Modern Approaches To Diagnosis, Etiology And Pathogenesis Of The Upper Permanent Canine Retention Formation (Literature Review)

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ABSTRACT: The article outlines the main reasons for the development and formation of the upper permanent canine retention. The author presented a wide literature review of both foreign and domestic scientists, detailed this pathology course and development. It also describes various methods for evaluating X-ray studies and modern approaches to diagnostics and treatment planning for the upper permanent canine retention, which are used in practice by an orthodontist.

Keywords: Canine retention, dental anomalies, orthopantomography, cone beam computed tomography.

A tooth that has changed its position during eruption without obstruction from the adjacent tooth side is an impacted tooth, as stated in the international diseases classification of the tenth revision (K01.0).

"Impact tooth"- is a tooth that has changed its position during eruption due to obstacles from the adjacent tooth side, this term is also widely used in foreign literature to refer to unerupted teeth (K01.1) [1; 2].

Unilateral retention of the medial incisors and canine in the upper jaw and second premolars in the lower jaw are most common among the permanent teeth retentions [3; 6]. Among the impacted complete teeth, the permanent canines of the upper jaw are more likely to undergo retention than other teeth - 51.1% [20].

Worldwide data of Russian and foreign authors, the patients referral with this pathology for surgical and orthodontist care is different. In the structure of patients referrals with dentoalveolar anomalies (DAA) in Russia, according to J.Yu. El-Badawi (2013), D.V. Ivanova (2011), Mazen Shuk (2004), G.V. Stepanova (2000), from 4.0 to 18.0% patients with the upper permanent canine retention. Abroad, the prevalence of the upper permanent canine retention, according to recent data, is significantly lower, ranging from 0.8 to 3.0% [81].

Adjacent teeth roots resorption, the odontogenic cysts formation, abnormal eruption of adjacent teeth, impaired seizure and food biting are a number of morphological problems and functional disorders that entail the upper permanent canine retention. This, in turn, leads to a number of aesthetic complaints that are presented by patients with the upper permanent canine retention, including the smile line violation, the dentition center displacement, anomaly in the teeth position, facial asymmetry [16; 18; 53; 83].

The development and then upper permanent canine eruption begins with prolonged intraosseous movement. As the tooth germ develops, an adaptive organization of the dental plate takes place, which is gradually replaced by lamellar bone with the bone framework formation called bone crypt. The canine bony crypts are located near the outer border of the nasal opening anterior to the maxillary sinuses, from which they are separated only by a thin bone plate. By 6 - 7 years, the calcification of the upper canine crowns is completed, and their roots are formed along the bone crypt border with the nasal cavity wall. Teething begins after one third of the tooth root has developed. As up to one third of the roots of the lateral incisors advance, the canines erupt almost strictly vertically with a slight mesial slope. Further eruption of the canine occurs along the distal surfaces of the lateral incisors until the first reaches the occlusal plane [69]. Following the above-described eruption trajectory of the upper canine permanent, characteristic changes are clinically determined. At 8-9 years old, on the alveolar process palpation of the upper jaw, the bulge is determined in the milk canine apex area, at 10-11 years old, the bulge is determined better and is slightly lower. At 11-12 years, the dairy canine mobility increases [70].

Dental retention is the result of a complex interplay of endogenous and exogenous factors. By the action time, the factors can be prenatal, natal and postnatal. There are also general and local factors [50; 51]. Among the general endogenous factors, genetic and endocrine ones occupy a special place [52; 53].

The leading etiological factor of tooth retention and dystopia is the masticatory apparatus reduction, which occurs in the phylogenesis process, which is confirmed by anthropometric studies of human skulls from the Neolithic period to the present day [23; 31].

It is known that the child will inherit from the parents the morphological features of the dentoalveolar system, such as the size, shape, teeth number, anterioposteric position and the jaws size. In the child phenotype, the interaction of both parents genotypes can lead to the appearance of a disproportion in the teeth and jaws size. So, a space deficit in the dentition for individual teeth, thereby causing their retention and dystopia, lead to wide teeth with a narrow jaw [9; eleven; fourteen].

With a number of hereditary syndromes, as a systemic disorder, there may be a delay in the eruption of permanent teeth. With hair-dento-bone syndrome, craniofacial dysostosis of Cruson, Parry-Romberg syndrome, multiple retention or delay in teething is determined in children, which also leads to changes in the oral mucosa. [48].

The endocrine factors related to the endocrine glands functions, which are of great importance for the child development, have been studied, significantly influencing his dentoalveolar system formation and oral mucosa development. They can influence the dental anomalies occurrence during both prenatal and postnatal development of the child.

Hypothiosis, endemic goiter, idiopathic form of hypoparathyroidism, pseudohypoparathyroidism, cerebral pituitary dwarfism, Frohlich's disease, rickets, according to many domestic and foreign authors, can lead to an abnormal position and violation of the eruption timing [50; 66; 73].

In addition to the above general factors, the dentoalveolar system development of the child is influenced by the unfavorable environment state: fluoride deficiency in drinking water, insufficient ultraviolet irradiation, excessive radioactive background[4; 13; 65].

Postnatal common causes of upper permanent canine retention include impaired nasal breathing. First of all, the nasal breathing violation is the cause of the physical disorder. In children breathing through the mouth, the lips are not closed, the mouth is half-open [3; 18]. The tongue is located at the bottom of the oral cavity and causes the upper dentition narrowing, which in turn leads to a lack of space for all complete teeth eruption, which substantially affects the oral mucosa development. In the absence of a child's ability to breathe through the nose, narrowing of the nasal passages occurs, the oral mucosa dryness [19].

