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Case report

Using Cone Beam Computed Tomography in surgical-orthodontic treatment of impacted maxillary canines - a case report

Jelena Elez,
Slavoljub Tomić,
Tanja Ivanović,
Jelena Krunić

University of East Sarajevo,
Faculty of Medicine Foča, Foča,
Republic of Srpska,
Bosnia and Herzegovina

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Corresponding author:
Dr Jelena Elez, Assistant
Studentska 5, 73300 Foča
e-mail: jelenaelez93@gmail.com

Summary

Introduction. The purpose of this case report was to present a surgical-orthodontic treatment of bilaterally impacted maxillary canines using Cone Beam Computed Tomography (CBCT).

Case report. A 16-year-old girl accompanied by parents was admitted to the Specialist Center for Dentistry, Faculty of Medicine Foča, for orthodontic consultation related to aesthetic reasons. Clinical examination revealed the existence of deciduous canines on both sides of maxilla and palpable a tooth-like structure at the level of root of the maxillary right canine. The maxillary left permanent canine was neither visible nor palpable. CBCT analysis showed bilateral impaction of upper canines: the crown of maxillary right canine was positioned centrally in the alveolar processus, while the maxillary left canine was palatally impacted. The treatment plan included combined surgical-orthodontic treatment: fixed orthodontic appliance with standard conventional metal braces, extraction of both deciduous canines and surgical release of impacted permanent canines using closed eruption technique. Favorable clinical results were observed within nine months after initiation of treatment. After two years canines erupted at proper position in dental arch, reaching the occlusal plane with a present of harmonious soft tissue and an adequate zone of keratinized gingiva around teeth.

Conclusion. The impaction of maxillary canines is frequent condition which requires a multidisciplinary treatment approach by orthodontist and oral surgeon, and also a motivated patient. The use of CBCT can increase success of the therapy with the proper localization of impacted canines and surrounding anatomical structures.

Key words: upper canine, impaction, surgical-orthodontic treatment, CBCT

Introduction

The tooth impaction presents the failure of tooth eruption in a predisposed place in the dental arch, when the time for its eruption passes within the normal period of tooth growth [1]. The second most common impacted tooth, after third molars, is the maxillary permanent canine, with an incidence from 1% to 2.5%. The position of impacted maxillary canine in arch can be labially, centrally

or palatally. It has been reported that two thirds of maxillary canine impactions are located palatally [2], while only 8% of patients have bilateral impactions [3]. Considering sex, impacted canines are twice more common in females than in males [3]. Canine impaction has profound impact on esthetic and function but also may be responsible for root resorption of neighboring teeth [4]. Etiological factors for canine impactions can be generalized and localized. Generalized factors usually include among others endocrine deficiencies and irradiation. Local etiological factors include one or combination of different factors such as: enamel hypoplasia, infraocclusion of primary molars, cyst or tumors, ankylosis, root dilacerations, presence of an alveolar cleft, iatrogenic, and trauma [5].

The treatment approach of this condition involves early diagnosis and interceptive treatment which includes the selective extraction of the deciduous canines, reshaping of the dental arch by expanding it transversely, or use of a cheek arch. Effective early orthodontic intervention can simplify treatment and potentially eliminate the need for surgery, ultimately reducing both costs and treatment duration. However, surgical exposure of the impacted canine, followed by orthodontic forced eruption using fixed prosthodontic is frequently indicated [6]. The orthodontic-surgical treatment approach of bilateral canine impactions presents a significant clinical challenge due to their complex spatial orientation and potential for complications. These cases often require prolonged treatment durations, precise anchorage control and surgical intervention to facilitate proper tooth eruption and alignment [7]. On the other hand, if teeth left untreated, problems like root resorption of adjacent teeth, cyst formation, or ankylosis can occur [4, 8]. Radiographs allow identification of impacted teeth and many important anatomical structures. Anatomic superimposition, lack of bucco-palatinal dimension and geometric distortion are noted as main drawbacks of conventional radiographs, which can significantly influence determination of location of the impacted canines and treatment planning. Cone Beam Computed Tomography (CBCT) is advanced 3-dimensional imaging technique which can obtain more detailed and accurate determination of anatomical features and the exact position of impacted tooth making a good prognosis for teeth eruption and treatment planning [9]. CBCT derived data is important for selecting the surgical approach (open vs. closed), determination the feasibility of orthodontic traction and identifying the need for adjunctive procedures such as bone grafting or temporary anchorage devices [10]. The success rate of impacted maxillary canines treatment can be improved by carefully selecting patients and choosing the appropriate surgical technique based on CBCT examination [4].

