

Maxillary Central Incisor Root Resorption due to Canine Impaction after Trauma. Is the Canine Substitution for Maxillary Incisors a suitable Treatment Option?

Two Case Reports

*Cinzia Maspero**, *Andrea Fama**, *Guido Galbiati**, *Lucia Giannini**, *Laima Kairyte**,
*Luca Bartorelli**, *Marco Farronato**

SUMMARY

Objective. Canine impaction is a dental anomaly involving intraosseous displacement of the unerupted tooth. This situation is of significant importance causing orthodontic, surgical and interceptive problems. Trauma in the incisor area is a possible cause of the displacement of the tooth bud of the permanent canine resulting in the deviated eruption path. The aim of this article is to present two clinical cases with diagnosis of maxillary canine displacement and impaction in the incisor region after a traumatic injury during childhood, discussing treatment possibilities and outcomes achieved after orthodontic treatment.

Materials and methods. In this article ectopic maxillary canines migration in the central incisor area after a traumatic injury to the anterior upper teeth are described. The path of eruption of the canine can cause severe central incisor root resorption. Treatment strategy established for the case reports described involves orthodontic space opening, extraction of the central incisor, uncovering the impacted canine and orthodontic traction of the tooth in place of central incisor. Modification of crown morphology and color were essential to obtain an aesthetic and function outcome.

Results. The patients finished treatment with normal and stable occlusion, an adequate width of attached gingiva and good aesthetic results.

Conclusion. Authors suggest that might have been a possible connection between the trauma of primary dentition causing the displacement of the tooth bud of permanent canine and the deviated path of eruption. For the growing patients with a combination of dental trauma and ectopic eruption, maxillary canine to replace a central incisor was a viable option, offering excellent aesthetic results without recourse to prosthetic replacement.

Key words: impacted maxillary canines, root resorption, ectopic eruption.

INTRODUCTION

Canine impaction is a dental anomaly involving intraosseous displacement of the unerupted tooth. This situation is of significant importance causing orthodontic, surgical and interceptive problems.

The permanent central incisor is considered one of the most important teeth in terms of aesthetics while the position of the permanent maxillary canine

at the angle of the dental arch is important both in maintaining the symmetry, the harmony of occlusal relationship and from the functional point of view.

The maxillary canine is the second most frequently impacted tooth, with a prevalence ranging between 1% and 2% (1).

The aesthetic and functional importance of canines requires an early diagnosis in order to recognize tooth displacement and to predict the resulting failure in eruption. For this reason, eruption process should be monitored in order to identify the etiological factors that lead to impaction of the maxillary canines (2). The process causing the deviation of the eruption path seems to be related to the lack of guidance

*Department of Orthodontics, University of Milan, Fondazione IRCCS Ca' Granda, Ospedale Maggiore Policlinico, Milano, Italy

Address correspondence to Giampietro Farronato, Department of Orthodontics, University of Milan, Fondazione IRCCS Ca' Granda, Ospedale Maggiore Policlinico, via Francesco Sforza 35, 20122 Milano (Mi), Italy.
E-mail address: laimakairyte@gmail.com



Fig. 1. Frontal view of the injured teeth of the patient at the age of 4. It is possible to see the interference of centrals deciduous teeth with the occlusion



Fig. 2. Frontal extraoral view of the patient



Fig. 3. Frontal intraoral view before treatment



Fig. 4. Upper occlusal intraoral view before treatment



Fig. 5. Lateral headfilm before treatment



Fig. 6. Panoramic film before treatment. It is possible to observe the resorption of the root of the central left maxillary incisor

normally rendered by the root of the lateral incisor (3-7). Traumatic injury to the maxillary region has not been mentioned in the literature as a direct etiologic factor of impaction, although it is considered so in the cases of dental transposition (8, 9).

Root resorption of the adjacent teeth is one of the most common and irreversible sequelae of maxillary canine impaction (10). Root resorption is a condition associated with either a physiologic or a pathologic process resulting in a loss of dentine, cementum and/or bone (11).

