# Autotransplantation for the Management of Impacted Maxillary Canines

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## ABSTRACT

The impaction of maxillary canines is a spread condition, with a prevalence in females. The treatment necessity is mainly related to the aesthetic and functional roles played by these teeth, but also to the possible development of sequelae over time. The gold standard in pediatric patients is the interceptive treatment, but in adults, orthodontic treatment might not be indicated and autotransplantation, when possible, may provide the best solution.

*Keywords:* impacted canines, orthodontics, oral surgery, tooth autotransplantation.

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*A 30-year-old female patient with bilateral upper canine impaction had interceptive and orthodontic treatment, succeeding only in rehabilitation of element 1.3, while 2.3 remained impacted. Due to the previous orthodontic failure, treatment times and costs, the autotransplantation was performed to manage the impacted canine.*

*In adult patients the management of upper canine impaction cannot always be finalized by orthodontic or surgical-orthodontic treatment. In such cases, autotransplantation represents a successful choice. It involves atraumatic surgical removal of the donor tooth from its impaction or ectopic site, the creation of the receiving socket, and the transplantation. Its success is determined by different factors, mainly the presence of healthy periodontal ligament cells on the root surface, the root formation stage and its splinting once replanted.*

*Autotransplantation of an impacted tooth is a well-documented and successful technique, which can be considered as a valid solution for both functional and aesthetic aspects for the management of impacted and, or ectopic maxillary canines when the orthodontic treatment is not practicable.*

## SUMMARY

*Introduction:* The impaction of maxillary canines is a spread condition, with a prevalence in females. The treatment necessity is mainly related to the aesthetic and functional roles played by these teeth, but also to the possible development of sequelae over time. The gold standard in pediatric patients is the interceptive treatment, but in adults, orthodontic treatment might not be indicated and autotransplantation, when possible, may provide the best solution.

*Presentation of the case:* A 30-year-old female patient with bilateral upper canine impaction had interceptive and orthodontic treatment, succeeding only in rehabilitation of element 1.3, while 2.3 remained impacted. Due to the previous orthodontic failure, treatment times and costs, the autotransplantation was performed to manage the impacted canine.

*Discussion:* In adult patients the management of upper canine impaction cannot always be finalized by orthodontic or surgical-orthodontic treatment. In such cases, autotransplantation represents a successful choice. It involves atraumatic surgical removal of the donor tooth from its impaction or ectopic site, the creation of the receiving socket, and the transplantation. Its success is determined by different factors, mainly the presence of healthy periodontal ligament cells on the root surface, the root formation stage and its splinting once replanted.

*Conclusion:* Autotransplantation of an impacted tooth is a well-documented and successful technique, which can be considered as a valid solution for both functional and aesthetic aspects for the management of impacted and, or ectopic maxillary canines when the orthodontic treatment is not practicable.


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## I. INTRODUCTION

Impaction is a condition defined as the failed eruption of a permanent tooth with a completely developed root. The most commonly impacted teeth are, consecutively, third molars, maxillary canines, mandibular premolars and maxillary central incisors [Kaczor-Urbanowicz et al. 2016]. The prevalence of impacted maxillary canines ranges from 1% to 2.5% worldwide, with a prevalence in females. Upper canines can be impacted palatally (54%), buccally (32%) or in line with the dental arch (12%) [Merlini and Gallini 1991; Grybienė et al. 2019]. The etiology can be found into two theories: the *genetic* one declares that maxillary palatal impaction has familial and hereditary components and includes other associated dental anomalies, such as missing or small lateral incisors. The *guidance theory* explains that the canine erupts along the distal surface of the root of the lateral incisor, which acts as a guide. If this is absent or malformed, the canine might not erupt. In addition to these explanations, other factors causing the impaction may be physical obstacles (like supernumerary teeth, odontoma or cysts), crowding, trauma, long eruption path, or syndromes [Counihan et al. 2013; Kaczor-Urbanowicz et al. 2016].

According to the literature, the main reasons why patients and clinicians are concerned about this condition and look for treatment are the aesthetic and functional roles that they play, seen their importance in an ideal mutually protected occlusal scheme. An impacted tooth may also develop several sequelae over time, like migration of the neighboring teeth and loss of arch length, internal resorption and/or external root resorption of the impacted tooth or adjacent teeth, development of follicular cyst, infection and referred pain [Bishara 1992]. That is why it is required the earliest possible diagnosis and a rational treatment plan that allows recovery, while respecting the integrity of the supporting tissues.