The purpose of this case report was to present the surgical-orthodontic treatment of bilaterally impacted maxillary canines using CBCT.

Case report

A 16-year-old girl accompanied by her parents was admitted to the Specialist Center for Dentistry, Faculty of Medicine for orthodontic consultation related to aesthetic reasons. The patient and parents reported the absence of eruption of permanent canines in the upper jaw. The patient was in good general health, had no prior orthodontic treatment or tooth extraction. Clinical examination revealed the existence of deciduous canines on both sides of maxilla. The tooth-like structure at the level of the maxillary right canine area was palpable, whereas the maxillary left canine was neither visible nor palpable. CBCT was indicated for accurate treatment planning. CBCT analysis showed bilateral impaction of upper canines (Figure 1). The crown of maxillary right canine was positioned centrally between the lateral incisor and first premolar near the apex of deciduous canine. The maxillary left canine was palatally impacted between lateral incisor and apex of deciduous canine. The

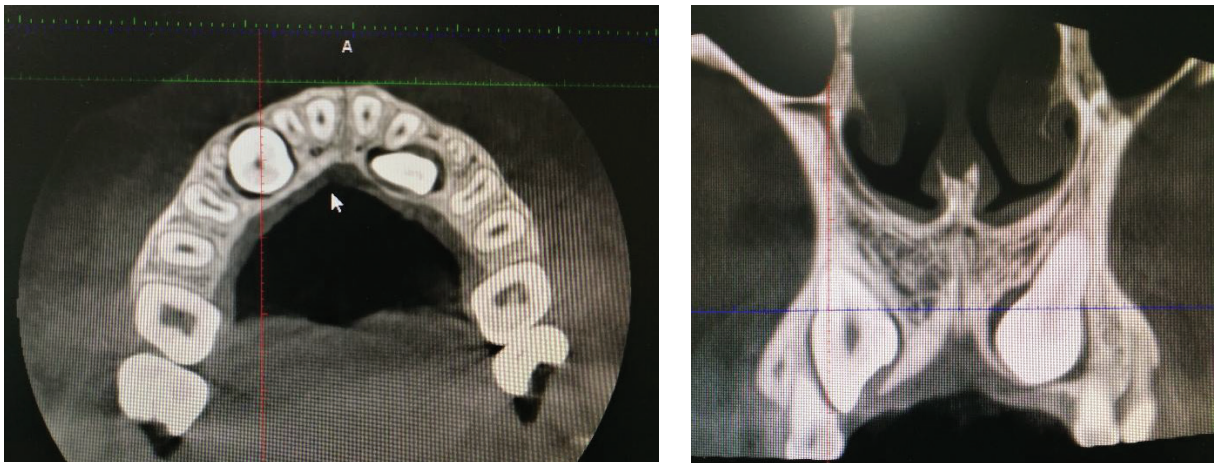

Figure 1. Axial (A) and coronal (B) projection of the patient's CBCT with bilateral impacted maxillary canines

Figure 2. Extraction of right (A) and left (B) maxillary deciduous canine

decision-making process involved a multidisciplinary team and included detailed discussions with the patient and her parents regarding the treatment options, anticipated duration, and potential risks. Informed consent was obtained from parents prior to treatment procedures. The treatment protocol was conducted in accordance with principles of the Declaration of Helsinki. The research was approved by the Ethics Committee of the Faculty of Medicine (01-2-57).

The treatment plan included combined surgical-orthodontic treatment: fixed orthodontic appliance with standard conventional metal braces, extraction of both deciduous canines and surgical release of impacted canines. For surgical technique (closed vs. open technique) several factors were considered, such as the tooth position, depth of impaction, keratinized tissue availability, esthetic considerations, and patient cooperation. Therefore, the closed eruption technique was selected for impacted canines. The timing of intervention was based on CBCT analysis, clinical findings, and space availability in the dental arch.

