

Interdisciplinary orthodontic-periodontal treatment of unerupted permanent maxillary incisors following traumatic injury to deciduous teeth. Case report with long-term follow-up (11 years)

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Abstract

Orthodontic and periodontal treatment of the permanent maxillary teeth, which were retained due to trauma on the deciduous dentition, showed a perfect alignment of the teeth associated with healthy and stable periodontal tissues during an 11-year follow-up.

KEYWORDS

deciduous trauma, impacted teeth, periodontal treatment

1 | INTRODUCTION

This clinical report describes a young patient who showed a delayed eruption of permanent maxillary incisors as a consequence of trauma that occurred when he was 4 years old. A combined orthodontic-periodontal treatment was carried out resulting in adequate alignment in the arch, associated with healthy periodontal tissues.

The presence of supernumerary teeth or trauma to the primary dentition is the most frequent cause of anomalies in the eruption of the permanent teeth.¹ Since the root of the deciduous tooth and the germ of the permanent tooth have a close relationship in a restricted area for a period of 5-6 years during the mixed dentition age,²⁻⁴ a trauma to the deciduous teeth could affect the formation or the position of the permanent successors, in relation to age and the intensity and direction of the trauma.⁵⁻⁷

Trauma of the primary incisors could directly affect the formation of permanent teeth causing white or yellow dyschromia or circular enamel hypoplasia, dental malformation, duplication of the root, arrest of root development, and root or crown dilaceration.^{1,5,8,9} On the other hand, an indirect

effect may occur when trauma causes the necrosis of the deciduous tooth with the consequent failure of root resorption and/or the development of periapical lesions. The persistence of deciduous roots may cause impaction or ectopic or delayed eruption of the permanent teeth over the physiologic eruption time.¹⁰⁻¹³

This case report describes (a) the combined interdisciplinary ortho-perio treatment of unerupted maxillary central and lateral incisors and a canine after dental trauma to the primary incisors and (b) the outcomes of the therapy during an 11-year follow-up.

2 | CASE REPORT

The present case report follows the CARE checklist for reporting data.

In 2004, the parents of a 10-year-old boy brought him for an office visit (AC) because they were worried about the persistent absence of the left maxillary central and lateral incisors in the arch. The parents reported that the child had suffered a facial and dental trauma when he was 4 years old.

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A panoramic radiography (Figure 1) performed 1 year before in another practice showed a huge periapical lesion extending apically to teeth 6.1 and 6.2; the permanent incisors (2.1 and 2.2) were present and displaced in the maxilla.

On the basis of this situation (April 2004), the orthodontist (AC) decided to extract teeth 5.2, 6.1, and 6.2 (Figure 2) while the deciduous canine was left in place; the permanent incisors (2.1 and 2.2) were present and displaced in the maxilla. No orthodontic treatment was planned at that time while awaiting the spontaneous eruption of the permanent lateral incisor.

One year and half later (September 2005) after the spontaneous eruption of the lateral incisor (Figure 3), the orthodontic treatment was started using a round stainless steel wire (0.016-0.018 inches) and standard brackets on the maxillary teeth associated with a palatal arch fixed to teeth 1.6 and 2.6 (Figure 4). A stringent protocol of oral hygiene was also established.

After 3 months (December 2005), periodontal surgery was planned to expose the crown of the impacted central incisor in order to guide it in the arch. The periodontal procedure consisted of the elevation of a full-thickness flap. The flap was raised by a horizontal incision at the center of the alveolar ridge, associated with two oblique releasing incisions extending apically to the mucogingival junction (MGJ), 2-3 mm from the gingival margin of the right central incisor, and the left lateral incisor to avoid the possible development of gingival recessions. Once the flap was raised, the follicular socket of the central incisor was visible and was gently removed with a periodontal curette. The tooth appeared horizontally placed on the sagittal plane and rotated 90 degrees. The third incisal part of the crown was completely exposed, and the enamel was dried with gentle suction and a dry gauge; a fine mesh was bonded with light curing for 60 seconds. A wire chain with approximately 1.5 mm in diameter rings was hand-fabricated with a 0.011-inch ligature wire and fastened to the mesh. Bonding was tested with a traction force of 150 g applied with a dynamometer. The flap



FIGURE 1 Baseline panoramic radiograph showing a periapical lesion extending apically to the left central and lateral deciduous incisors; the permanent incisors and canine were present and displaced in the maxilla

was then repositioned in its original site with interrupted silk sutures (Figure 5A-D). The sutures were removed 8 days after surgery. The chain emerged from the coronal margin of the flap and was tied to an elastic device (TP Orthodontics:

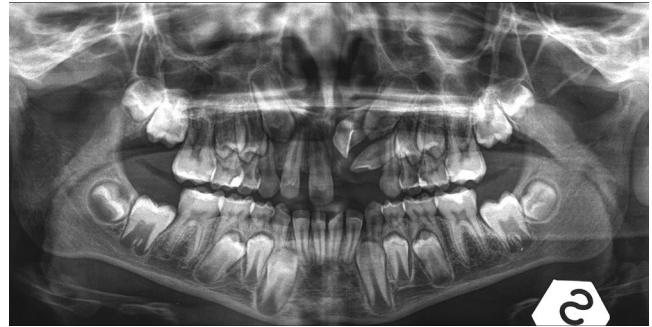


FIGURE 2 Panoramic radiograph 1 year later, after the extraction of the deciduous central and lateral incisors; the eruption process had begun and the permanent lateral incisor was close to spontaneous eruption in the arch



FIGURE 3 Frontal view of the case after the eruption of the lateral incisor

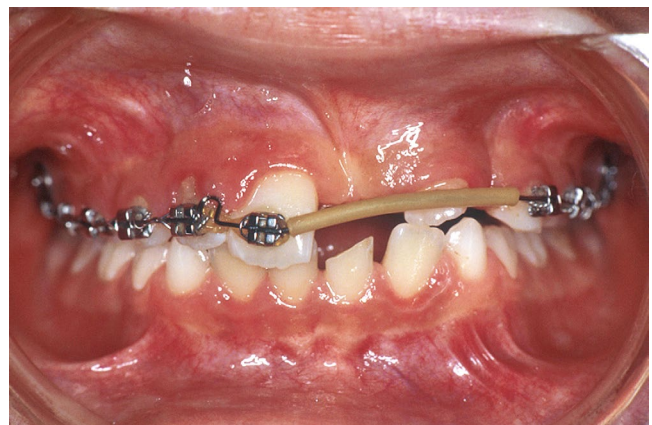


FIGURE 4 Frontal view of the case at the start of orthodontic treatment using a round stainless steel wire (0.016-0.018 inches) and standard brackets on the maxillary teeth

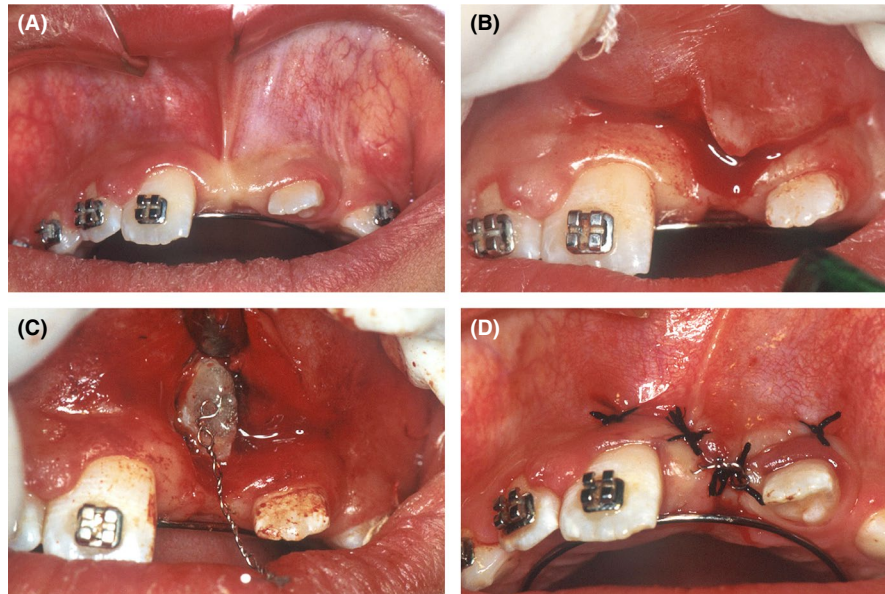
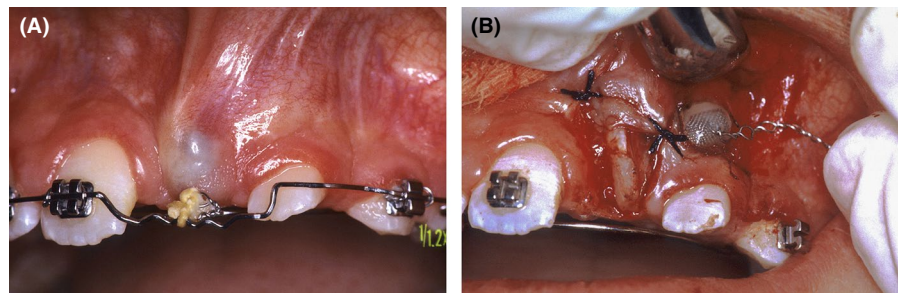