Investigations may be carried out both clinically, with visual inspection of the canine bulge, and radiographically, involving the use of orthopantomography, parallax or cone beam computerized tomography (CBCT). The management of impacted canines usually involves up to five treatment options:

- No active treatment, leaving the elements in situ and monitoring radiographically for cyst formation or root resorption;
- Interceptive removal of the deciduous canine;
- Surgical exposure with or without orthodontic alignment;
- Surgical repositioning or autotransplantation;
- Extraction of the permanent canine for prosthetic or restorative treatment [Counihan et al. 2013].

Treating adult patients, the orthodontic appliance is sometimes impracticable, especially due to the position of the impacted tooth. On the other hand, the patients often refuse it because of the long time required, or for economic reasons. In such cases, autotransplantation might provide a valid alternative, if there is sufficient space for the transplanted tooth [Zufía et al. 2020]. This is nowadays a well-documented technique with a long-term success for both mature and immature teeth in the treatment of agenesia, impacted or ectopic teeth, traumatic tooth loss, loss of teeth due to tumors or iatrogenic causes, replacement of teeth with bad prognosis and/or dental

development anomalies [Czochrowska et al. 2002; Boschini et al. 2018; Boschini et al. 2020].

The aim of this manuscript is to present a successful case of autotransplantation of an impacted maxillary canine to its physiological position in the upper dental arch, in an adult female patient.

## II. CASE REPORT

The reported case concerns the management of an impacted maxillary canine.

A 30-year-old female came to our attention after an interceptive orthodontic treatment performed by another dentist for the management for a bilateral upper canine impaction. The orthodontic treatment was only successful with the tooth 1.3; the orthodontist was unable to align tooth 2.3 despite an apparently favorable position (Figures 1 and 2). The failure in the descent of the tooth could be justified by the presence of an obstacle, in fact the X-Rays showed a radiopacity compatible with a root of a deciduous tooth actually ankylosed (Figure 2). Because of the tooth impaction, the patient received a resin template as provisional restoration that she used for nearly twenty years.

Although a further orthodontic treatment was proposed, the patient refused, preferring to replace the tooth with implant supported prosthesis. The choice was conditioned to the past orthodontic failure and to the long treatment time. The dentist who made the first orthodontic treatment was also consulted and he advised against a further orthodontic attempt because he failed to achieve success even if the tooth was in an extremely favorable position.

After the clinical and radiological examination, an autotransplantation of the element 2.3 was proposed. The space available for the canine transplantation was less than necessary, but with a slightly rotated positioning it would still have allowed the tooth to be seated. The implant option was considered as a second choice in case of failure of the autotransplantation. The patient accepted the therapy and the surgery was planned.

*Figure 1:* Pre-operative image showing the absence of the permanent canine and the sufficient space for its descent

*Figure 2:* Pre-operative x-ray showing the impaction of the canine. A radio-opacity is present distal to the canine, compatible with an ankylosed root

To decrease the intraoral bacterial load, the patient underwent an oral hygiene session a week before the surgery and 3 days before local antiseptic therapy (chlorexidine digluconate 0,2% mouth rinse, twice a day) was prescribed. Furthermore, prophylaxis with 2 g of amoxicillin + clavulanic acid was administered 1 hour before the surgery. After local anesthesia with arthicaine 4% + adrenaline 1:100.00, a mucoperiosteal triangular flap was performed (Figure 3); the two incision lines were in mid-crest position and mesial to the lateral incisor. The mid-crest incision allowed to preserve the keratinized mucosa that will be positioned buccal to the transplanted canine. After the flap elevation, the osteotomy for the canine exposition was performed using a micro-drill (KaVo Sonicflex®) (Figure 4). Then luxation and extraction were executed applying slight forces. In order to simplify the gingival healing and to thicken the soft tissue around the transplanted tooth, the pericoronal follicle of the canine was maintained and sutured to the flap edge (Figure 5). The donor canine was replanted coronally without bone remodeling of the receiving socket in line with the dental arch (Figures 5b and 6) and stabilized through semi-rigid splinting with orthodontic wire and polyamide suture (Figure 5d). The splinting was removed two weeks after surgery. According to pre-operative planning, the replanted tooth resulted slightly turned, but the patient was however satisfied with her smile.