The presence of root resorption may have a significant effect on the treatment strategy. When root resorption of a permanent maxillary central incisor is diagnosed before orthodontic treatment begins, a decision must be made as to whether the resorbed tooth should be extracted, followed by orthodontic alignment of the impacted canine, space closure, and reshaping, or whether it would be better to move the impacted canine away from the resorbed tooth.

The purpose of this article is to present two clinical cases with diagnosis of maxillary canine displacement and impaction in the incisor region after a traumatic injury during childhood, discussing treatment, possibilities and outcomes achieved after orthodontic treatment.

CASE REPORT 1

The first case was an 11 years old girl visited in the Orthodontic Department of Milan University.

The medical history was unremarkable while the dental history evidenced a severe traumatic injury to the maxillary primary incisors at the age of 4. The parents provided photos documenting loss of the upper lateral primary incisor, extrusion of both incisors, subluxation and mobility of the left primary canine (Figure 1). As the extrusion of the central incisors interfered with mouth closure, they were extracted.

Extra-oral examination showed an ectomorphic face with a convex profile (Figure 2). Intra-oral examination showed the absence of both upper permanent canines, reduced maxillary width, Angle's class II on both sides, midline deviations towards the left side and crowding of the mandibular incisor (Figures 3-4). Cephalometric analysis showed a skeletal Class I malocclusion with hyper-divergent growth pattern (Figure 5; Table 1). Orthopantomography showed right and left upper canines impaction and a severe root resorption of the upper left central incisor (Figure 6). Clinical examination revealed a III degree mobility of the incisor.

The following treatment options were considered and proposed to the patient in a crescent degree of expected final aesthetic and functional outcome: no treatment (12), prosthetic restoration after extraction of central incisor or/and left canine, orthodontic space closure after extraction, but the best expected result with less invasiveness was orthodontic space maintainer after extraction of the central incisor and canine traction into its position.



Fig. 7. Upper occlusal intraoral view of modified palatal expander in situ. The arm on the left side is made with a loop to extrude the upper left impacted canine.



Fig. 8. Orthodontic extrusion of the left impacted canine



Fig. 9. Frontal intraoral view with fixed orthodontic appliance. It is possible to observe the correct extrusion of the left impacted canine



Fig. 10. Frontal intraoral view after treatment. It is possible to observe the good extrusion of the canine with the supporting tissues.



Fig. 11. Face of the patient at the end of the orthodontic treatment

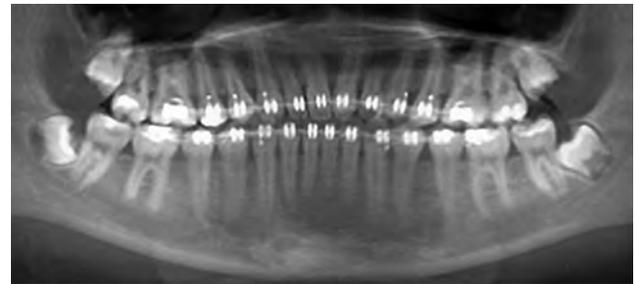


Fig. 12. Panoramic film at the end of orthodontic treatment with the appliance in situ incisor



Fig. 13. Frontal intraoral view at the end of the prosthetic phase



Fig. 14. Frontal extraoral view at the end of the prosthetic phase

Written consent was obtained.

Objectives included the alignment of both dental arches and the achievement of facial and dental aesthetics by substituting the extracted central incisor with the canine. The central left permanent incisor was then extracted after maxillary expansion and the impacted canine was repositioned in the central incisor area. A modified palatal expander was realized with two bands on the first upper molars and a central screw was applied (Figure 7) (13). A vestibular arm extending from the upper left molar band to the central incisor, with two loops to support the orthodontic traction of the impacted canine, was constructed and bonded to the incisor before the expansion. The purpose was to gain space to the right side of the arch and prevent anterior movement of upper central left incisor into the space created by the palatal expansion and restoring correct symmetry

of the midlines. The left vestibular arm was made with a distal eyelet and a mesial one, positioned near the impacted canine area.

