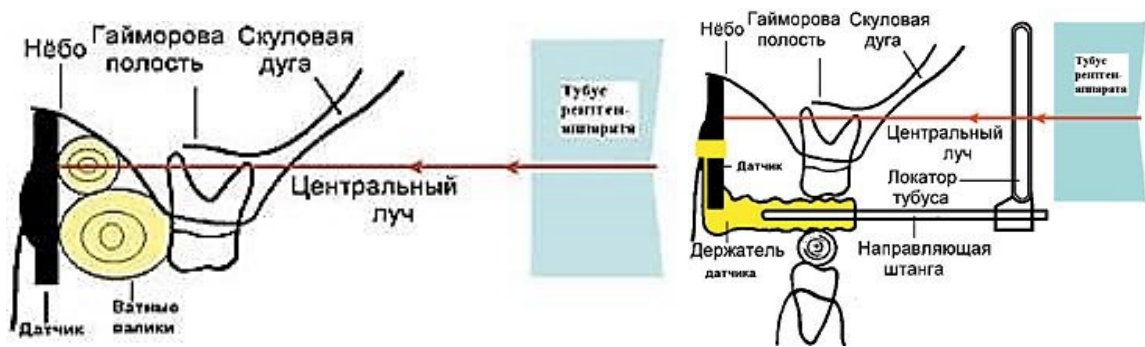


Рис. 26. Схеми випуску верхніх резців: А — положення плівки во рту б'яга м'яко; Б — схема соотношений между направлением центрального луча, положением плівки и осью зуба.

The radiograph of the arch of the oral cavity ("bite") allows you to study the structure of the bony palate and front teeth of the upper jaw. The structure of the bony palate, the anterior part of the alveolar process of the upper jaws and the incisors are well visualized.

3.6. Radiography with increasing focal length by a parallel beam of rays (long-focus radiography) avoids the shortcomings of contact imaging and preserves its positive aspects: coverage of a large part of the alveolar process vertically, complete tooth image, clear bone structure. One of the important advantages of imaging with parallel rays is that the image of the marginal parts of the alveolar processes is not distorted, and therefore the technique can be recommended for widespread use in periodontology. The X-ray film is located in the mouth parallel to the long axis of the tooth, for which special film holders or hemostatic clamps are used (you can also use rollers made of cotton wool or gauze).



Parallel technology. The image receiver is installed by means of cotton wool rollers, with the help of a positioner.

3.7. Orthopantomogram (panoramic image of teeth).

In panoramic tomography, the X-ray passes through the object and is perceived by the receiver as an image directly during the movement of the X-ray tube and sensor around the patient's head.

The generator and the console of the image receiver are equipped with dense collimators, so the beam passing through the object is perceived by the receiver in the form of a fan. In the process of shooting at each point of movement, the focus of the beam is strictly perpendicular to the image receiver (sensor or film), the image covers the entire area of the alveolar part of both jaws; the image itself is a layer (slice, area) deployed in the plane, through which the focus moved during shooting.

In panoramic tomography, the radiation source and the image receiver move relative to the object along certain trajectories, describing an arc of 270° .



The trajectory of focus movement in panoramic tomography.



The direction of the beam (arrow) and the scheme of passage of the selected layer vertically in the area of the molars.

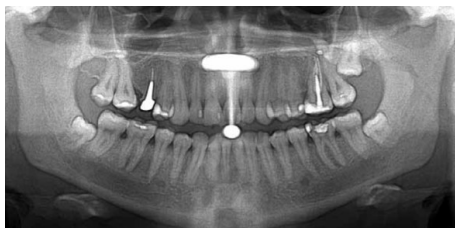


The scheme of the passage of the selected layer vertically in the sagittal plane in the area of the frontal group of teeth.

3.8. Artifacts in violation of the rules of radiographs.



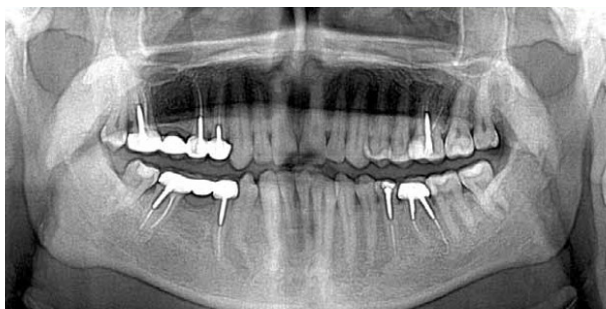
Layering of artifacts (unsealed earrings) on the upper molars.