Due to the age of the patient and to the complete formation of the donor canine root, the root canal treatment was performed 6 months after the surgery, a sufficient time for complete bone and periodontal ligament healing.

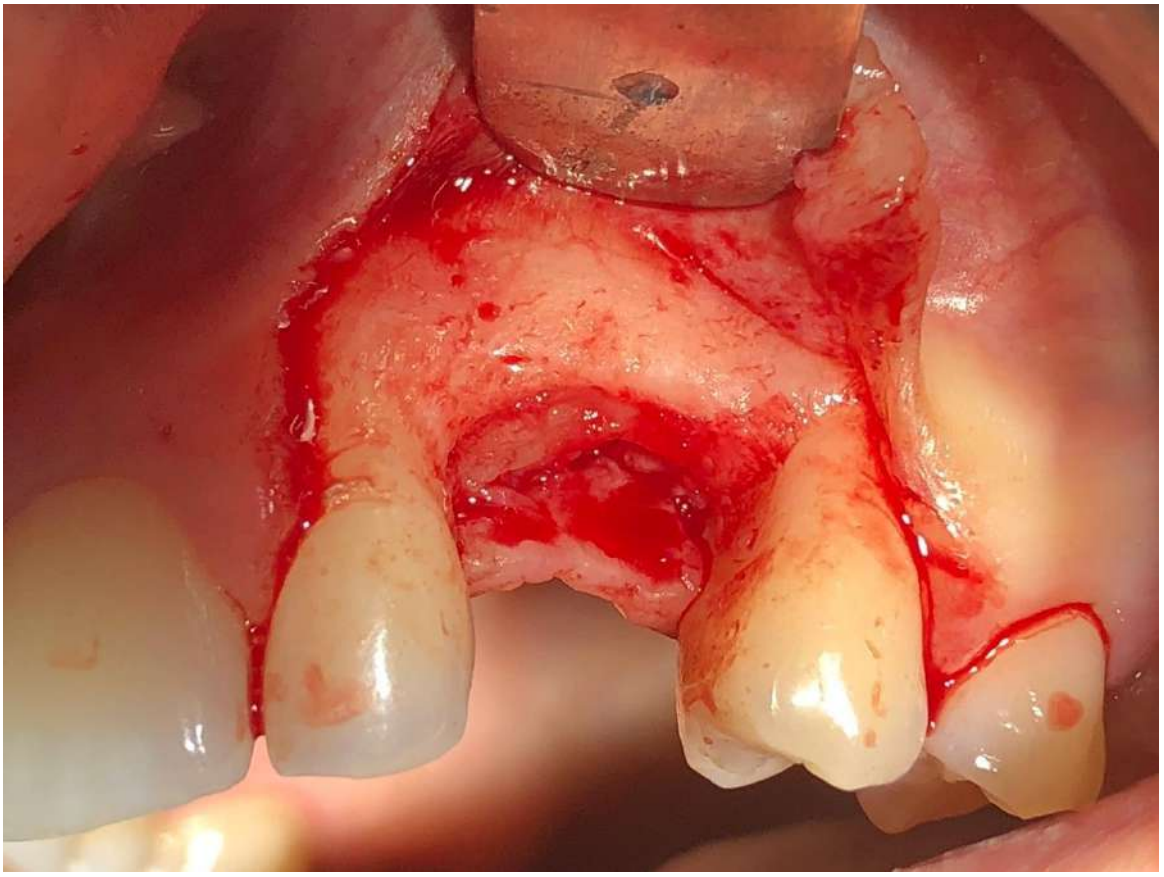

*Figure 3:* Elevation of the triangular flap

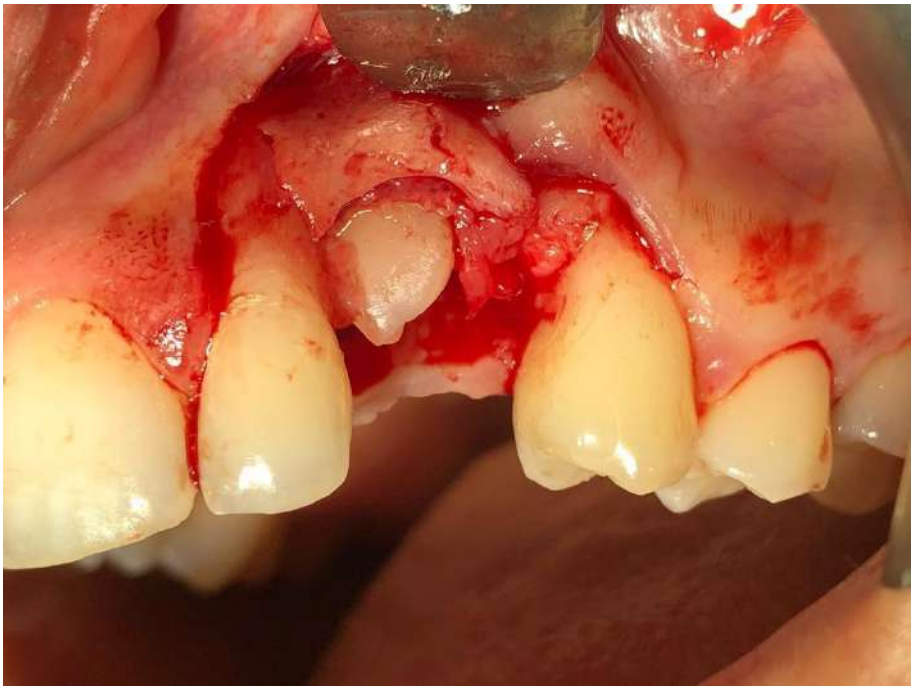

*Figure 4:* Crown of the impacted canine was exposed

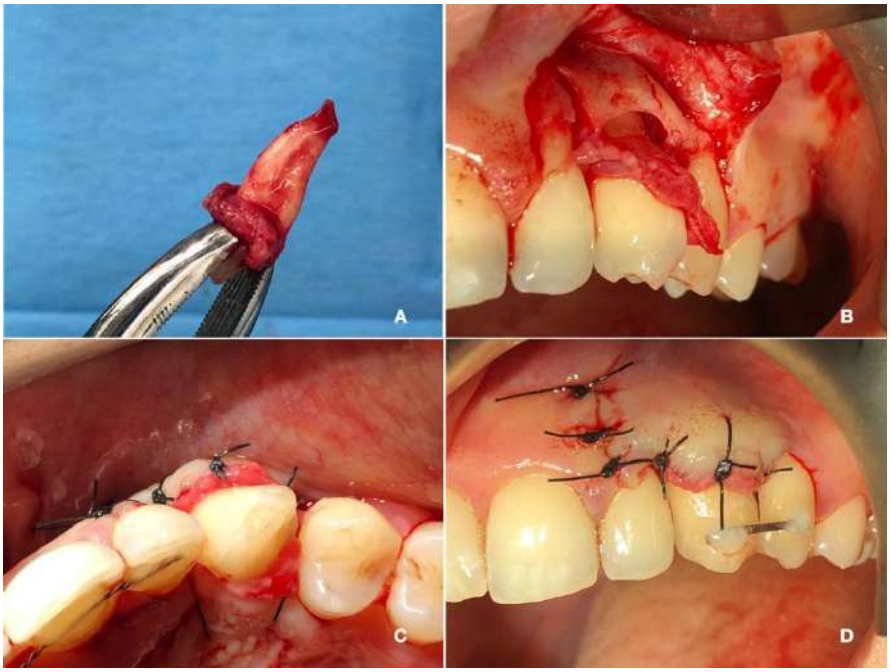


*Figure 5:* a) Donor tooth; b) Repositioning in line with the other teeth; c) Suture of the follicular cap with the gingival edge of the flap; d) Splinting

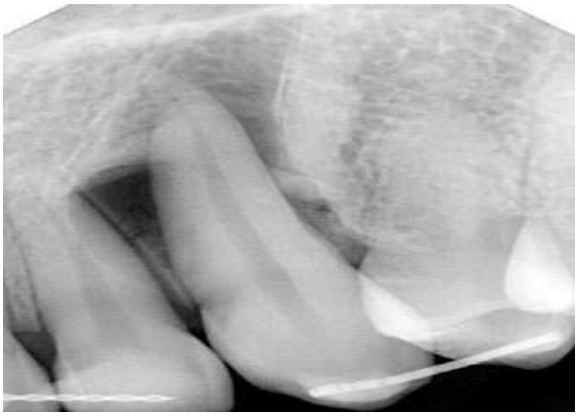

*Figure 6:* Immediate post-operative x-ray

The two-year follow-up shows soft tissues in a good condition (Figure 7), with a keratinized gingiva similar to that of the neighboring teeth. The X-ray shows bone reformation around the root with the presence of a black line compatible with the periodontal interspace and a fully healed lamina dura (Figure 8).