FIGURE 5 First surgery: A, the area planned for exposing the crown of the central incisor. Notice the submucosal position of the tooth apical to the alveolar crest. B, The flap was raised by means of a horizontal incision at the center of the alveolar ridge, associated with two oblique releasing incisions extending apically to the MGJ, 2-3 mm from the gingival margin of the right central incisor and the left lateral incisor to avoid the possible development of gingival recessions. C, Once the flap was raised the tooth appeared horizontally placed on the sagittal plane and rotated 90 degrees. The third incisal part of the crown was completely exposed. A fine mesh was bonded with light curing for 60 s. A wire chain with rings approximately 1.5 mm in diameter was hand-fabricated with a 0.011-inch ligature wire and fastened to the mesh. D, The flap was then repositioned in its original site with interrupted silk sutures

FIGURE 6 Second surgery: A, the permanent central incisor was still submucosal close to the eruption; B, after exposing the crown of the central incisor, a laterally pedicle flap was moved from the lateral incisor and sutured apically to the exposed crown of the central incisor



elastic thread light, item no. 100-225) that was fastened to the buccal round stainless arch (AJ Wilcock, Australian wire 0.018 item no. 232-410).

At this point, the orthodontic movement started and was aimed at guiding the submucosal central incisor toward the center of the alveolar ridge. Six months after the orthodontic traction, the crown of the tooth (2.1) was still submucosal but closer to the center of alveolar ridge.

Then, in April 2006, a second periodontal surgical procedure was performed to expose the crown of the permanent central incisor and provide an adequate amount of keratinized tissue on this tooth.

The exposure of the crown of the central incisor, which was still positioned submucosally, was performed with two vertical releasing incisions in the alveolar mucosa associated with a horizontal incision at the center of the ridge. The mucosal flap was moved apically thus exposing the third part of

the crown of the central incisor. Then, a curved horizontal incision was made 3 mm from the gingival margin of the lateral incisor to avoid the risk of a possible recession. A vertical incision distal to the lateral incisor was performed starting from the distal angle of the horizontal one extending apically to the MGJ; an oblique incision starting from the mesial angle was also made. The 3 incisions made it possible to raise a full-thickness pedicle flap that was rotated mesially and sutured apically to the exposed crown of the central incisor providing an adequate amount of keratinized gingiva.

Following the rotation of the pedicle flap, the crown of the permanent canine was exposed; a fine mesh was bonded to the exposed crown and a handmade chain was applied; the alveolar mucosa was sutured to the gingiva of the lateral incisor (Figure 6A,B). The silk sutures were removed after 1 week.

One month later (June 2006), the derotation of the central incisor started and was accomplished using a light elastic

thread from a button on the buccal surface of the central incisor to the bracket placed on the contralateral right central incisor (Figure 7).

After the complete derotation of the central incisor (November 2006), the deciduous canine was extracted. The permanent canine was guided distally toward the extraction site of the deciduous canine using an elastic device that passed through the loop of the round arch and was fastened to the bracket of the first permanent molar (Figure 8).

While the canine was located distally to the root of tooth 2.2 (March 2007), the correction of the lateral incisor was started using a round arch and an additional device (AO Ni Ti Memory Wire 0.014 item no. 857-3U-14H) (Figure 9).

During the ensuing years (2008 and 2009), the final alignment of teeth 2.1, 2.2, and 2.3 was accomplished using round and rectangular wires (Figure 10). The treatment was completed in May 2009 after 5 years and 2 months when the patient was 15 years old. At the end of active orthodontic treatment, the patient was discharged with Hawley plates and lingual retainers. The final clinical and radiologic outcomes of the combined periodontal-orthodontic treatment are shown in Figures 11 and 12; the teeth are perfectly aligned in the arch, and the periodontal tissues are healthy.