The width of the pear-shaped opening affects the crypts location of the upper permanent canine and ensuring their correct eruption. In the case a narrow pear-shaped opening, the distance between the canines decreases accordingly, which leads to the incisors roots convergence and their crowding and subsequently does not allow a canal formation for the permanent canine eruption [39].

Local causes of tooth retention, according to many authors, are varied. Feeding a child over 3 years old with soft food leads to the fact that the dentition does not receive sufficient load, which may result in the three absence between the temporary front teeth, and subsequently - incorrect eruption [32; 70].

Ectopic is any deviation from the normal tooth eruption trajectory. This is often an abnormal position result of the tooth bud in the crypt during crown calcification. However, sometimes the eruption trajectory deviates, despite the initially normal position of the anlage, usually as a trauma result to the upper incisors [85; 86].

Permanent canine retention can occur as caries result, its complications and the associated removal of individual deciduous teeth, more often in children there is a loss of temporary molars, which leads to displacement of adjacent teeth, eruption anomalies or mesial eruption of the first permanent molars. The mesial displacement result of the first permanent molars is a dentition shortening in the support zone area and a lack of space for the canine eruption [36; 40].

Chronic apical destructive processes of milk teeth determine position anomalies and violations of permanent teeth eruption timing as a result of their primordia displacement by granulation tissue, which is confirmed by a number of studies [47; 50; 87].

An important point in a permanent tooth eruption is the temporary predecessor preservation, since the bone crypt of a permanent tooth anlage is connected by a guide canal to the temporary tooth [26]. This intraosseous canal contains a fibrous cord with remnants of the dental plate epithelium and combines the crypt with the cortical plate and sometimes with the alveoli wall of the milk tooth. The structural features of the intraosseous canal have a significant impact on tooth eruption, however, this stroke diameter varies depending on the tooth size. The crown diameter of a permanent canine is much larger than its predecessor.Thus, the sufficient eruption space creation for the permanent canine depends on bone and root resorption of the primary tooth [83; 84]. Delayed prolapse of milk canine is a consequence, not a cause, of permanent canine dystopia [76].

The roots of the lateral incisors are another guide for the eruption of the upper permanent canine. In a child of eight to nine years, the roots of the lateral incisors must be sufficiently formed to withstand the pressure from the crowns of the erupting canine [21, 86]. As a result, the final eruption of the canine should lead to a straightening of the position of the incisors and the formation of adequate interdental contacts. In the absence of contact between the crown of the canine and the root of the lateral incisor, the eruption path of the canine can deviate either vestibularly or palatally relative to the dental arch. Edentulous or microdentia of lateral incisors leads to the absence of a guide for canine eruption [33; 34; 7; 82].

Supernumerary teeth located in the direction of permanent complete teeth often cause their retention [80; 81]. This phenomenon is called hyperdentia. More than 80% of supernumerary teeth are found on the upper jaw and 90% of them are located in its anterior part [70].

Pressure on the rudiments of the corresponding permanent teeth from cysts or tumor foci can also cause retention [73]. Odontoma is the most common odontogenic neoplasm, consisting of abnormal or incorrectly differentiated odontogenic tissues [76; 77]. Clinically, odontoma is practically indistinguishable from a supernumerary tooth and can also prevent the development and eruption of permanent canine.

Odontogenic cysts are most often associated with a violation of the eruption of permanent teeth. The upper canines are affected more often than the rest of the teeth. Sometimes the cause of the cyst is the pulpitis of the milk tooth. After excision of the neoplasm, the tooth can erupt independently provided there is sufficient space in the dental arch [50; 61].

Shortening and narrowing of the upper dentition, associated with the upper micrognathia, leads to a deficit of space for all complete teeth, which may be one of the reasons for canine rejection [12; 36; 37; 41; 51].

It is not always possible to divide the factors leading to the retention of the permanent canine of the upper jaw into general and local, endogenous and exogenous, therefore, this division, according to many authors, is conditional [42; 43; 46].

T.V. Komarova (2000) systematized the etiological factors leading to tooth retention into groups. In the case of canine retention, the author identified the following as the main reasons: atypical formation of canine rudiments or adjacent teeth, supernumerary teeth, odontomas and cysts during eruption, premature mineralization of the apex of the erupting canine [38].

E.A. Vakushina (2007) proposed, based on the results of her own research, a clinical and morphological classification of anomalies in the timing of eruption of permanent teeth, which takes into account the following etiological factors: lack of space in the dentition, anomaly in the position of an unerupted tooth, anomaly in the size and shape of an unerupted tooth, supernumerary teeth, congenital pathology of the maxillofacial region [15].

Based on the variety of etiological factors leading to retention of the upper permanent canine, it can be concluded that dynamic monitoring of the eruption of these teeth in children is necessary, starting from the period of mixed bite.

It is known that it is possible to establish tooth retention only on the basis of an X-ray examination of the alveolar parts of the jaws [7; 20; 49; 71]. Intraoral X-ray techniques, orthopantomography, teleradiography, multispiral computed tomography, cone-beam computed tomography are currently used to diagnose impacted and dystopic teeth [45; 59; 62, 74].

Intraoral radiography is performed using dental X-ray diagnostic devices. It includes the following types of studies: contact, occlusal and interproximal radiography. In the diagnosis of impacted and dystopic teeth, intraoral radiography is of limited use, since it does not provide a holistic view of the state of the dentoalveolar system. However, with its help, it is possible to reveal the presence of a tooth rudiment and its condition, to determine the stage of formation and development of the tooth root, to assess the condition of the perapical tissues, to detect supernumerary teeth, to determine the prospects for tooth eruption, to identify a pathological focus of a limited nature [17; 22; 25, 67].

Since 1987, radiovisiography has developed in dentistry. Computer processing of information increases the diagnostic information content of the study by manipulating contrast, brightness, clarity, size by eliminating technical errors, highlighting areas of interest. The advantages of radiovisiography are also a significant reduction in radiation exposure, the ability to archive information [44].