The central screw was activated by a quarter turn twice a day for 14 days and then blocked with a ligature wire. The space created by palatal expansion allowed the repositioning of the teeth only on the side where there was lack of space near the impacted canine. The appliance was left for 6 months in order to stabilize transverse maxillary dimension. The central incisor was then extracted and the crown bonded

Table 1. Cephalometric values of the first clinical case

SAGITTAL MEASURES

SNA: 82°

SNB: 79°

ANB: 3°

Wits: +3 mm

DENTOALVEOLAR MEASURES

ILs^SN: 103°

IIs^SNP-SNA: 115°

ILi^Go-Gn: 93°

VERTICAL MEASURES

SN^SNP-SNA: 13°

SN^Go-Gn: 39°

SNP-SNA^GoGn: 26°

N-SNA: 59 mm

SNA-Me: 69 mm

N-Me: 124 mm

Landmarks: S, sella; N, nasion; Go, gonion; A, Point A; B, Point B; Pog, pogonion; Gn, gnathion; Me menton; PNS, posterior nasal spine; U, tip of soft palate; Ptm, pterygomaxillary fissure; Ba, basion



Fig. 15. Frontal extraoral photo of the patient



Fig. 16. Intraoral view of the injury of the patient at the age of 6. It is possible to observe the extrusion of the right central permanent incisor, luxation of the left permanent incisor and right upper primary canine.



Fig. 17. Panoramic film at the time of injury



Fig. 18. Splint of the injured teeth

to the arm of the appliance with composite resin to give the patient the aesthetics she required during canine extrusion. The left upper impacted canine was surgically exposed and bonded with a button and a ligature wire. A mucoperiosteal flap was raised and the crown of the impacted tooth was exposed using a round bur on low-speed handpiece and an intraosseous path was created. This procedure allowed the passage of the ligature wire to the unerupted tooth. The flap was then sutured into its original position. The surgical technique preserved a correct quantity of the attached gingiva. Orthodontic traction was directed between the inner and outer cortex allowing the impacted tooth to follow an eruptive path

similar to the physiological one preserving the keratinized gingiva (14, 15). Orthodontic traction was performed with light forces, activated monthly (Figure 8).

When the canine was close to the dental arch, the expander was removed and a fixed multi-bracket appliance was positioned (Figure 9).

Orthodontic traction was applied with light monthly-

activated forces. The direction of force was adjusted so as to guide the impacted canine into the correct position.

The canine was repositioned in the left central incisor area. The orthodontic attachments were removed when the correct alignment was achieved.

Probing showed periodontal health and a satisfactory occlusion was achieved (Figures 10-11). The orthopantomography revealed good parallelism of the roots in the upper anterior area (Figure 12). Aesthetic reconstruction of the left upper first premolar was performed to obtain a correct canine guidance and to camouflage the morphological characteristics of a canine.

Modification of crown morphology and color were essential to obtain reasonable esthetics. For these reasons, cosmetic reconstruction by veneer of the canine was performed (Figure 13). The patient shows an aesthetic smile at the end of the treatment (Figure 14).

Table 2. Cephalometric values of the second clinical case

SAGITTAL MEASURES

SNA: 84,5°

SNB: 79,5°

ANB: 5°

Wits: +4 mm

DENTOALVEOLAR MEASURES

ILs^SN: 105°

ILs^SNP-SNA: 110°

ILi^Go-Gn: 91°

VERTICAL MEASURES

SN^SNP-SNA: 2°

SN^Go-Gn: 21°

SNP-SNA^GoGn: 19°

N-SNA: 55 mm

SNA-Me: 81 mm

N-Me: 134 mm

Landmarks: S, sella; N, nasion; Go, gonion; A, Point A; B, Point B; Pog, pogonion; Gn, gnathion; Me menton; PNS, posterior nasal spine; U, tip of soft palate; Ptm, pterygomaxillary fissure; Ba, basion

CASE REPORT 2

The second case was a male patient (Figure 15) referred for an orthodontics consultation from his general dentist.