*Figure 7:* 2 Years clinical healing


*Figure 8:* a) 6 Month x-ray follow up; B) 1 Year x-ray follow-up; C) 2 Years x-ray follow up

## III. DISCUSSION

The management of the impaction of maxillary canines starts with interceptive treatment as the best long-term solution. This procedure usually allows the permanent tooth to become upright and erupt properly into the dental arch [Bedoya and Park 2009]. In fact, according to Ericson and Kurol, early extraction of primary maxillary canines may result in normal eruption of ectopically permanent corresponding elements. Particularly, extracting the primary canine before the patient is 11 years old would normalize the erupting position of the permanent element in 91% of the cases if the crown is distal to the midline of the lateral incisor root. This success rate decreases to 64% if the permanent canine crown is mesial to the midline of the lateral incisor root [Ericson and Kurol 1988a]. The degree of crowding, extent of overlap of the canine on the lateral or central incisor, angulation, and height of the canine are all important predictive factors for success, and these need to be taken into account before a treatment decision can be formulated [Ericson and Kurol 1988b; Patel et al. 2011].

Surgical exposure may be also considered as a solution alone or combined with orthodontic treatment: uncovering the tooth may encourage its autonomous eruption and, in addition, an eventual odontoma may be removed letting the canine arise. Access to the tooth may be provided for the later placement of an attachment and for the application of orthodontic traction. Excepting the very simplest forms of impaction, orthodontics will be necessary to properly resolve the impaction and then align the tooth. This being so, the dental arches need to be aligned and leveled and adequate space provided in the canine location: this preparatory step takes time, occasionally a year or more [Becker and Chaushu 2015]. When the root development stage is more favorable, orthodontic traction is planned in order to obtain ideal function and aesthetics through correct positioning of the impacted canine [Dalessandri et al. 2017]. Several potential complications may arise following surgical exposure and orthodontic forced eruption of the impacted maxillary canine, including root resorption, periodontal defects, poor esthetic outcome, and immobility [Chapokas et al. 2012].

The orthodontic treatment is not always accepted by patients, particularly senior ones, because it might last up to 2 or 3 years, depending on many factors like the canine position, aesthetic, and economical considerations. In adults, it might also be contraindicated because of some risks that can accompany the extrusion and the subsequent alignment, such as loss of vitality, loss of periodontal attachment, and root resorption of both the canine and adjacent teeth [Boschini et al. 2018].

In such cases, and with sufficient space, autotransplantation of the canine may be considered a good solution.

Autotransplantation involves atraumatic surgical removal of a tooth from its impaction or ectopic site, the creation of a socket at the donor site, and then replantation of the tooth into the correct position within the alveolus [Patel et al. 2011].

According to the literature, autotransplantation success is determined by different factors, such as patient age, developmental stage of the transplanted tooth, type of tooth, surgical technique, and extra-alveolar time between the extraction and the replanting. The presence of healthy periodontal ligament cells on the root surface is a critical factor for healing and long-term success [Andreasen 1981], and the administration of a single prophylactic dose of antibiotics, combined with perioperative antiseptic local treatment, reduce the bacterial load minimizing the risk of initial infection.

Unlike an osseointegrated dental implant, in fact, tooth autotransplantation provides vital periodontium and continuous skeletal growth. The advantages of autotransplantation, compared to prosthetic rehabilitation, are improved aesthetics, function and mastication; in addition, the alveolar bone volume is preserved, due to maintained proprioception and physiological stimulation of the periodontal ligament. The prognosis of these elements is comparable to that with dental implants, even though proper complications may occur. Infection-related root resorption and ankylosis are reported frequently in cases of donor tooth with complete root formation [Czochrowska et al. 2002; Chung et al. 2014; Boschini et al. 2018].

Tooth autotransplantation can be the best option in case of pediatric patients in which dental implants are contraindicated because of the developing maxillary jaws. Moreover, the transplantation of a tooth implies also the maintenance of the proprioception, which is otherwise almost completely lost in case of implants [Boschini et al. 2020].