The method of carrying out orthopantomography (OPTG) was proposed in 1939 by Blackman, then mathematically substantiated and prepared for wide practical application by Finnish specialists Soila and Paatero (1956) [57]. When carrying out orthopantomography, the doctor gets the opportunity to assess both jaws, teeth, temporomandibular joints, paranasal sinuses, which makes it possible to determine the degree of mineralization of the crowns and roots of the teeth, their formation, the stage and type of resorption of the roots of deciduous teeth, which is important for the diagnosis of possible pathology of the structures of hard dental tissues. According to OPTG, it is possible to identify the rudiments of unerupted teeth, to determine their position in the jaw and the perspective of eruption [79]. In addition, orthopantomography is performed to determine the inclination of erupted and retained teeth in relation to neighboring ones [45].

In order to determine the position of the crown of the impacted canine of the upper jaw in the vestibulo-oral direction, Shuk Mazen (2004) suggested using principles based on the laws of optics: 1) the X-ray shadow of the impacted palatal tooth will always be larger than the symmetrical tooth on the orthopantomogram; 2) the X-ray shadow of the impacted tooth located in the thickness of the alveolar ridge, on the orthopantomogram, will approach the size of the shadow of a symmetrical tooth; 3) the X-ray shadow of the impacted tooth located vestibularly on the orthopantomogram will always be smaller in size than the symmetrical tooth; 4) the edge sharpness of a tooth farther from the plane of the film will always be lower than the shadow of a tooth located closer to the plane of the film [45].

In 2009, a study was conducted at the Manchester medical university, where, according to a questionnaire survey of dentists, from 22 dental centers with an X-ray department, they analyzed the popularity of this technique in dental practice. It was found that 73.3% of the surveyed doctors consider orthopantomography the most informative technique compared to intraoral X-ray examinations of teeth and periapical tissues for dental therapists during endodontic treatment, for dental surgeons when planning surgery, as well as for orthodontists when diagnosis and treatment of dental retention [72]. Thus, orthopantomography has long served as the main method of radiological examination of patients with impacted teeth [25, 52].

The method of orthopantomography, despite its high information content, has a number of disadvantages. The spatially selected layer of the image is a plane located strictly vertically, but horizontally U-shaped, with a thickness of 1-2 cm. The largest percentage of distortions, overlaps and misses occurs in the frontal section. The shadow of the spine and the lumen of the uncompressed tongue can be superimposed on the image of the frontal part of the jaws in the picture. The magnification of objects in the picture can be from 1: 1.2 to 1: 1.75, depending on the design of the apparatus and the area of the picture [57].

Teleradiography was proposed by the Italian anthropologist Paccini in 1922. In orthodontism, it was first used in 1931 by Hofrath in Germany and Broadbent in the USA, and in 1934 it was proposed to do cephalometric analysis on the basis of a teleroentgenogram [10]. The method is used in orthodontism to diagnose the consequences of malformed jaws (according to Andresen), malposition of teeth, occlusion disorders, jaw shape, joint pathology. Despite certain disadvantages, the method is part of the survey, with the help of which numerous variants of dysgnathias can be technically classified depending on skeletal and dentoalveolar relationships. In an orthodontist clinic, teleroentgenograms are performed both in frontal and lateral projections. For a correct assessment of tooth retention, it is inappropriate to use it without orthopantomography [64; 67].

The localization of the upper canine constants can be established using standard radiological methods, with image distortion, overlapping three-dimensional structures, artifacts, projection errors, and sometimes poor image quality [74; 75].

Computed tomography is by far the most informative method of radiation diagnostics in dentistry and maxillofacial surgery [8, 58]. Many domestic and foreign authors consider computed tomography as a priority method for studying patients with dystopia and dental retention [11; 29; 68].

The first computed tomograph was tested in 1974. Subsequently, its creators, engineers Cormack and Housefield, received the Nobel Prize for this invention. Despite the widest diagnostic capabilities, until now, computed tomography, as a method of examining patients with dentoalveolar anomalies, has rarely been used in dentistry. This was due to the high radiation exposure from the study and the fact that in most cases the computed tomogram had an image quality that was insufficient for the needs of dentists [56].

Until recently, there were three types of computed tomographs: spiral, sequential, magnetic resonance [19; 57; 77]. One of the first comparative radiological studies was carried out at Vienna medical university in 1995. Orthopantomograph and computed tomography were used to study 29 patients with 36 permanent impacted teeth. The analysis used 2 programs (conventional and dental). The authors summarized the following: 1) both computer tomography programs are visually more informative than orthopantomography; 2) the dental program of a computed tomograph is more effective than the usual program in the diagnosis of retention, because allows to more accurately diagnose resorption of the roots of adjacent teeth [91].

At Pavia radiology institute, research work was carried out on spiral computed tomography to determine the localization of the impacted maxillary canine and further plan treatment. For this, 19 patients with 29 impacted permanent canines were examined, differently located in the thickness of the alveolar process (palatal and vestibular). The patients were subsequently examined using orthopantomography, lateral teleradiography, and spiral computed tomography. As a result of the studies carried out by the authors, it was found that on the orthopantomogram it is impossible to detect the resorption of the root of the adjacent incisor, especially on its palatine and buccal surfaces. When conducting computed tomography in 26 clinical observations, the space between the impacted canine and the adjacent incisor was easily diagnosed, and in 8 clinical observations, the resorption of the adjacent incisor root [60].

The authors concluded that computed tomography facilitates the diagnosis of impacted canine, especially when it is tilted toward the apex of the maxillary alveolar ridge, reduces the time of radiological examination, and reduces the risk of possible movement of the patient's head [79].

