

Planning of Surgical Procedures in Complex Orthodontic Treatment of Patients with Impacted Teeth. Review of Treatment Methods and Two Clinical Cases

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Abstract

Tooth impaction is common and complex anomaly of dentition. The approach to treatment of patients with impacted teeth should be comprehensive and to combine surgical treatment, aimed at creating conditions for eruption of impacted teeth and orthodontic movement them into the dental arch.

The article presents methods of surgical techniques planning in patients with impacted teeth and demonstrates two clinical cases of treatment with differentiated access to crowns. At their vestibular position, surgical exposure should be carried out with a wide access, and at a palatal one, the access should be limited to sparing.

The developed diagnostic and treatment algorithm made it possible to achieve acceleration of bite restoration terms and increase in the effectiveness of stabilization measures in 85% of cases.

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Introduction

The effectiveness of complex orthodontic treatment of impacted teeth largely depends on communication and interaction with the oral surgeon. The choice of the optimal variant of surgical access to the crowns of impacted teeth requires a balanced determination of all possible risk due to the fact that this pathology is a polyetiologic dentoalveolar anomaly.^{1,2}

Thereby, methods of surgical access to crowns of impacted teeth need to be constantly improved, in order to optimize their orthodontic movement. At the stage of planning technique of mucoperiosteal flap excision over the crowns of impacted teeth, it is necessary to take into account all the features of impacted teeth location and follow the indications in each specific case in order to avoid errors, complications and obtain the desired end

result.^{3,4,5}

Known methods of treatment of impacted teeth provide, first of all, the creation of favorable conditions for their natural eruption, which ensures the normalization of chewing functions, speech, and improve aesthetics. However, the duration of treatment is significantly increased in the case of their deep location, oblique or horizontal position, as well as in the presence of supernumerary teeth⁶.

It has been established that in mucosa located over impacted teeth, there is a deterioration in the filling of microvasculature, dyscirculatory disorders, which leads to formation of ischemic zones and development of dystrophic and sclerotic processes in this area. It should be noted that with the location of impacted teeth in the alveolar process, the vestibular difference was found in the mucosa over them with the prevalence of dystrophic and sclerotic processes. While in the palatal location, these manifestations were less expressive.^{7,8,9} In addition, the study of the presence of CD68+ and CD163+ cells revealed imbalance in their ratio in individuals with vestibular impacted teeth due to a higher density of infiltration of the lamina propria by CD163+ (M1) compared to CD68+ (M2) cells, which 1.8 times differed compared

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with control group. In patients with palatally impacted teeth, the ratio of CD68+/CD163+ in it increased 3.6 times due to a higher density of infiltration by CD68+ cells. In biopsy specimens of the lamina propria over vestibular impacted teeth, the ratio $M1/M2 = 0.91 \pm 0.11$ ($p < 0.001$) decreases, with a predominance of macrophage CD163+ (M2) activity. Over palatally impacted teeth, the balance of macrophages M1/M2 increases ($M1/M2 = 2.10 \pm 0.32$, $p < 0.001$), due to an increase of CD68+ (M1) density infiltration, which plays a significant role in the processes of bone tissue remodeling and dentition.^{10,11,12,13}

Therefore, the results of literature review and our own experience indicate the necessity to develop new and improve existing approaches to surgical intervention planning in complex orthodontic treatment of patients with impacted teeth, taking into account the latest scientific developments.

The aim is to present an review of surgical methods planning in treatment of patients with impacted teeth and to demonstrate two clinical cases with differentiated exposure of impacted teeth crowns, taking into account structural and morphological changes and immunohistochemical features of the mucosa depending on vestibular or palatal location.

Materials and methods

We have proposed a method for the surgical exposure of impacted teeth crowns^{14,15}, which has been used for treatment of 46 patients, aged from 8 to 25 years, with delayed eruption of permanent teeth. The treatment was based on the results of clinical and additional research methods (photometric examination of the face, study of diagnostic models of the jaws, orthopantomogram data, 3D computed tomography), the patient was diagnosed clinically and the sequence of treatment stages was planned. At the preparatory stage, the space in the dentition was created for conditions of impacted tooth eruption, and, according to indications, surgical correction of abnormally located soft tissues of the oral cavity was performed. In addition, active orthodontic treatment was started and, first of all, a space for the impacted tooth in the period of mixed dentition was created with the help of individual removable orthodontic appliances. Orthodontic brackets were used in the period of permanent

dentition. At the second stage, surgical exposure of the impacted tooth crown was performed and at the same time a triangular channel was formed for its eruption, the base of it was adjacent to the impacted tooth and it ended with an angle in the dental arch. Preliminary, a clear determination of the localization, size and depth of impacted tooth was carried out by examining sections of computed tomography with 3D reconstruction (3D-CT), taking into account immunomorphological changes in the mucosa depending on it vestibular or palatal access.