The patient medical history was unremarkable. The dental history underlined a traumatic injury at the age of 6. Clinical and radiographic examination revealed a luxation with extrusion of the right central permanent incisor, luxation of the left permanent incisor and right upper primary canine (Figure 16, 17). At the time, the central right upper incisor was repositioned, and a splint was applied for one month to allow the teeth to stabilize (Figure 18). Extraoral examination showed a mesomorphic face, competent lips and a mild convex profile (Figure 15). The orthopantomography showed root resorption of the central upper right incisor caused by an ectopic eruption of the right upper permanent canine (Figure 19).

The intraoral examination revealed the absence of the first upper right canine (Figure 20), a reduced



Fig. 19. The resorption of the central right maxillary incisor is evident



Fig. 20. Frontal intraoral view before treatment



Fig. 21. Frontal view intraoral view of modified palatal expander. The arm on the right side is made with a loop to extrude the upper right canine impacted while the left arm is bonded in order to obtain middle lines' symmetry using the space created by the expander

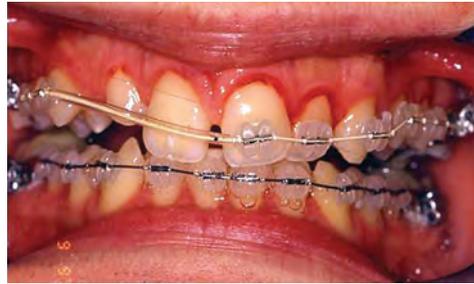


Fig. 22. Frontal intraoral view with fixed orthodontic appliance



Fig. 23. Central right permanent incisor extracted. The resorption of the root of the central right maxillary incisor is evident.

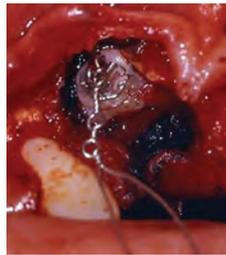


Fig. 24. Surgical exposition of the right permanent canine

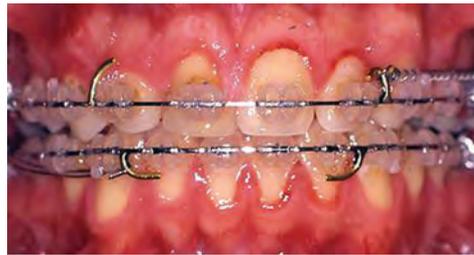


Fig. 25. Orthodontic finishing phase

mesial-distal width of the upper right lateral incisor, a midline deviation towards the right and a posterior crossbite on the right side. Cephalometric tracings showed a skeletal Class II (Table 2).

The same treatment alternatives proposed for the first patient were considered.

The objective of the treatment was to remove the central incisor with poor prognosis in order to allow the mechanical eruption and alignment of the ectopic maxillary canine, with the aim of substituting the incisor with a natural tooth and to maintain adequate gingival support during repositioning of the impacted canine. It was decided to expand the maxilla through a modified palatal expander. Written consent was obtained.

A rapid palatal expander with a vestibular arm extending from the upper left molar to the

incisor was constructed and bonded to the incisor before expansion. The purpose was to save space on the right side of the arch and prevent anterior movement of the upper right incisor into the space created in order to obtain correct symmetry of the midline. The right vestibular arm was made with a distal eyelet and a mesial one, positioned near the impacted canine (Figure 21).

The central screw was activated by a quarter turn twice a day for 14 days. It was then blocked with a ligature wire. The space created by palatal expansion allowed the migration of dental elements only on the side where there was a lack of space near the impacted canine. The appliance was left in place for 6 months. A fixed orthodontic appliance was then applied. It was decided not to place the brackets on the right upper central and lateral incisor to avoid the movement of its root,

which could cause the resorption of the root itself and/or impacted canine (Figure 22).