At Hokkaido medical university, a radiological study was carried out on the issue of three-dimensional assessment of impacted incisors, canines, premolars, and molars of the upper jaw at the stage of planning surgery. The authors compared images of the shape of the roots of impacted teeth using intraoral images, orthopantomograms and computed tomograms in 27 patients. With statistical reliability ($P < 0.01$), the authors proved the difference in the reliability of the obtained X-ray information and made it possible to conclude that only computed tomography allows an accurate diagnosis of retention, with a clear definition of the shape of the root of the impacted tooth in three-dimensional space [80].

The study of the use of spiral computed tomography in patients with retention of the upper permanent canine was carried out by domestic authors. D. A. Volchek in 2007, based on a comparison of X-ray examination methods, revealed that spiral computed tomography is the most optimal additional method for assessing the location of the impacted canine in three planes, determining its location relative to adjacent teeth, assessing the morphology of the surface of the canine roots and adjacent teeth on the upper jaw, to reveal the resorption of the roots of adjacent teeth on the side of the retention. Based on the observations, the author developed a protocol for X-ray examination of patients with canine retention in the upper jaw, which allows planning orthodontist treatment based on OPTG data, occlusal radiographs, spiral computed tomography (SCT), and lateral TRG. The advantages of the presented protocol are that it systematizes the diagnostic process when planning treatment for patients with retention of the upper permanent canine and clearly defines the indications for SCT. The disadvantages include the need for a large number of X-ray studies, including the SCT technique, in addition, this method has a high radiation exposure. The protocol is used only for the purpose of diagnostic study of patients with retention of the upper permanent canine and cannot be applied when their eruption is delayed.

E.A. Vakushina (2007), based on the data of spiral computed tomograms, proposed a mathematical model created by means of personal electronic computer (PC), which makes it possible to finish editing the entered data at the output and implement the calculated amount of free space by a computer method, predict the result of treatment of patients with retention of the upper constants canine [16].

Multispiral computed tomography with 3D reconstruction was used by J.Yu. El-Badawi (2013) on the basis of Moscow state university of medicine and dentistry (MSUMD) for the computer program development for calculating the impacted tooth traction trajectory. This method allows the doctor in a real situation to simulate the position, change the trajectory of movement, taking into account the applied force vector, and visually predict the results of treatment [61, 69].

The most innovative direction of radiation diagnostics of the XXI century in dentistry was the creation and active introduction into practice of cone-beam computed tomography. In the literature, there are various names for this research method, however, according to the version of the European Academy of DentoMaxilloFacial Radiology and the American International Institute of Cone Beam Tomography, the method is called cone beam computed tomography(CBCT) [56; 88].

Cone beam computed tomography (CBCT) provides a high quality X-ray image of the dentoalveolar system and maxillofacial region in three mutually perpendicular planes. The fundamental difference between specialized dental tomographs from sequential and spiral CT is that, firstly, in this case, one plane sensor is used for scanning, and, secondly, the generated beam is collimated in the form of a cone. During shooting, the emitter works continuously, and information is read from the sensor several times per second. Then the information is processed in a computer and a virtual three-dimensional model of the scanned area is restored [28, 68, 80].

Possessing all the advantages of multislice computed tomography, cone-beam computed tomography allows performing a similar study at lower radiation exposure, which is extremely important in pediatric patients, who constitute the largest group of patients with retention of the upper permanent canine [35; 54]. Less radiation exposure during cone beam computed tomography (CBCT) is achieved due to the fact that the value of the current and anode voltage (voltage) in installations is many times less - 70-90 kV and 3-8 mA, for multispiral computed tomography (MSCT) data the values are - 120-140 kV and 100 mA, respectively. Thus, the radiation exposure from one study varies from 0.04 to 0.08 mSv, depending on the type of tomograph [83]. According to SanRaR 2.6.1.802-99, for practically healthy individuals, the annual effective dose during preventive medical X-ray procedures should not exceed 1 mSv. Based on these data, the method of cone-beam computed tomography can be classified as a low-dose study [1].

In contrast to conventional X-ray imaging, cone-beam computed tomography is the most informative, since it allows obtaining images of any anatomical structures in three planes, highlighting the layer of an object of interest and nearby organ complexes with a thickness of 1 to 10 mm [69]. Alqerban (2011) determined that cone beam computed tomography (CBCT) is significantly better than panoramic radiography for determining the level of root resorption of lateral incisors in the small and severe resorption categories [77]. The largest comparative study was a prospective study in which radiological data were analyzed by seven independent physicians. In this case, the patients underwent traditional (intraoral and panoramic) and high-tech (cone-beam computed tomography) X-ray methods. Experts independently from each other drew up a treatment plan for each patient (having data from either traditional research methods or high-tech ones). Discussing the results of X-ray examination, calculating statistically the accuracy of the diagnosis and the correctness of the chosen treatment, it was concluded that for the diagnosis of dental anomalies and the choice of treatment tactics, it is more expedient to use cone-beam computed tomography [72].

However, according to a number of authors, this diagnostic method has not found wide application due to the lack of a clear systematic methodology that allows for comprehensive diagnostic studies [63; 84].

R.A. Fadeev, Yu.P. Sheveleva and M.A. Chibisova proposed an informative and systematic method for diagnosing retained teeth using cone-beam computed tomography (Sirona “GALILEOS”, Morita “3DX”). The technique included: 1) determination of the location of the impacted teeth in the anterior and lateral areas of the jaws, as well as the angle of inclination of the longitudinal axes of the impacted teeth to the coordinate axes; 2) determination of the distance from the impacted tooth to the compact plate of the jaw; 3) determination of bone density in the area of retained teeth and comparison with the density of bone tissue in the area of the same teeth on the opposite side [62].The method offers an algorithm for studying the data of cone beam computed tomography (CBCT), but does not give a total assessment of the severity of tooth retention.