In the initial orthodontic phase brackets were placed on all teeth and a 0.012 nickel-titanium (NiTi) arch wire was applied. In this case the metal brackets of 0.018 slot were used. Open coil spring was positioned between 1.2 and 1.4 to increase the space for the permanent canine. The surgical approach was performed under local anesthesia after the placement of fixed orthodontic appliance. Primary canines were extracted (Figure 2) and full thickness flap surgery was performed to expose the impacted canines (Figure 3). Fibrous attachment and bone over the canines were removed, exposing the teeth crowns completely. The orthodontist placed an orthodontic bracket and traction pins for pulling impacted canines (Figure 4).

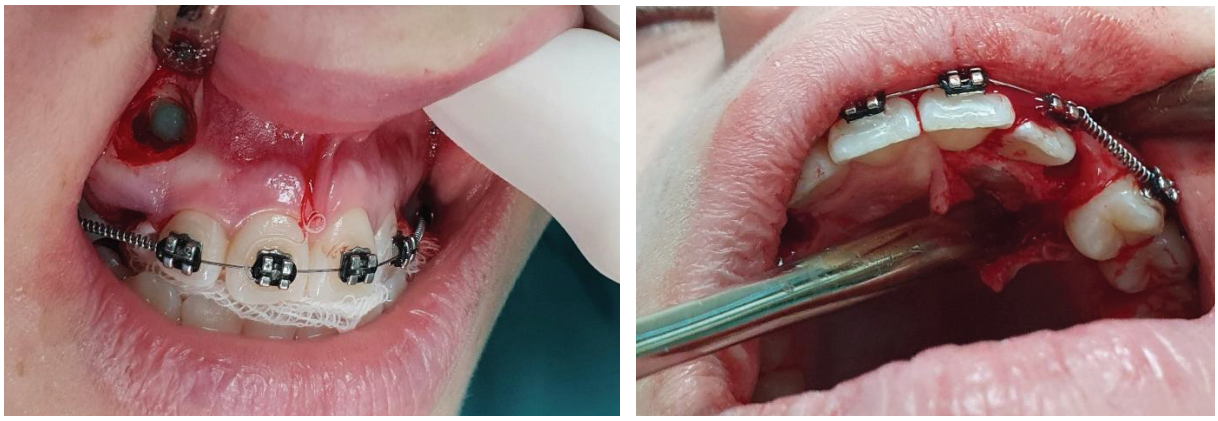

Figure 3. Vestibular surgical approach of right impacted maxillary canine (A) and palatal surgical approach of left impacted maxillary canine (B)

Figure 4. Traction pin placement and chain placement on right (A) and left (B) impacted maxillary canine

Figure 5. Eruption of right maxillary canine nine months after initation of the tretament (A). Eruption of lefth maxillary canine 12 months after initation of the tretament (B)

The wounds were washed with a physiological solution and flap was sutured in an apical position with silk 4-0. Individual stitches were removed seven days after the surgery. Postoperative instructions were given to the patient regarding oral hygiene maintenance, the use of cold compresses, and dietary recommendations, and antibiotics were prescribed. Further orthodontic treatment was focused on the extrusion of the impacted canines, its positioning in the dental arch and reaching the occlusal plane. The levelling and alignment phase was done by

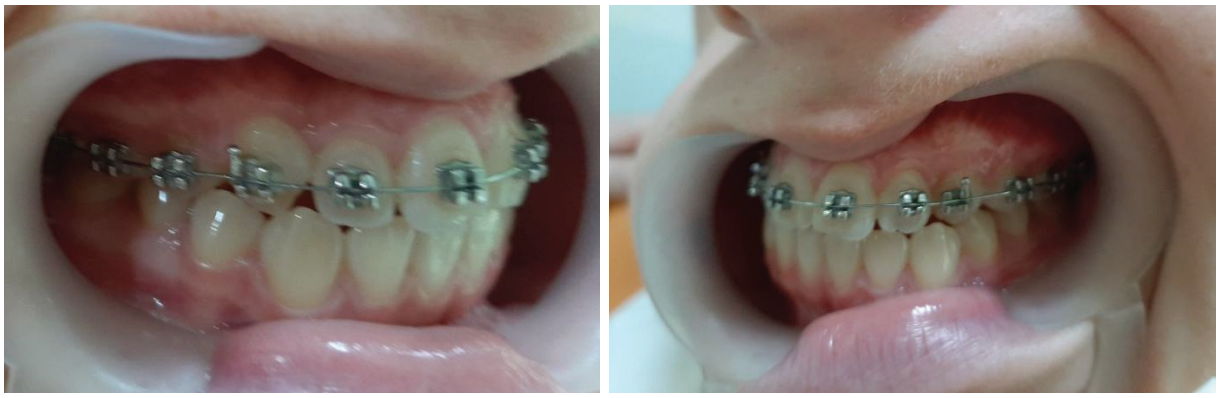

Figure 6. Maxillary right and left canines 24 months after initation of the tretament