The central upper right incisor was extracted (Figure 23) due to severe root resorption during the surgical exposure of the upper right canine (Figure 24). The first left upper premolar was extracted so as to obtain the right symmetry of maxillary arch. The aim of surgical technique was to preserve a correct attached gingiva and it was performed as stated in the previous case report. The flap was then sutured into its original position. Orthodontic traction was directed between the inner and outer cortex, allowing the impacted tooth to follow an eruptive path similar to the physiological one preserving the keratinized gingiva (16). Orthodontic traction was applied with light monthly-activated forces (Figure 25). When the canine was



Fig. 26. Frontal intraoral view after treatment. It is possible to observe the good extrusion of the canine with the supporting tissues.



Fig. 27. Upper occlusal intraoral view at the end of treatment



Fig. 28. Panoramic film at the end of treatment

close to the arch, a bracket for upper right incisor was placed on the canine: this has allowed the reduction of mesio-distal size of the canine respect to incisor (from a $+8^\circ$ tip to a $+4^\circ$ tip), and also provided a positive torque to the element, instead of a negative one (from a -7° torque to a $+17^\circ$ torque).

A bracket for an upper right canine was placed on upper left first premolar in order to increase the tip of the upper first premolar to assume the canine's one (from a tip 0° to a tip $+8^\circ$). A correct occlusal relationships were obtained.

A root canal therapy and crown reconstruction of the canine were made to give it the same appearance as a central incisor (Figures 26-28).

Root canal therapy was necessary because the tooth lost the vitality after extrusion.

A prosthetic solution using porcelain veneers to harmonize the color of anterior area was also proposed to the patient. However, he decided to postpone any later prosthetic solution.

An enamel recontouring of the right first premolar which was repositioned in the canine position was performed in order to obtain a correct canine guidance. In addition, a cosmetic reconstruction of upper right lateral incisor was performed to obtain a correct mesial-distal diameter.

DISCUSSION

Dental trauma has been presented as a factor affecting the further development of the successors to injured teeth. The effect of trauma to the incisors on canine impaction may be indirect, as suggested in the previously mentioned cases reports (3). Untreated impacted canines may result in several complications like displacement and loss of vitality of the adjacent incisors, shortening of dental arch, formation of follicular cysts, canine ankylosis, recurrent infections, internal and/or external resorption. A proper diagnosis and early intervention may influence any further treatment strategy in the final outcome.

Canine substitution for maxillary incisors is a suitable treatment option described in the literature (17). Campbell et al. state that canines offer a relatively favourable template to simulate a central incisor because they are closer in mesiodistal width to a central incisor and also in vertical height having more compatible gingival architecture. However, modifications to crown morphology and colour are essential to achieve aesthetic results (17).

In the first clinical case presented, the root of the left lateral incisor was shortened, probably as the result of the traumatic injury. This process could affect the path of eruption of the adjacent canine bud. However, after the injury, the left canine seemed to deviate from the normal eruption path, while the right canine continued to erupt into its normal position. In the second case presented, the root of the right central incisor was shortened and the misalignment of the anterior elements after the traumatic injury may have been responsible for loss of guidance to the erupting canine. The decision to extract the left premolar was in order to obtain the right symmetry of maxillary arch.

However, moving an impacted tooth also involves the risk of a loss of tooth vitality, discoloration, injury to adjacent teeth, alveolar bone loss, gingival recession which can lead to aesthetic problems or tooth loss.

To avoid such complications light and continuous orthodontic forces are advisable because they simulate the natural eruption of the tooth.

The orthodontic-surgical treatment is advisable compared to the surgical treatment alone because it is aimed at extruding the impacted tooth into proper position (18).

Both cases report successful treatment of surgical exposure of impacted canines followed by orthodontic traction and alignment in the upper central incisor position after extraction of this tooth.