McSherry (1996) described the relationship between the distance of the retention canine of the upper jaw from the occlusal plane and the likelihood of their removal. This pattern is called the "rule of vertical thirds" and can be used to predict treatment [67; 68].

P.S. Fleming and co-authors in 2009 proposed a cone beam computed tomography (CBCT) assessment method that takes into account a number of parameters of the position of the impacted canine: angle of inclination, vertical position relative to the occlusal plane, anteroposterior position of the root apex and the degree of overlap of the adjacent incisor. Based on the assessment of these parameters, the author determines the prognosis of the eruption of the upper canine constants [75].

A. Miresmaeili et al. In a 2015 publication point out the fact that in orthodontist practice there is no single agreement, according to which criteria for determining the feasibility of orthodontist treatment of impacted canine would be highlighted.

As a result of a literature review, 237 articles devoted to the retention of the upper permanent canine, the authors identified 10 parameters for determining the difficulty of treatment of impacted canine using cone beam computed tomography (CBCT) data. So, according to the authors, the complexity of the orthodontist treatment of patients with retention of the upper permanent canine is influenced by such factors as: the patient's age; the position of the impacted tooth in three planes; the presence of transposition of the impacted tooth with a lateral incisor or first premolar, the presence of dilaceration of the root of the impacted tooth, the presence of resorption of the roots of adjacent teeth. In conclusion of this work, the authors point out that the most important parameters for assessing the difficulty of treating impacted canine using cone beam computed tomography (CBCT) data are the patient's age, inclination relative to the occlusal plane, dilaceration, shadowing of the impacted canine on adjacent teeth, distance to occlusal plane [62].

Thus, summarizing 87 articles literature review, various X-ray research methods can be used to diagnose retention of the upper permanent canine. The most modern of the currently available is cone beam computed tomography (CBCT), which combines the acquisition of a large amount of diagnostic data with low radiation exposure to the patient. In the literature, various methods of assessing X-ray studies are described in order to diagnose and plan treatment of retention of the upper permanent canine, however, there are no works concerning the X-ray assessment of the dentoalveolar system of children during the mixed bite in order to prevent the formation of canine retention. And still, we have no right to judge and insist on the use of this or that technique for X-ray studies, because a lot depends on the economic development of a particular region. It also depends a lot on the doctor - orthodontist, namely in the ability to read the information received by this or that resource.

REFERENCES.

[1] "Hygienic requirements for the design and operation of X-ray rooms, apparatus and X-ray studies." San. Pin. 2.6.1.802-99.
[2] Alimova M. Ya. Dentistry. International classification of diseases. Clinical characteristics of nosological forms. / M. Ya. Alimova. - Moscow: GEOTAR-Media. - 304 p.
[3] Azimova Sh.Sh., Abruev U.R., Rasulov M.M. Distribution of anomalies of the dental system among school-age children in Bukhara. // Doctor's Bulletin. 2020. - №1. - S. p. 23-28.
[4] Anikienko A. A. Clinical manifestations and etiology of disorders of eruption of permanent teeth / A. A. Anikienko // Orthodontics. - 2000. - No. 1-2. - p. 57-60.
[5] Anokhina A. V. The need for orthodontic treatment among edentulous children aged 12-15 years in Samara and the Samara region / A. V. Anokhina, A. F. Ishmuratova // Prevention of dental diseases and oral hygiene: mat. III Russian scientific and practical conference. - Kazan, 2010. - p. 11-16.
[6] Anokhina A. V. Epidemiological study of the prevalence and structure of dentoalveolar anomalies in children aged 12-15 years of Samara and the Samara region / A. V. Anokhina, A. F. Ishmuratova // Prevention of dental diseases and oral hygiene: mat. III Russian scientific and practical conference. - Kazan, 2010. - p. 7-11.
[7] Arjantsev A.P. Methods of X-ray examination and X-ray diagnostics in dentistry / A.P. Arjantsev. - Moscow, 2015 .—260p.
[8] Balin V. N. Experience of using computed tomography in the diagnosis of diseases of the dentoalveolar region / V. N. Balin // Dentistry. - 1994. - No. 1. - P. 30—32.
[9] Baranova A.A.Physical development of children and adolescents in the Russian Federation. Sat. materials (issue VI) / ed. acad. RAS and RAMS A. A. Baranova, corresponding member RAMS V.R.Kuchma. - M .: Publishing house "Pediatr", 2013. - 45-48 p.
[10] Bimbas E.S.Diagnosis of dentoalveolar anomalies. Textbook for independent work of students / E. S. Bimbas, N. V. Myagkova. - Yekaterinburg, USMU, 2017 .- 63 p.
[11] Bimbas E. S. Differential diagnosis and treatment of varieties of mesial occlusion: dis. ... Cand. med. sciences / E.S.Bimbas. - Perm, 1989. - p. 143-145.
[12] Bragin E.A. The use of computed tomography in the diagnosis and treatment of impacted teeth / E. A. Bragin // Orthodontics. - 2004. - No. 2 (26). - p. 43-45. 118
[13] Bragin A.E. Assessment of gnathological indicators of patients with abnormalities in the timing of eruption of permanent teeth: dis. ... Cand. med. Sciences / A.E. Bragin. - Stavropol, 2011 .- 21 p.
[14] Budnikova T. S. Retention of teeth, plan and prognosis of treatment / T. S. Budkova, I. Yu. Zhigurt, F. Ya. Horoshilkina // New in dentistry. - 1997. - No. 1 (special issue). - p. 46-53.
[15] Vakushina E. A. The effectiveness of modern methods of diagnosis and treatment in the complex rehabilitation of patients with anomalies in the position and timing of the eruption of permanent teeth: dis. ... Cand. med. sciences / E. A. Vakushina. - Volgograd, 2007.