Shadow from the tongue piercing, which is layered on top of the roots of the incisors of the upper jaw.



The positioning error caused the layers of the vertebrae on the centrally located teeth of the upper and lower jaws.

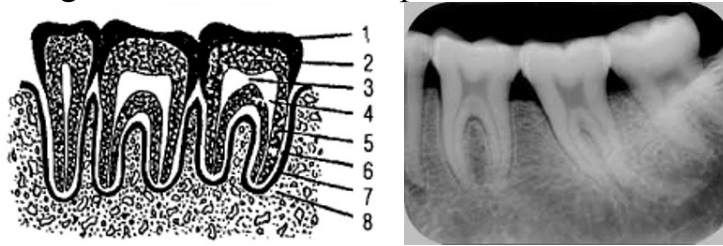


The wide lumen at the time of the radiological examination led to an artifact in the area of the incisors of the upper jaw.

3.9. Scheme of X-ray image of the tooth.

- 1 - shadow of the enamel cover of the crown;
- 2 - shadow dentin crown;
- 3 - enlightenment corresponding to the tooth cavity;
- 4 - enlightenment corresponding to the root canal;
- 5 - the shadow of the root of the tooth, consisting of the shadow of dentin and indistinguishable from it the shadow of cement;
- 6 - enlightenment, corresponding to the lateral parts of the periodontal space;
- 7 - dense strip of the cortical layer of the walls of the hole;

- 8 -image of the interdental septum.



3.10. Scheme of the algorithm of the analysis of the radiograph:

1) Determining the quality of the radiograph and the feasibility of its analysis; radiograph should be contrasting, clear, structural, without projection distortions;

2) Definition on the image of localization (upper or lower jaw). For the upper jaw, normal X-ray features are the projection of the bottom of the cavities (maxillary, nasal) and fine-loop pattern of the cancellous bone, and for the lower jaw - the absence of projections of the cavities (maxillary, nasal) and large-loop bone pattern.

3) Determination of the anterior or lateral jaw by the shape of the crowns of the teeth and the anatomical formations of this department in their X-ray image (especially in the absence of teeth).

Intraoral radiographs of the upper jaw on the anterior, as a rule, projected 7 main anatomical formations: the bottom of the nasal cavity, nasal membrane, lower nasal conchae, lower nasal passages, anterior nasal axis, intermaxillary suture and incisor (last - not always) in the lateral part of the 3 main formations: the bottom of the maxillary cavity, the bottom of the nasal cavity, the zygomatic bone and the third molar (if you get an X-ray of eight teeth) additional 4 formations: maxillary hump, outer flap of the pterygoid process, hook

On radiographs of the lower jaw in the anterior part is projected only the chin hump and in the lateral part of the 3 main formations: chin hole, mandibular canal and external oblique line;

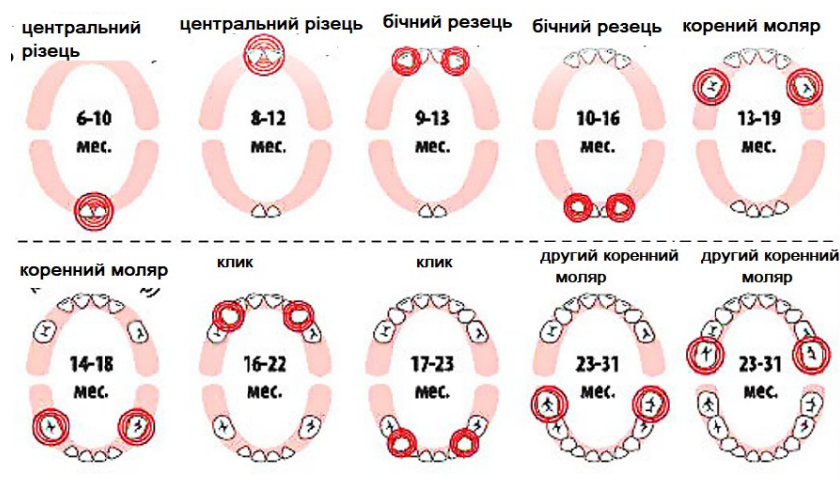
4) Detailed analysis of each tooth separately:

- evaluation of the crown: size, shape, contours, intensity of hard tissues;
- tooth cavity: presence, absence, shape, size, structure;
- tooth root: number, size, shape, contours;
- root canal: presence, absence, width, in the presence of filling material - the degree of filling;
- periodontal gap: width, uniformity;
- compact plates of the alveoli: presence, absence, width;
- violation of integrity;
- surrounding bone tissue: osteoporosis, destruction, osteosclerosis;
- interalveolar membranes: location, shape of the apex, safety -locking compact plate, structure;

5) Determination of pathology in the area of the upper and marginal periodontium;

6) Determination of pathology in the bone tissue of the jaw.

3.11. Scheme of eruption of deciduous teeth in children



3.12. It is necessary to clearly understand that light areas on radiographs (negative!) are reflections of X-ray shadows, and dark - enlightenment. Compact parts of bones and teeth that hold X-rays more intensely look light on radiographs, while soft tissues (such as perimeters) weakly retain X-rays, so they appear as dark areas. It is necessary to remember and be able to find on radiographs signs of a normal condition of a tooth and surrounding fabrics: borders of a crown of a tooth are equal, without usurps and ledges; the image of the crown around the pulp chamber is homogeneous. The shape of the pulp chamber corresponds to the type of tooth. The root canal has smooth walls and a uniform lumen, goes from 12 pulp chambers to the top of the root without deviations; the compact closing plate of a tooth alveolus has identical thickness on all its extent and without interruption passes through a top of an intercellular partition on the next alveoli; the apex of the intercellular septum has an acute shape. Determination of the area and number of the tooth of the lower and upper jaws is carried out by the following areas: chin (incisors), chin holes (premolars), mandibular canal (premolars and molars), angle of the mandible (molars), ascending branch of the mandible (molars), incisal canal and incisor hole (incisors), lateral wall of the nose and the bottom of the maxillary sinus (premolars and molars), chin bone (molars). The anatomical features of different types of teeth (crown shape and pulp chamber, number of roots) are also taken into account. It is necessary to be able to recognize in pictures of jaws of children images of dental follicles containing crowns of future teeth, and on the images of the jaws of the elderly signs of dystrophic changes: atrophy of the alveolar processes, bone porosity. It is necessary to remember and learn to find on radiographs signs of abnormalities in the structure of teeth and jaws: hypoplasia of tooth enamel - radiologically manifested by heterogeneity of the crown shadow, expressed in alternating areas of greater and lesser density, mostly horizontal, and create the impression of stripes; enamel hyperplasia - small grains of cement covered with enamel (so-called enamel drops) are found. Radiologically, enamel drops appear in the form of small, rounded foci of dense tissue, with smooth contours. Anomalies in the shape and size of the teeth are often accompanied by changes in the shape and size of the roots. The role of X-ray examination in orthodontic treatment should be especially remembered. Proper fixation of the equipment and the correct calculation of the force of

pressure on the tooth does not change the radiological picture. When making mistakes in the method of orthodontic treatment, X-ray examination reveals a pronounced process of restructuring the bone structure around the top of the tooth, which is expressed, in addition to widening the gap, in resorption of the compact plate of the cavity wall, and often in destruction. Analyzing telerradiograms of the skull, it is necessary to learn to recognize occlusion anomalies: prognathic, prognathic, cross; see the relationship between occlusal abnormalities and anatomical variants of the skull; to judge the location of soft tissues and their relationship with the bone base of the facial skeleton, as well as the dynamics of changes that occur during growth and treatment.

3.13. Normal radiography of the maxillofacial region.

It is recommended to follow the following procedure for studying the radiograph:

1) make sure that the image meets the basic requirements: contour, structure, separate image and the correct size of the teeth; determine the type of radiograph;

2) find out whether the upper or lower jaw is removed;

3) what kind of teeth;

4) identify pathological changes in the following sequence: tooth crown, tooth cavity, root canals; root surface, periodontal fissure, compact hole plate, surrounding bone tissue.