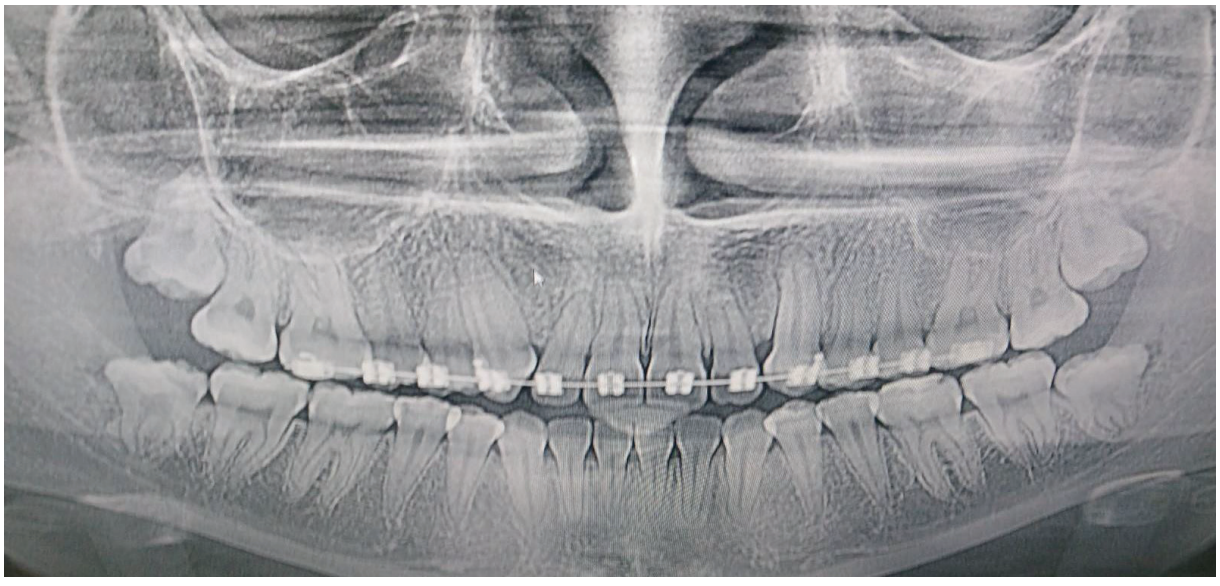

Figure 7. Control panoramic radiograph two years after the beginning of therapy

wire sequences of 0.012", 0.014", 0.016", 0.018", 0.016" x 0.022" NiTi, followed by 0.016" x 0.022" stainless steel arch wire.

Favorable clinical results were observed within nine months after initiation of treatment when the right maxillary canine was near the arch and the final orthodontic phase started (Figure 5). Finalizing therapy was achieved with stainless steel arch wire of 0.016" x 0.025"when the right maxillary canine appeared in dental arch earlier than the one on the left side. At 12 months follow-up visit, the left maxillary canine erupted in the oral cavity (Figure 5).

The patient was regularly invited for check-ups during the treatment. During the first six months, clinical evaluations were conducted every three weeks, focusing on canine position, occlusion, gingival health, and soft tissue healing. In the following six months, clinical controls were scheduled every six weeks, prioritizing occlusal stability, gingival tissue health, and functional assessment. In the second year of treatment, evaluations were performed every eight weeks, with particular attention given to the stability of canine alignment, periodontal status, and occlusion. After two years, canines had erupted at proper position in dental arch, reaching the occlusal plane with a present of harmonious soft tissue and an adequate zone of keratinized gingiva around teeth, without any signs of tooth resorption and with proper root alignment (Figure 6 and 7).

Throughout these phases, precise control of angulation, rotation, and torque was essential to guide the canine into its correct anatomical position. Throughout the follow-up period, no signs of root resorption, periodontal deterioration, or relapse were observed. The patient maintained good oral hygiene and reported satisfaction with both esthetic and functional outcomes.