[16] Vakushina E. A. The prevalence of retention of permanent teeth / E. A. Vakushina // New in the theory and practice of dentistry: Sat. scientific papers. - Sevastopol, 2007. - p. 244—248.
[17] Williams S. Conceptual Orthodontics II. Growth and orthopedics / S. Williams. - Lviv: GalDent, 2006 .-200 p.
[18] Gafforov S.A., Bakaev Dj.N. Features of the relationship of diseases of the oral mucosa with somatic pathology // Bulletin of the TMA. - Tashkent, 2019. - No. 3. - P.20-24.
[19] Gafforov S.A., Bakaev J.N. Diseases of the oral mucosa - pathological aspects and basics of prevention // Dentistry. - Tashkent, 2019. - №4 (77). - p.75-80.
[20] Gasimova ZV Retention of individual teeth: diagnosis and complex treatment / ZV Gasimova // Orthodontics. - 2002. - No. 2. - P. 2-7.
[21] Glukhova Yu.M. Analysis of the causes and clinical manifestations of combined pathology (retention of teeth and malocclusion) in adolescents and adults according to cone-beam computed tomography / Yu. M. Glukhova, N.S. Shpak, V.P. Sinyakov // Institute of Dentistry.— 2016. — № 70. — p. 72—73.
[22] Glukhova Yu.M. Clinical substantiation of the diagnostic and therapeutic complex for patients with dentoalveolar anomalies complicated by periodontal diseases / Yu.M. Glukhova, A.I. Kiryutina // Institute of Dentistry. — 2012. — № 1. — p. 62—64.
[23] Gorelik E.V. Age features of the craniofacial complex in persons at different age periods / E.V. Gorelik, T.I. Izmailova, A.M. Berlinchik // Materials of the scientific-practical conference dedicated to the 100th anniversary of the regional clinical hospital. - Volgograd, 2005. - p. 172-173.
[24] Danilova M.A. Clinical and morphological substantiation of the formation of bad habits in young children / M. A. Danilova, Yu. V. Gvozdeva, E. S. Patlusova // Medical Bulletin. - 2010. - No. 4. - P. 62.
[25] Doroshenko S.I., Kulginsky E.A. Clinic and differential diagnosis of various forms of retention in children / S. I. Doroshenko, E. A. Kulginsky // Suchasna orthodontics. - 2010. - No. 01 (19). - p. 3-13. 120
[26] Elizarova V. M. Dentistry of children: textbook. At 3 o'clock / V.M. Elizarova. - Part 1. - M .: GEOTAR-Media, 2016 .- 480 p.
[27] Innovative technologies in complex treatment for retention of permanent teeth in children and adolescents / EB Kuznetsova et al. // Russian dental journal. - 2014. - No. 5. - P. 18-22.
[28] Investigation of indicators of the gnathological triad in patients with retention of permanent teeth according to modern diagnostic methods // E. A. Vakushina, A. E. Bragin, P. A. Grigorenko, S. E. Bragin // Medical Bulletin of the North Caucasus. — 2013. — T. 8, № 1. — p. 42—44.
[29] Ishmuratova A.F. Relevance of timely diagnosis of tooth retention in the context of mass dental care / A.F. Ishmuratova, G.V. Stepanov // Pediatric dentistry and prevention. — 2011. — № 3. — p. 61—63.
[30] Ishmuratova A.F. Coordination of the activity of an orthodontist and a pediatrician in the formation of dental health in children / A.F. 121 Ishmuratova, G. Zh. Sarguzhina // Actual problems in pediatrics: mat. XV Congress of Pediatricians in Russia with international participation. - M., 2011 .- p. 356.

[31] Ishmuratova A. F. Primary partial adentia (epidemiology, clinical and organizational and managerial aspects): dis. ... Cand. med. Sciences / A. F. Ishmuratova. - Kazan, 2013 .- 22 p.
[32] Ishmuratova A.F.Problems of timely diagnosis of hypodentia in the context of mass dental care / A.F. Ishmuratova// In collection: Achievements of orthodontics, orthopedic and general dentistry in the specialty and its teaching. — M., 2012. — p. 99—104.
[33] Ishmuratova A.F. The prevalence of hypodentia in the Samara region / A.F. Ishmuratova // In: Achievements of orthodontics, orthopedic and general dentistry in the specialty and its teaching. - M., 2012 . P. 104—107.
[34] Ishmuratova AF Comparative assessment of the degree of complexity of the diagnosed dentoalveolar anomaly in children with primary partial adentia in the framework of a comprehensive program of detection, dental treatment and rehabilitation, depending on the age of patients and the method of organization [Electronic resource] / AF Ishmuratova, A. V. Anokhina, T. I. Sadykova // Modern problems of science and education. - 2012. - No.6. - P. 200. Access mode: https://elibrary.ru/contents.asp?issueid=1381400.
[35] Johan K.M. Radiation load during X-ray imaging of teeth and maxillofacial area in pediatric dentistry / K.M. Johan. - Moscow: Dental-Expo, 2013 .- P. 3—7.
[36] Kalivradjian E.S. Analysis of methods for the treatment of narrowing and shortening of the dentition in the temporary and initial stages of mixed bite/E. S. Kalivradzhiyan, S. I. Burlutskaya// Journal of Practical and Theoretical Biology and Medicine. — 2003. — T. 2, № 4. — p. 335—336.
[37] Karakotova L. Sh. Features of diagnosis and complex treatment of patients with unilateral vestibulo-occlusion: dis. ... Cand. med. sciences / L. Sh. Karakotova. - Stavropol, 2010 .- 143 p.
[38] Komarova T.V. Methods of moving impacted teeth with orthodontic appliances with a dosed load: dis. ... Cand. med. Sciences / T.V. Komarova. - Volgograd, 2000 .- 119 p.
[39] Corbando J.M. Surgical and orthodontic treatment of impacted teeth / J.-M. Corbando, A. Patti. - M .: Azbuka, 2009 .- 135 p.
[40] Lazareva E.A. Studying the prevalence and prerequisites for the occurrence of canine retention / E. A. Lazareva // Orthodontics. - 2013. - No. 2. - P. 53.
[41] Lazareva E.A.Peculiarities of peripheral blood flow in the area of impacted canines of the upper jaw / E.A.Lazareva // Dental Forum. - 2014. - No. 4. - P. 66-68.
[42] Lazareva E.A. Features of cephalometric parameters in patients with retention of the canines of the upper jaw / E. A. Lazareva // Actual problems of pediatric dentistry and prevention: mat. III regional conference dedicated to the 25th anniversary of the Department of Pediatric Dentistry. - Khabarovsk, 2013. - P. 117-120. 123
[43] Lazareva E.A. Comparative analysis of methods of early orthodontic treatment in order to create a place for permanent canines of the upper jaw in children with late mixed dentition / E. A. Lazareva // Orthodontics. - 2014. - No. 3. - P. 77—79.
[44] Radiation diagnostics in dentistry / A. Yu. Vasiliev, Yu. I. Vorobiev, N.S. Serova etc. - M .: GEOTAR-Media, 2008. - 201—220 p.
[45] Mazen Shuk. Clinical and X-ray diagnostics and instrumental-surgical treatment of canine retention: dis. ... Cand. med. sciences / Shuk Mazen. - Tver, 2004.