In the picture, the signs of the normal state of the tooth and the surrounding tissues are as follows:

1) The boundaries of the crown of the tooth should be smooth, without usurpations and protrusions.

2) The image of the crown, with the exception of the pulp chamber, is generally monotonous, gradually changing its hue inconspicuous transitions from the neck to the masticatory surface depending on the thickness of the enamel and the crown itself.

3) The shape of the pulp chamber should correspond to the type of tooth.

4) The channel is marked by a strip of enlightenment that goes from the pulp chamber to the top of the root without deviations to the side.

5) The same throughout the narrow light line perimeter sharply separates the tooth from the narrow strip of compact layer of bone lining the alveoli and passes without interruption from tooth to tooth.

6) The peripheral edge of the bone wall of the alveoli between the teeth should be sharp and limited by a dark line of the compact layer of bone.

5. Materials of methodical providing of employment.

5.1. Tasks for self-examination of the basic level of knowledge and skills.

1. Features of the so-called dental X-ray diagnostic devices.

2. Technique of obtaining intraoral X-rays. Dental x-ray film.

3. The rule of isometry in dental radiography.

4. Projections in dental radiography: orthoradial, medial-eccentric, distal-eccentric, axial.
 5. Extraoral radiographs of teeth and jaws. Projections.
 6. Features of radiography in orthodontics.
 7. The principle of panoramic radiography.
 8. Tomography of the facial skull and teeth: linear tomography, zonography, panoramic tomography of the dentition.
 9. Special methods of X-ray examination in dentistry: sialography, fistulography, sinusography, angiography.
 10. Features of X-ray picture of the upper and lower jaws of the child.
 11. Features of X-ray picture of the upper and lower jaws of an adult.
 12. Features of X-ray picture of the upper and lower jaws in old age.
 13. Features of the anatomy of the upper and lower incisors in the X-ray image.
 14. Features of the anatomy of the upper and lower premolars in the X-ray image.
 15. Features of the anatomy of the upper and lower molars in the X-ray image.
 16. Determination of the ratio of tooth roots and maxillary cavity on radiographs.
 17. Normal X-ray anatomy of the upper jaw.
 18. Hard tissues of the tooth, pulp chamber and perimeter in the X-ray image.
 19. Anomalies in the shape, size, number and position of teeth.
- 5.2. Methodical instructions for performing an individual task in class:
Having received radiographs for analysis, the student must correctly place them on the negatoscope, as well as analyze them, following a certain sequence according to the scheme-algorithm:
1. Determine the study area (body part, organ).
 2. Determine the method of research.
 3. Find out what was the direction of the rays (projection).
 4. Evaluate the image quality.
 5. Recognize visible images of anatomical formations.
 6. Find out the nature of the shadow of each anatomical formation and the existing deviations from the norm: position, shape, size, contours and intensity of the shadow.
 7. To establish the presence of pathological changes in transparency (shadows and enlightenment) and conduct their X-ray morphological analysis.
 8. Compare the detected changes in the images in different projections.
 9. On the basis of the analysis taking into account clinical data to make a differential diagnostic conclusion. Using the scheme of sequence of the analysis of radiographs, the student should answer in writing each question stated in this scheme, and to make schematic sketches from radiographs. Then submit everything to the teacher for monitoring and joint analysis of the results.
- 5.3. The information necessary for the formation of knowledge and skills can be found in textbooks:

-main (basic):

1. Radiology (radiation diagnostics and radiation therapy). Kyiv, Book Plus, 2018. -721 p.
2. Radiology (radiation diagnostics and radiation therapy). Test tasks. Part 1. Kyiv, Book Plus. 2015. -104 p.
3. Radiology (radiation diagnostics and radiation therapy). Test tasks. Part 2. Kyiv, Book Plus. 2015. -168 p.
4. Radiology (radiation diagnostics and radiation therapy). Test tasks. Part 3. Kyiv, Book Plus. 2015. -248 p.
5. Smaglyuk LV Basic course in orthodontics / LV Smaglyuk, AE Karasyunok, AM Belous. - Poltava: Blitz Style, 2019. - P.151-152.
6. Tkachenko PI Clinical and morphological aspects of anomalies in the development of teeth / PITkachenko, II Starchenko, SO Bilokon, OV Gurzhiy. - Poltava: ASMI LLC, 2014.– 79 p. (Monograph).