CONCLUSIONS

Although substitution of maxillary canine for a central incisor is comparatively rare, the canine

offers a suitable alternative to simulate a central incisor. A correct tip, torque and position of the canine are the keys for a correct treatment.

FINANCIAL SUPPORT

This study is free from any financial support.

CONFLICT OF INTERESTS

Authors state to not have any conflict of interest.

LOAN FOR WORK

Authors state to not have received institutional loans for this work.

REFERENCES

- Ericson S, Kurol J. Longitudinal study and analysis of clinical supervision of maxillary canine eruption. *Community Dent Oral Epidemiol* 1986;14:112-6.
- Ericson S, Kurol J. Radiographic examination of ectopically erupting maxillary canines. *Am J Orthod Dentofacial Orthop* 1987;91:483-92.
- Brin I, Solomon Y, Zilberman. Trauma as a possible etiologic factor in maxillary canine impaction. *Am J Orthod Dentofacial Orthop* 1993;104:132-7.
- Becker A, Zilberman Y, Tsur B. Root length of lateral incisors adjacent to palatally-displaced maxillary cuspids. *Angle Orthod* 1984;4:218-25.
- Oliver RG, Mannion JE, Robinson JM. Morphology of the maxillary lateral incisor in cases of unilateral impaction of the maxillary canine. *Br J Orthod* 1989;19:9-16.
- Becker A, Smith P, Beahr R. The incidence of anomalous lateral incisors in relation to palatally-displaced cuspids. *Angle Orthod* 1981;51:24-9.
- Brin I, Becker A, Shalhav M. Position of the maxillary permanent canine in relation to anomalous or missing lateral incisor: a population study. *Eur J Orthod* 1986;8:12-6.
- Durack C, Patel S, Davies J, Wilson R, Mannocci F. Diagnostic accuracy of small volume cone beam computed tomography and intraoral periapical radiography for the detection of simulated external inflammatory root resorption. *Int Endod J* 2011;44:136-47.
- Ben-Bassat Y, Brin I, Zilberman Y. Effect of trauma to the primary incisors: multidisciplinary treatment approach. *J Dent Child* 1989;50:112-6.
- Alqerban A, Jacobs R, Lambrechts P, Loozen G, and Willem G. Root resorption of the maxillary lateral incisor caused by impacted canine: a literature review. *Clin Oral Investig* 2009;13:247-55.
- Tronstad L. Root resorption—etiology, terminology and clinical manifestations. *Endod Dent Traumatol* 1988;4:241-52.
- Cavuoti S, Matarese G, Isola G, Abdolreza J, Femiano F, Perillo L. Combined orthodontic-surgical management of a transmigrated mandibular canine: A case report. *Angle Orthod* 2016;86:681-91.
- Farronato G, Giannini L, Galbiati G, Maspero C. Modified Hyrax expander for the correction of upper midline deviation: a case report. *Minerva Stomatol* 2011;60:195-204.
- Farronato G, Giannini L, Galbiati G, Consonni D, Maspero C. Spontaneous eruption of impacted second molars. *Prog Orthod* 2011;12:119-25.
- Ericson S, Kurol J. 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* 1988;94:503-13.
- Otto RL. Early and unusual incisor resorption due to impacted maxillary canines. *Am J Orthod Dentofacial Orthop* 2003;124:446-9.
- Campbell CM, DiBiase A, Fleming PS. Concomitant dilaceration, transposition, and intraosseous migration: report of a patient treated with maxillary canine-central incisor substitution. *Am J Orthod Dentofacial Orthop* 2014;146:514-21.
- Farronato G, Giannini L, Folegatti C, Brotto E, Galbiati G, Maspero C. Impacted maxillary canine on the position of the central incisor: surgical-orthodontic repositioning. *Minerva Stomatol* 2013;62:117-25.

Received: 19 06 2017

Accepted for publishing: 20 09 2018