Due to the fact that, the activity of M2 macrophages with osteoblastic activity predominate in the mucous membrane over vestibular impacted teeth, the eruption channel was formed wider and deeper. In the biopsy specimens of mucosa over the palatally impacted teeth, the number of M1 macrophages increases, they have an osteoclastic orientation and contribute to the acceleration of jaw bone tissue resorption, which facilitates the process of dentition and therefore the eruption channel was formed with less width and depth. In that case, spontaneous eruption of impacted tooth occurred in a month in 39 patients (85%). Subsequent orthodontic measures included adjustment and correction of occlusal plane, normalization of intermaxillary relationships in order to achieve optimal functional occlusion, and stabilization of treatment results.

Results

Case Reports

The proposed method is illustrated by the following specific examples.

First case presentation

Patient X., aged 8 (outpatient card No. 10), complained of an aesthetic defect due to the absence of the maxillary right central incisor. According to the clinical and radiological examination (orthopantomography, 3D-CT), impaction and dystopia of 11 tooth were diagnosed.

Orthodontic treatment was started using a removable plate prosthesis with a screw, followed by surgical exposure of the impacted 11 tooth crown from the vestibular side and formation of a channel for its eruption. A month later, spontaneous eruption of 11 tooth occurred, after which an orthodontic button was fixed on its crown and traction began (Fig. 1).