In agreement with the literature, the percentage of survival from individual studies ranged widely at 30 - 100%. The success must be found in the absence of root resorption or ankylosis, both obtained with atraumatic surgery procedure, maintenance of the periodontal ligament cells on the root surface, and gentle manipulation of the tooth. Significant predictors are the extra-oral time during transplantation, which has to be between 5 and 18 minutes, because the clonogenic capacity of the periodontal ligament cells will fall to nearly 3% after 30 min of extra-oral dry storage. Teeth with completely formed roots with no extra-oral storage have less risk of pulpal necrosis compared to those which are stored until transplantation. The success rate is higher for teeth with incomplete root formation, and the presence of an open apex is considered one of the key factors for clinical success [Andreasen et al. 1990; Boschini et al. 2018; Grisar et al. 2021]. The management of an incomplete formed root tooth appears to be different: while pulp regeneration is unpredictable for adult teeth, it is otherwise probable for young forming teeth. This aspect implies a mandatory root canal treatment of the former; conversely, root canal treatment may be optional for the latest. Finally, splinting stabilization should not exceed 14 days in order not to cause ankylosis. Suture splint or flexible titanium wire with composite splint should be considered, according to more recent evidence that highlights a 3.7 RR in favor of suture splinting [Chung et al. 2014; Boschini et al. 2020].

While the transplantation of immature teeth has always been viewed with optimism, especially in the orthodontic field, the transplantation of mature teeth is often considered with skepticism.

A recent study showed that even mature transplanted teeth have survival rates of 90% over 10 years, making dental transplantation a valid alternative in cases where it is applicable (Boschini et al. 2020). For this reason, dental transplantation is suitable as a therapeutic proposal in orthodontic cases of management of impacted teeth in adult patients. This surgery does not preclude the performing of implantology or fixed prostheses in case of failure.

Furthermore, in addition to the biological benefits, the costs incurred by the patient are much lower than for an implant rehabilitation. In

a recent article the costs of transplantation and other rehabilitations were compared, revealing that the costs of the transplantation were 23.5% of the average costs of implant rehabilitations, according to the American 2016 Dental Fees, identifying the tooth autotransplantation as a valid economic alternative to the aforementioned solution. [Boschini et al. 2020]

For all these reasons tooth autotransplantation was one of the best options for the management of the impacted canine of the presented case. Time, costs and possibility to resort to implant rehabilitation in case of failure were the reasons why the patient accepted this kind of treatment.

## IV. CONCLUSION

Autotransplantation of impacted teeth is a well-documented and successful technique, which can be considered as a valid solution for both functional and aesthetic aspects for the management of impacted and/or ectopic maxillary canines.

Although surgical exposure and following orthodontic treatment remain the main and most documented techniques, this approach is not always practicable, especially in adults; on the other hand, the patient may simply refuse the orthodontic due to economic reason or timing.

In such cases, if the case meets the right requirement, autotransplantation should represent the best solution.

## V. CLINICAL RELEVANCE

Autotransplantation represents a successful choice in the management of canine's impaction in adult patients, when orthodontic or surgical-orthodontic treatments are impracticable. The success key of this therapeutic option is determined by different factors, mainly referred to the surgical procedure, as well as to the presence of healthy periodontal ligament cells on the root surface, to the root formation stage and to its splinting once replanted.