Throughout the duration of the treatment, the patient was recalled every 4 weeks to control and change the orthodontic appliances and every 4 months for professional oral hygiene. Orthodontic controls were repeated 3 and 11 years after treatment when the patient was 18 and 26 years old, respectively (Figures 13 and 14).

To evaluate the periodontal outcomes of the treated teeth, the periodontal parameters of probing depth (PD) and width of keratinized tissue (KT) were recorded by two expert periodontists (GPP and DF) at the end of active therapy for the orthodontically erupted teeth showing a physiologic sulcus depth (range 1.5 mm to 2.0 mm), an adequate amount of keratinized tissue (range 2.0 mm to 4.0 mm), and absence of gingival recession. Periodontal measurements repeated after

8 and 11 years during the follow-up period showed tissue stability and good oral health.

The patient signed a written informed consent with agreement to use his data for the case report, in accordance with the Helsinki Declaration of 1975, as revised in 2013.

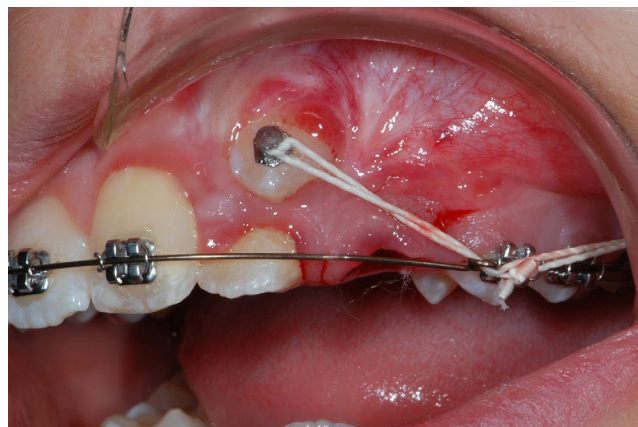


FIGURE 8 After extraction of the deciduous canine the permanent canine was guided distally

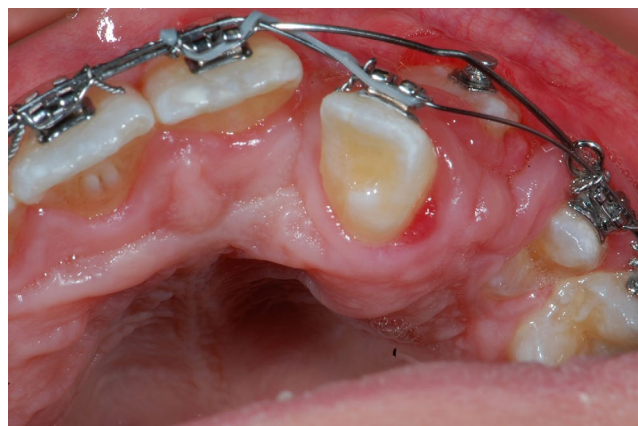


FIGURE 9 Alignment of the lateral incisor



FIGURE 7 Derotation of the central incisor



FIGURE 10 Providing the final alignment of the teeth using rectangular wires



FIGURE 11 An image at the end of active treatment showing a perfect alignment of the frontal teeth associated with a healthy periodontium and no signs of gingival recession



FIGURE 12 Panoramic radiograph showing the alignment of the roots and the absence of root resorption



FIGURE 13 Year 2012: the patient (16 y old) 3 y after the end of treatment; the tissues are healthy with a perfect alignment of the frontal teeth

3 | DISCUSSION

Dental trauma of maxillary deciduous teeth can cause direct or indirect lesions to the permanent dentition and/or alter



FIGURE 14 Year 2020: the patient (26 y old) 11 y after the end of treatment showing stable outcomes

the timing and the physiological sequence of the eruption process.^{1,5-9,14}

Consequently, the crowns and roots of permanent teeth can be damaged directly, or the teeth may be retained in the maxillary bone beyond the physiologic time of eruption or an ectopic tooth eruption may occur.^{6,8,9} Often dental trauma may occur a long time before the eruption of the permanent teeth and patients tend to forget this fact. For this reason, obtaining an accurate history and radiological examination is of paramount importance in order to make a correct diagnosis and plan an appropriate treatment strategy.

The therapy of these cases can only be considered successful when the treated teeth are properly aligned in the arch and are associated with healthy periodontal tissues over a long period of time. Therefore, the diagnosis and treatment of impacted teeth involve an interdisciplinary orthodontic-periodontal approach.