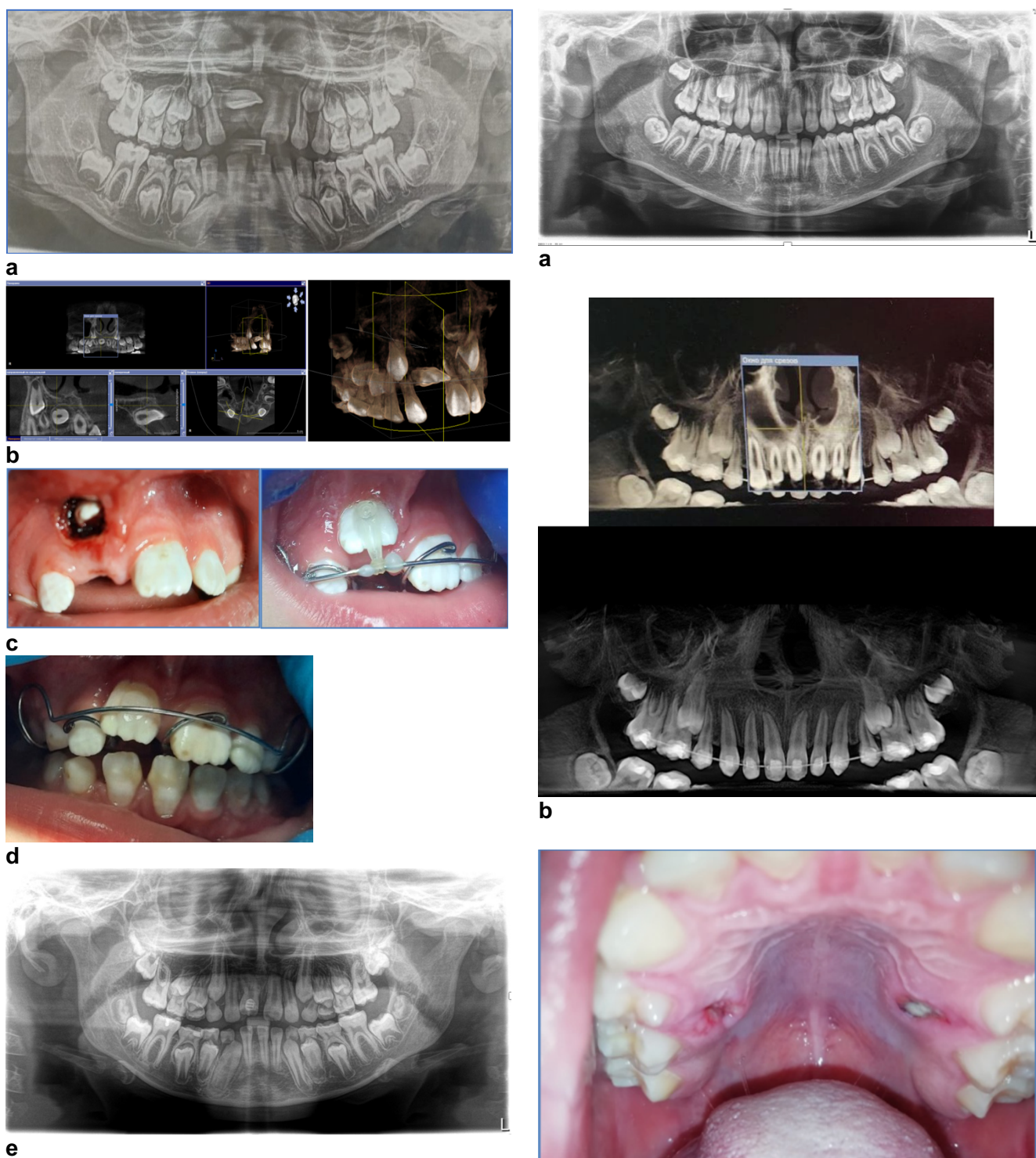


Figure 1. Patient X.: (a) orthopantomogram before treatment, (b) 3D computed tomography (dystopia and impaction of 11 tooth are indicated), (c) photo after surgery, (d) - 11 tooth in the process of orthodontic movement to dentition, (e) – orthopantomogram, taken at the stage of orthodontic treatment.