[46] Microvascular tone of periodontal tissues and its reactive response to treatment using non-removable orthodontic equipment / E. A. Karton, N. V. Snetkova, S. N. Ermoliev etc. // Orthodontics. - 2013. - No. 2. - P. 45—46.
[47] Millett D. Problem solving in orthodontics and pediatric dentistry / D. Millett, R. Welbury. - Medpress-inform, 2009 .- 200 p. 124
[48] Hereditary syndromes and medical genetic counseling / S. I. Kozlova, N. S. Demikova, E. Semanova, O. E. Blinnikova // Atlas-reference book. - M .: Practice, 1996 .- 416 p.
[49] Nechaeva N.K.Cone-beam tomography in dental implantology / N.K. Nechaeva. - M .: GEOTAR-Media, 2016 .- 96 p.
[50] Olimov S.Sh. The value of metabolic parameters of saliva in the development of dentoalveolar anomalies in children with metabolic syndrome. // Scientific-practical conference "Current issues in the treatment and prevention of dental diseases." Buxoro. 2016.- 33p.
[51] Olimov S.Sh., Gafforov S.A. The scientific basis of the relationship between dental system defects and somatic diseases in children. (literature review) .// Journal. Dentistry. -2019y №1.60-65 p.
[52] Olimov S.Sh., Saidov A.A., Gaffarov S.A., Khojimetov A.A. The role of the hepatobiliary system in the pathogenesis of dental defects in school-age children.//Journal Doctor's Gazette. Samarkand. 2019 -№2. - pp. 35-39.
[53] Olimov S.Sh. Evaluation of the effectiveness of preventive measures in the orthodontic treatment of children with dentoalveolar deformities.// Educational-methodical manual. Approved by the SSV of the Republic of Uzbekistan on 13.11.08. Tashkent. 2019. - 21 p.
[54] The use of cone-beam computed tomography in surgical dentistry, maxillofacial surgery and otorhinolaryngology for the differential diagnosis of dental diseases / A.L.Dudarev, A.A.Zubareva, M.A. Chibisova, M.A. ... - 2012. - No. 4. - P. 20-25.
[55] Profit U. R. Modern orthodontics; per. from English. / W. R. Proffit; ed. L. S. Persina. - 2nd ed. - M .: MEDpress-inform, 2008 .- 560 p.
[56] Rogatskin D.V. Radiodiagnostics of the maxillofacial region. Cone beam computed tomography. Basics of visualization / D.V. Rogatskin. - Lviv: GalDent, 2010 .- 148 p.
[57] Rogatskin D.V. Panoramic tomography of the dentition. Methodical recommendations / DV Rogatskin. - SPb .: Man, 2010 .- 48 p.
[58] Serova N. S. Radiation diagnostics in dental implantology / N. S. Serova. - M.: GEOTAR-Media, 2015 .- 220 p.
[59] Stepanov G.V. Complex diagnostics and treatment of malocclusion in case of dentoalveolar shortening: dis. ... Dr. med. Sciences / G.V. Stepanov. - Samara, 2011 .- 43 p.
[60] Stepanov G.V. Resorption of the roots of teeth during orthodontic treatment / V.G. Stepanov, A.F. Ishmuratova // Endodontics Today. - 2011. - No. 1. - P. 52-53.
[61] Topolnitskiy OZ.Dentistry of children: textbook. At 3 o'clock / O. Z. Topolnitsky. - Part 2. - M .: GEOTAR-Media, 2016 .-- 320 p.
[62] Fadeev R.A. Methodology for assessing the position of impacted teeth according to dental computed tomography / R.A.Fadeev, Yu.P. Shveleva, M.A. Chibisova // Institute of Dentistry. - 2010. - No. 47. - P. 16-18.