## REFERENCES


1. Andreasen JO. (1981) Periodontal healing after replantation and autotransplantation of incisors in monkeys. Int J Oral Surg. 10 (1):54-61. doi:10.1016/s0300-9785(81)80008 -7. PMID: 6792095.
2. Andreasen JO, Paulsen HU, Yu Z, Bayer T, Schwartz O. (1990) A long-term study of 370 autotrans-planted premolars. Part II. Tooth survival and pulp healing subsequent to transplantation. Eur J Or-thod. 12(1):14-24. doi:10.1093/ejo/12.1.14. PMID: 2318259.
3. Becker A, Chaushu S. (2015) Surgical Treatment of Impacted Canines: What the Orthodontist Would Like the Surgeon to Know. Oral Maxillofac Surg Clin North Am. 27(3):449-58. doi:10.1016/j.coms.2015.04.00 7.PMID:26231817.
4. Bedoya MM, Park JH. (2009) A review of the diagnosis and management of impacted maxillary canines. J Am Dent Assoc.140(12) :1485-93. doi:10.14219/jada.archive.2009.00 99.PMID:19955066.
5. Bishara SE. (1992) Impacted maxillary canines : a review. Am J Orthod Dentofac Orthop 101:159–71.
6. Boschini L, M. Tepedino, M. Melillo, F. (2018) Mastrangelo, M. Laurenziello, C. Chimenti, L. Lo Muzio, D. Ciavarella, Autotransplantation of an impacted maxillary canine with complete root formation in a young female – a case report. Oral Surg. 12 139–147, https://doi. org/10.1111/ors.12393.
7. Boschini L, Melillo M, Berton F. (2020) Long term survival of mature autotransplanted teeth: A retrospective single center analysis. J Dent. 98:103371. doi:10.1016/j.jdent. 2020. 103371. Epub 2020 May 7. PMID: 32389731.
8. Chapokas AR, Almas K, Schincaglia GP. (2012) The impacted maxillary canine: a proposed classification for surgical exposure. Oral Surg Oral Med Oral Pathol Oral Radiol. 113(2):222-8. doi:10.1016/j.tripleo.2011.02. 025. Epub 23. PMID: 22677740.
9. Chung WC, TuYK, LinYH, Lu HK. (2014) Outcomes of autotransplanted teeth with complete root formation: A systematic review and meta-analysis. J Clin Periodontol 41: 412-23.

10. Counihan K, Al-Awadhi EA, Butler J. (2013) Guidelines for the assessment of the impacted maxillary canine. Dent Update. 40(9):770-2, 775-7. doi:10.12968/denu.2013.40.9.770.PM ID:24386769.
11. Czochrowska EM, Stenvik A, Bjercke B, Zachrisson BU. (2002) Outcome of tooth transplantation: survival and success rates 17-41 years posttreatment. Am J Orthod Dentofacial Orthop. 121(2):110-9; quiz 193. doi:10.1067/mod.2002.119979. PMID:11840 123.
12. Dalessandri D, Parrini S, Rubiano R, Gallone D, Migliorati M. (2017) Impacted and transmigrant mandibular canines incidence, aetiology, and treatment: a systematic review. Eur J Orthod. 1;39(2):161-169. doi:10.1093/ ejo/cjw027. PMID: 27036134.
13. Ericson S, Kurol J. (1988a) Early treatment of palatally erupting maxillary canines by extraction of the primary canines. Eur J Orthod. 10(4):283-95. doi:10.1093/ejo/10.4. 283. PMID: 3208843.
14. Ericson S, Kurol J. (1988b) Resorption of maxillary lateral incisors caused by ectopic eruption of the canines. A clinical and radiographic analysis of predisposing factors. Am J Orthod Dentofacial Orthop. 94(6): 503-13. doi:10.1016/0889-5406(88)90008-x. PMID: 3195514.
15. Grisar K, Smeets M, Ezeldeen M, Shaheen E, De Kock L, Politis C, Jacobs R. (2021) Survival and success of autotransplanted impacted maxillary canines during short-term follow-up: A prospective case-control study. Orthod Craniofac Res. 24(2):222-232. doi:10.1111/ ocr.12422. Epub 2020 Sep 1. PMID: 32777135.
16. Grybienė V, Juozėnaitė D, Kubiliūtė K. (2019) Diagnostic methods and treatment strategies of impacted maxillary canines: A literature review. Stomatologija 21(1):3-12. PMID:3161 9657.
17. Kaczor-Urbanowicz K, Zadurska M, Czochrowska E. (2016) Impacted Teeth: An Interdisciplinary Perspective. Adv Clin Exp Med. 25(3):575-85. doi:10.17219/acem/37451. PMID:27629748.
18. Merlini C, Gallini G. (1991) Diagnosi precoce e terapia delle inclusioni. Ilic Ed.
9. Patel S, Fanshawe T, Bister D, Cobourne MT. (2011) Survival and success of maxillary canine autotransplantation: a retrospective investigation. Eur J Orthod. 33(3):298-304. doi: 10.1093/ejo/cjq071. Epub 2010 Sep 5. PMID: 20819783.
20. Zufía J, Abella F, Gómez-Meda R, Blanco H, Roig M. (2020) Autotransplantation of impacted maxillary canines into surgically modified sockets and orthodontic treatment: a 4-year follow-up case report. Int J Esthet Dent. 15(2):196-210. PMID: 32467948.