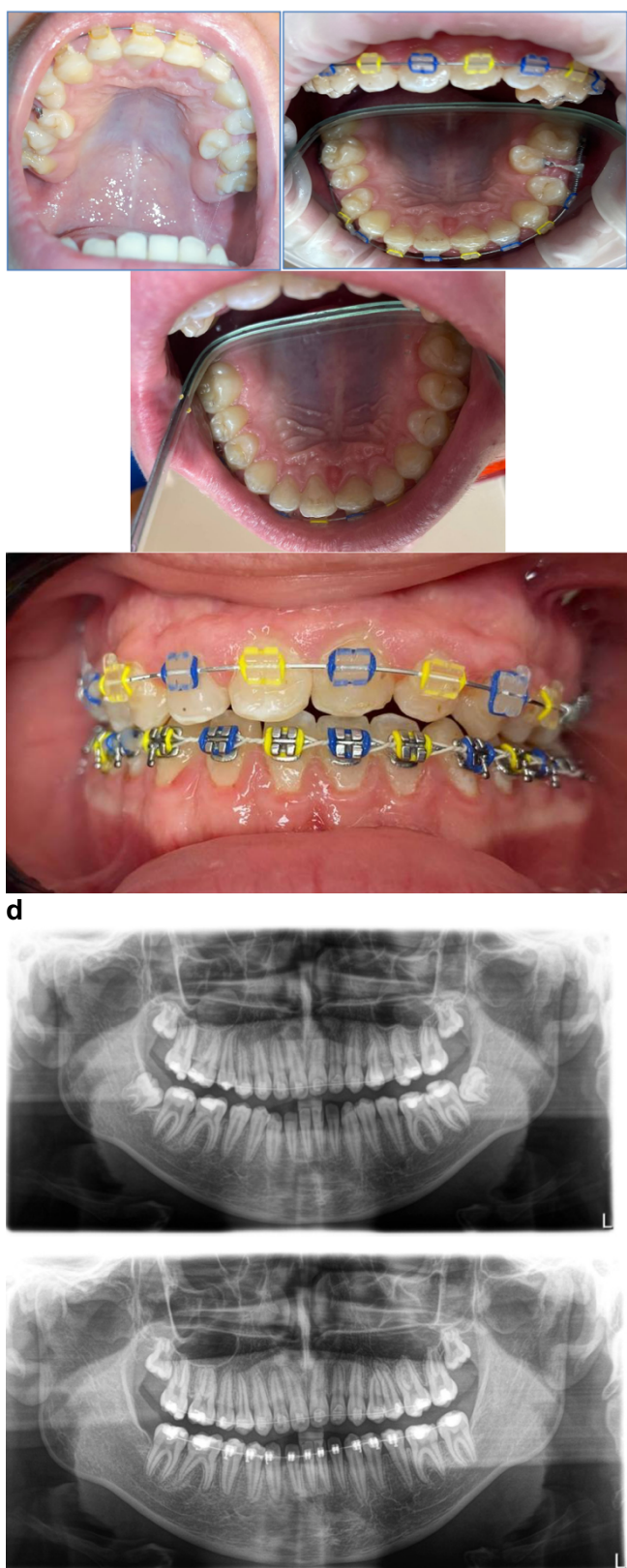


Figure 2. Patient D. (1) orthopantomogram before treatment, (2) 3D computed tomography, impaction of teeth 15 and 25 is visible, (3) - surgical exposure of crowns of palatally impacted

teeth 15 and 25, (4) - photo of the stages of teeth traction using bracket techniques, (5) – orthopantomograms taken at the stages of orthodontic treatment.

Second case presentation

Patient D., aged 13 (outpatient card No. 21) complained of an aesthetic defect due to malocclusion. After a clinical examination, analysis of the orthopantomogram, impacted teeth 15 and 25 were identified. Preparatory active orthodontic treatment included normalisation of the upper jaw dental arch shape, creation of space for their eruption using orthodontic brackets technology. A month after the surgical exposure of the crowns of teeth 15 and 25 from the palatal side, spontaneous eruption of impacted teeth occurred, on which two buttons were fixed and they were moved into the dental arch until the intermaxillary ratios normalized. The period of movement of impacted teeth 15 and 25 into the dental arch was 12 months (Fig. 2).

Discussion

The main task of modern orthodontics is to ensure a balanced, morphologically stable occlusion, in harmony with facial aesthetics and functional adaptation. Facial contours and jaw ratio largely determine the position of teeth.^{16, 17}

Overall prevalence of delayed eruption of permanent maxillary anterior teeth among children is 42,84%. Deficiency of space in the dental arch and ectopic eruption path were the most common causes that provoked delayed eruption of permanent teeth. It mainly occurs in the upper jaw. Impacted most often are canines (48%), central (24%) and lateral incisors (15%), less often (13%) premolars and molars of the upper jaw. When determining the depth of impacted teeth, it was found that most of them are located at levels I and II, their topographic ratio was measured depending on their position in the alveolar process (vestibular or oral). Thus, for impacted central incisors and canines, the amount with vestibular position exceeds the palatal position, and the first and second premolars in a larger percentage are placed orally. Orthodontic correction in patients with impacted teeth involves, first of all, elimination of barriers for eruption, providing space for them in the dental arch and simultaneous treatment of

concomitant malocclusion. The effectiveness of complex influence on such situation largely depends on the correct choice of surgical and orthodontic protocol.^{18,19, 20}

A well-known method for predicting the development of canine impaction and establishing their position in dental arch is to build so-called "canine triangle", which characterizes the severity of violations during eruption of canines and allows correction of axial inclination at early stage. However, the use of the known method, unfortunately, does not take into account the features of topography of tooth impaction (vestibular or oral location).²¹

Understanding the cellular and molecular mechanisms underlying tooth impaction allows to choose most effective orthodontic treatment. It has been established that tooth retention may be associated with impaired activation of the Caspase-3 cascade and imbalance in RANKL/RANK/OPG system and, as a result, blocking of bone resorption process.²² But at the same time, authors did not take into account the histotopographic state and quantitative parameters of the populations of M1 (CD68+) and M2 (CD163+) macrophages of mucosa over the crowns of impacted teeth, which exhibit osteoclastic and osteoblastic activity, presented in this scientific work.

Conclusions

The review of the literature and our own clinical experience indicate the need for further development of new approaches to improve existing methods for increase of the effectiveness of complex surgical and orthodontic treatment in patients with impacted teeth. At their vestibular position in the alveolar process of the upper jaw, surgical exposure should be carried out with a wide access, and at a palatal one, the access should be limited to sparing. The developed diagnostic and treatment algorithms with the combined use of author's surgical techniques and orthodontic measures make it possible to achieve significant positive clinical dynamics in terms of acceleration the restoration of occlusion and increasing the effectiveness of stabilization measures in 85% of cases.

Patients agreed to have photos published in articles for research purposes. The photos do not identify the patient.

Declaration of Interest

The authors declare no conflicts of interest.

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