[63] Fleischer G. Propedeutics of pediatric orthopedic dentistry / G. Fleischer. - LAP, 2014.-- 68 p.
[64] Friedrich Pasler A. X-ray diagnostics in the practice of a dentist / Friedrich A. Pasler, Heiko Wissler. - M .: MEDpress-inform, 2007. - p. 118-131.
[65] Khamadeeva A. M. Prevention of dental diseases in ecologically unfavorable regions on the example of Chapaevsk / A. M. Khamadeeva, N. V. Nogina, A. F. Ishmuratova // Prevention of dental diseases and oral hygiene: mat. III Russian scientific and practical conference. - Kazan, 2010. - pp. 198—201.
[66] Khoroshilkina F. Ya. Orthodontics. Defects of teeth, dentition, malocclusion, morphological and functional disorders in the maxillofacial region and their complex treatment / F. Ya. Khoroshilkina. - M .: MIA, 2006 .-- S. 544
[67] Cephalometric substantiation of orthodontic diagnosis / L. S. Persin, J. A. Lendengolts, E. A. Karton, Z. I. Vagapov. - M .: Pekan Blocknote, 2010 .-- 84 p.
[68] Chibisova M.A.Algorithms for examining patients when using dental volumetric tomography in outpatient dental practice / M.A. Chibisova // Dental Market. - 2010. - P. 76-78.
[69] El-Badaui J. Yu. Analysis of the frequency of canine retention in children and adolescents / Zh. Yu. El-Badaui, EB Kuznetsova, OZ Topolnitsky. - M .: Dental-Review, 2011. - p. 171-172.
[70] El-Badawi J. Yu. Canine retention in children (diagnosis and complex treatment): dis. ... Cand. med. Sciences / J. Yu. El-Badawi. - Moscow 2013.
[71] A comparative study for spatial resolution and subjective image characteristics of a multi-slice CT and a cone-beam CT for dental use / H. Watanabe, E. Honda, A. Tetsumura, T. Kurabayashi // European Journal of Radiology. — 2011. — № 77 (3). — P. 397—402.
[72] A novel 3D classification system for canine impactions — the KPG index / C. H. Kau, P. Pan, R. L. Gallerano, J. D. English // International Journal of Medical Robotics and Computer Assisted Surgery. — 2009. — V. 5. — P. 291—296.
[73] Associations among sella turcica bridging, atlas arcuate foramen (ponticulus posticus) development, atlas posterior arch deficiency, and the occurrence of palatally displaced canine impaction / M. Haji Ghadimi, F. Amini, S. Hamedi, V. Rakhshan // American Journal of Orthodontics and Dentofacial Orthopedics. — 2017. — № 151 (3). — P. 513—520.
[74] Aydin, U. Transmigration of impacted canines / U. Aydin // Dentomaxillofac Radiol. — 2003. — Vol. 32, № 3. — P. 198—200.
[75] Becker A. Orthodontic Treatment of Impacted Teeth, 3rd Edition / A. Becker // Wiley-Blackwell. — 2012. — P. 456.
[76] Becker A. Etiology of maxillary canine impaction: a review / A. Becker, S. Chaushu // American Journal of Orthodontics and Dentofacial Orthopedics. — 2015. — № 148 (4). — P. 557—567.
[77] Comparison of two cone beam computed tomographic systems versus panoramic imaging for localization of impacted maxillary canines and detection of root resorption / A. Alqerban, R. Jacobs, S. Fieuws, G. Willems // Eur J Orthod. — 2011. — V. 33, № 1. — P. 93—102.

[78] Comparison of 6 cone-beam computed tomography systems for image quality and detection of simulated canine impaction-induced external root resorption in maxillary lateral incisors / A. Alqerban, R. Jacobs, S. Fieuws et al. // American Journal of Orthodontics and Dentofacial Orthopedics. — 2011. — № 140 (3). — P. 129—139.

[79] Comparison of methods for localization of impacted maxillary canines by panoramic radiographs / S. An, J. Wang, J. Li et al. // Dento-Maxillo-Facial Radiology. — 2013. — № 42. — P.125—132.

[80] Comparative analysis of traditional radiographs and cone-beam computed tomography volumetric images in the diagnosis and treatment planning of maxillary impacted canines / E. Haney, S. A. Gansky, J. S. Lee et al. // American Journal of Orthodontics and Dentofacial Orthopedics. — 2010. — Vol. 137, № 5. — P. 590—597.

[81] Ericson, S. Radiographic examination of ectopically eruption maxillary canines / S. Ericson, J. Kurol // Am. J. Orthod. — 1987. — № 6. — P. 483—492.

[82] Ericson S. Resorption of incisors after ectopic eruption of maxillary canines: A CT study / S. Ericson, J. Kurol // Angle Orthod. — 2000. — V. 70. — P. 415—423.

[83] Evaluation of the morphology of the canalis sinuosus using cone-beam computed tomography in patients with maxillary impacted canines / G. Gurler, C. Delilbasi, E. E. Ogut et al. // Imaging Science in Dentistry. — 2017. — № 47 (2). — P. 69—74.

[84] Extraction of primary (baby) teeth for unerupted palatally displaced permanent canine teeth in children / N. Parkin, S. Furness, A. Shah et al. // Cochrane Database Syst Rev. — 2012. — № 12. 131

[85] Fleming P. S. Self-ligating brackets do not increase treatment efficiency / P. S. Fleming, K. O'Brien // American Journal of Orthodontics and Dentofacial Orthopedics. — 2013. — Vol. 143, № 1. — P.11—19.

[86] How far is the root apex of a unilateral impacted canine from the root apices arch form? / S. H. Kim, Y. M. Kim, S. Oh et al. // American Journal of Orthodontics and Dentofacial Orthopedics. — 2017. — № 51 (2). — P. 351—356.

[87] Jacobs R. Dental cone beam CT and its justified use in oral health care. JBR-BTR 139 / R. Jacobs // Journal Belge de Radiologie — Belgisch Tijdschriftvoor Radiologi. — 2011. – № 94 (5). — P. 254—265.