Discussion

Maxillary canines are crucial for the correct smile line and facial esthetics because of support to the upper lip and alar base. Moreover, maxillary canines are important in occlusion since they provide disocclusion of posterior teeth during the lateral articulation movements [11]. The most important step for managing impacted maxillary canines is early diagnosis and localization of the impacted teeth. In early diagnosis it is important to know the time of eruption of maxillary permanent canines, which is about 12 years and 3 months for girls and about 13 years for boys. In the present case, both maxillary canines were impacted in 16-years old girl, with no signs of any systemic disease or dental anomaly which could influence teeth eruptions.

The occurrence of bilaterally impacted canines, with one positioned palatally and the other vestibularly, presents a complex clinical scenario. This asymmetry necessitated precise three-dimensional imaging. CBCT was used for the diagnosis, localization of the impacted teeth and treatment. In comparison to conventional radiographs, CBCT allowed the 3-dimensional evaluation of morphology of the impacted tooth, its location and inclination, the depth and type of inclusion, and the relationships with other elements [12]. By this imaging technique, dentists can also assess any damage to the roots of adjacent teeth and the amount of bone surrounding each tooth. About 27% to 38% of adjacent lateral incisors and 9% to 23% of adjacent central incisors have been shown in CBCT to exhibit root resorption associated with an impacted canine [13].

Moreover, the proper localization of the impacted tooth plays a crucial role in determining the feasibility of surgical approach as well as the access for the surgical approach and direction for the application of orthodontic forces [14]. The aim of impacted tooth therapy is to place tooth in adequate position, but also to save the alveolar bone height and healthy zone of attached gingiva [15]. In treatment planning, communication between the orthodontist and the oral surgeon is essential as well as between the dentists and the patient. Patients need to be informed about treatment plan, therapy duration and possible complications [16]. In this study, the patient and parents agreed with the treatment plan proposed by orthodontist and oral surgeon, which included combined surgical-orthodontic treatment. The late mixed dentition stage is considered as the ideal time for orthodontic intervention, as it follows the transitional phase of tooth eruption.

Orthodontic treatment duration is typically longer in bilateral impaction cases. Several studies report treatment times ranging from 18 to 30 months, largely depending on the position and depth of impaction, as well as patient-specific anatomical and compliance factors [17, 18]. Prolonged treatment may also be influenced by the need for sequential traction and careful biomechanical control to avoid undesirable effects such as midline shifts or loss of anchorage. This demands consistent patient compliance with oral hygiene, appliance maintenance, and regular follow-up visits. The two-year treatment of bilateral impacted canines in this case report is comparable to outcomes reported in similar bilateral cases managed with the closed eruption technique [19, 20]. This reinforces the value of combining early CBCT diagnosis with carefully timed intervention and interdisciplinary planning in managing bilaterally impacted canines.

Non-compliance can lead to delays, inflammation, or even failure of traction. In adolescent patients, maintaining motivation throughout the lengthy process is a known challenge and can impact overall treatment success. Although no complications occurred, there was a theoretical risk of root resorption of adjacent incisors due to the initial canine position. Excessive orthodontic force or periodontal ligament damage during surgery may be responsible for invasive cervical root resorption, especially in younger patients [4]. Fortunately, no resorption was observed radiographically. Additionally, we briefly address patient compliance, which was satisfactory in this case but remains an important factor in treatment success.

At present, two surgical techniques are routinely used to uncover palatally displaced canines: the open and closed techniques. The choice of technique depends on the depth of the tooth impaction, the anatomy of the affected area, and the type of orthodontic force applied. Achieving correct occlusion, healthy attached gingiva, and proper alveolar bone height is crucial during treatment [21]. The most common method for uncovering palatally impacted canine is closed technique. For labial positioned impacted canine three surgical techniques are proposed: gingivectomy, apically positioned flap, and closed eruption techniques. Therefore, in the present case we used the closed eruption technique. Comparing closed and open surgical techniques for impacted canines, Parkin et al [22] found minor aesthetic differences, but closed techniques led to less postoperative pain and faster recovery. The advantage of using closed technique especially in bilaterally impacted teeth is supported by other studies [23], where increased postoperative pain and functional impairment was related to open surgical technique. A split-mouth study by Chaushu et al. (2023), assessing labially impacted canines treated with the closed eruption technique, found no clinically significant differences in probing depth, attachment loss, or gingival recession compared to the contralateral, normally erupted canines [24].