-Auxiliary:

1. Abdelkarim A. Three-dimensional imaging for indirect-direct bonding could expose patients to unnecessary radiation. Am J Orthod Dentofacial Orthop. 2017Jan; 151 (1): 6. doi: 10.1016 / j.ajodo.2016.10.006. PubMed PMID: 28024783. Никберг И.И. Ionizing radiation and human health. K. Health, 1989, p. 6-13.
 2. Educational edition Center for testing the professional competence of specialists with higher education in the fields of "Medicine" and "Pharmacy". Collection of test tasks for passing the license exam: Step 3. Dentistry. Kyiv. Center for testing the professional competence of specialists with higher education in the fields of "Medicine" and "Pharmacy" (in Ukrainian) 2018. - 24 p.
 3. Possibilities of modern x-ray examination methods for diagnostics of hidden dental caries of approximal localization / I. I. Sokolova, S. I. German, TV Tomilina et all // Wiadomości Lekarskie. - Vol. LXXII, N 7. - 2019. - P. 1258–1265. (Scopus).
 4. Radiographic studies in dentistry: recommendations for the selection of patients and limiting radiation exposure. Educational and methodical manual for interns in the specialty "Dentistry" and dentists / Sokolova II, Udovychenko NM, Herman SI and others. // Kharkiv KhNMU, 2020, p.4-37.
 5. <http://www.dentalexpert.com.ua/index.php/stomatology/article/view/200>.
 6. <https://stom.tilimen.org/izmeneniya-kolichestva-i-formi-zubov.html>
- 5.4.Orienting map for independent work with literature on the topic:
«Radiation research methods and normal radiation anatomy of teeth. Radiation signs of diseases of the teeth and jaws».

№	Task	Instructions for the task	Independent records of students
1.	Make schematic sketches before the rule of isomerism in the intraoral	Draw in a workbook a diagram of the normal image of individual teeth in the X-ray	

	radiograph.	image.	
2.	Make a schematic sketch of the trajectory of the focus in panoramic tomography.	Schematically draw in the workbook a diagram of the trajectory of the focus during panoramic tomography.	
3.	Find on the Internet radiographs of teeth and jaws on which artifacts are found	Sketch the radiographs found and explain why the artifacts appeared	
4.	To study the scheme of eruption of deciduous and permanent teeth.	Draw in a workbook the scheme of eruption of deciduous and permanent teeth.	

6. Materials for self-control over the quality of training.

Questions for self-control.

1. Name the radial signs of a normal tooth image according to the scheme: the shadow of the enamel cover and dentin crowns; enlightenment of the tooth cavity and root canal; lateral parts of the periodontal space; image of the interdental membrane.

2. Name the signs of teeth of the upper and lower jaws. How are they different?

3. Name the criteria for assessing adjacent teeth.

4. Describe the features of children's dentition in the beam image.

5. Describe the turn of normal tooth changes.

6. Describe the development of the jaw in an X-ray image.

7. **Practical work (tasks) performed in class:**

1. Students according to the algorithm from their own workbooks (which have from the previous lesson) under the guidance of the teacher is a systematic analysis of typical radiographs of different parts of the facial skull and teeth.

2. The student receives an individual task in the form of sets of radiographs of the facial skull and teeth in normal and pathology. Each student individually analyzes the X-ray picture presented in the pictures, reveals the reflection of individual anatomical structures and details and performs a schematic sketch.

3. The result of the individual task is analyzed in a group.

8. The topic of the next lesson: "Radiation signs of diseases of the teeth and jaws."

9. **Tasks for UDRS and NDRS on the topic of the next lesson:**

Eclipse and enlightenment. Local change in tooth density and structure. Caries. Periodontitis (classification by radiological manifestations). Radiation signs of chronic fibrous periodontitis. Chronic granulating periodontitis of different localizations. Radiation signs of periodontitis (images of mild,

moderate and severe stages). Generalized periodontitis. Periodontitis. Staging by radiological signs.

Methodical recommendations were _____ as. Kaouk AS