The most appropriate orthodontic treatment should be able to simulate the physiological eruption pattern of the permanent teeth that occurs at the center of the alveolar ridge as some authors have already suggested.^{14,15} Orthodontic appliances and techniques designed for this purpose have been proposed specifically for repositioning the impacted teeth on the maxillary arch.¹⁶⁻²³

The surgical procedures performed to expose the impacted teeth should respect the soft tissue as much as possible. In case of submucosal palatal impaction where only soft tissue is involved, the keratinized gingiva must be preserved and an apically positioned flap (APF) should be raised.^{24,25}

In case of deep infraosseous impaction, a more delicate management of the soft tissues and bone is required to access the crown of the tooth and to avoid severe subsequent periodontal damage.

The flap approach seems to be an appropriate surgical choice allowing a minimal exposure of the tooth, reducing the surgical bleeding, and facilitating the placement of the attaching devices.^{18,19,26,27}

The periodontal status of the impacted teeth following surgical-orthodontic treatments was investigated with short-term follow-up evaluation.^{18,28-30} However, long-term evaluations are lacking as reported by Quirynen 2000.³¹

This case report shows how an accurate anamnestic evaluation, a correct diagnosis and a combined interdisciplinary orthodontic-periodontal treatment, made it possible to obtain optimal functional and esthetic results that were stable over a long period (11 years). Three-dimensional radiograph could have helped to understand the exact position of the impacted teeth; however, this technology was not used in this case because CBCT was not easily available in the years 2003/2004 and parents did not accept to have a computer tomography.

Indeed, this is the first reported clinical case followed for a period of 11 years, lasting from preadolescence to adulthood.

In the present case, the 10-year-old patient had suffered a dental trauma to the primary maxillary incisors when he was four (6 years earlier). The accident had caused dental necrosis, with the persistence of the deciduous roots causing the alteration of the eruption sequence and the consequent inclusion of the permanent teeth 2.1, 2.2, and 2.3. A possible risk following trauma could be the tooth ankylosis but this event did not occur in this case. The subsequent extraction of the central and lateral deciduous incisors permitted the elimination of the periapical infection and the spontaneous ectopic eruption of tooth 2.2.

The orthodontic technique described by Crescini¹⁹ was used to guide the impacted teeth to the center of the alveolar crest. Therefore, the first surgery involved raising a full-thickness trapezoidal flap to guarantee the exposure of the crown of tooth 2.1 and to position an orthodontic mesh and a handmade chain. The incisions of the flap were carried out distant from the marginal gingiva of the adjacent teeth to avoid the possible development of recession. It is interesting to notice that the flap was repositioned in the previous position allowing the complete coverage of the root of the central incisor.

In order to provide an adequate amount of gingiva on the central incisor during the orthodontic therapy and at the end of treatment, a second periodontal surgery was performed immediately before the eruption. This tooth was close to eruption in a submucosal position in an area of alveolar mucosa; therefore, a laterally positioned flap including an adequate amount of keratinized tissue was moved from the adjacent lateral incisor toward the central incisor. The exposed root of the central incisor was covered by the lateral positioned flap while the root of the left canine resulted covered by the alveolar mucosa sutured with the coronal attached gingiva. Therefore, in both the sites, the exposition of the roots was avoided.

A final but important factor in the success of the interdisciplinary orthodontic-periodontal approach was the strict application of the maintenance therapy. During the all recall

sessions, that is, every 4 months during the orthodontic therapy and every 6 months during the follow-up period, the oral hygiene maneuvers³² were checked and repeated and the periodontal parameters (PD, KT, and Rec) were also assessed.

4 | CONCLUSIONS

The final clinical and radiologic outcomes of the combined periodontal-orthodontic treatment of the permanent maxillary teeth (central, lateral incisors, and canine) that were retained due to trauma on the deciduous dentition showed a perfect alignment of the teeth in the arch associated with healthy and stable periodontal tissues during the 11-year follow-up.

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The authors reported no conflict of interest related to this study. No funding was available for the study.

CONFLICT OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

AC: curated data. PPGP and FD: curated data and wrote, reviewed, and edited the original draft.

ETHICAL APPROVAL

Comitato Etico Area Vasta, Florence, Italy - REF 19165.

DATA AVAILABILITY STATEMENT

The data generated during the current study are not publicly available but are available from the corresponding author on reasonable request (debora.franceschi@unifi.it).

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