A retrospective analysis by Naoumova et al. (2018) reported a 96% success rate in achieving full eruption and alignment of impacted canines using the closed eruption technique, with minimal need for retreatment or secondary interventions [25].

Despite the increased complexity, outcomes for bilaterally impacted canines can be highly favorable. Bishara (1992) and Crescini et al. (2007) noted success rates exceeding 85%, provided that comprehensive diagnosis, proper space management, and light, continuous orthodontic forces were utilized [26, 27].

Recent advancements in skeletal anchorage systems have introduced temporary anchorage devices (TADs), such as microimplants, as a reliable adjunct in the orthodontic traction of impacted canines. TADs offer stable, non-compliant-dependent anchorage, allowing for precise force application and reduced unwanted tooth movement. Their use is particularly beneficial in complex or bilateral impactions where conventional anchorage may be insufficient. Studies have demonstrated that TAD-assisted canine traction can improve control over force vectors and treatment efficiency, while minimizing side effects on adjacent teeth [28, 29].

Conclusion

The successful management of bilateral impacted maxillary canines in this case highlights the importance of early diagnosis, precise localization with CBCT, and careful interdisciplinary planning. The use of the closed eruption technique facilitated favorable periodontal and esthetic outcomes, preserving both the height of alveolar bone and the integrity of attached gingiva. This case, completed over a two-year treatment period, reinforces the efficacy of conventional approaches when

executed with careful planning, patient compliance, and individualized biomechanical control. Future research should evaluate the relative benefits of TAD-supported mechanics in similar cases.

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Ethical approval. The Ethics Committee of the University of East Sarajevo, Faculty of Medicine Foča, Foča, Republic of Srpska, Bosnia and Herzegovina, approved the study (No. 01-2-57) and informed consent was obtained from all individual respondents. The research was conducted according to the Declaration of Helsinki.

Conflicts of interest. The authors declare no conflict of interest.

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Primjena kompjuterizovane tomografije konusnog snopa u hirurško-ortodontskom liječenju impaktiranih maksilarnih očnjaka - prikaz slučaja

Jelena Elez, Slavoljub Tomić, Tanja Ivanović, Jelena Krunić

Univerzitet u Istočnom Sarajevu, Medicinski fakultet Foča, Foča, Republika Srpska, Bosna i Hercegovina

Uvod. Cilj ovog prikaza slučaja je da se predstavi hirurško-ortodontska terapija obostrano impaktiranih maksilarnih očnjaka korišćenjem kompjuterizovane tomografije konusnog snopa (CBCT).

Prikaz pacijenta. Djevojčica, 16 godina starosti, u pratnji roditelja primljena je u Specijalistički centar za stomatologiju, Medicinskog fakulteta Foča, zbog konsultacije sa ortodontom iz estetskih razloga. Kliničkim pregledom utvrđeno je postojanje mliječnih očnjaka sa obje strane maksile, kao i strukture nalik na zub koja se palpirala u nivou korijena gornjeg desnog očnjaka. Maksilarni stalni lijevi očnjak nije bio ni vidljiv ni palpabilan. CBCT analiza je pokazala bilateralnu impakciju gornjih očnjaka: kruna maksilarnog desnog očnjaka bila je pozicionirana centralno u alveolarnom nastavku, dok je maksilarni lijevi očnjak bio palatinalno impaktiran. Plan liječenja je uključivao kombinovani hirurško-ortodontski tretman: fiksni ortodontski aparat sa standardnim konvencionalnim metalnim bravicama, ekstrakciju oba mliječna očnjaka i hirurško oslobađanje impaktiranih stalnih očnjaka tehnikom zatvorene erupcije. Povoljni klinički rezultati su primijećeni u roku od devet mjeseci nakon početka liječenja. Poslije dvije godine očnjaci su izbili u pravilan položaj u zubnom luku, dostigavši okluzalnu ravan sa očuvanim mekim tkivom i odgovarajućom zonom keratinizovane gingive oko zuba.

Zaključak. Impakcija maksilarnih očnjaka je često stanje koje zahtijeva multidisciplinarni pristup, liječenje od strane specijaliste ortodoncije i oralne hirurgije, kao i motivisanog pacijenta. Upotreba CBCT može povećati uspjeh terapije sa adekvatnom lokalizacijom impaktiranih očnjaka i okolnih anatomskih struktura.

Ključne riječi: gornji očnjak, impakcija, hirurško-ortodontski tretman