Orthodontic-restorative treatment as an option for biologic replacement of a maxillary central incisor: 5-year follow-up

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The maxillary central incisor is the tooth most often affected by trauma, especially in the age range of 7 to 10 years, when high-impact sports are prevalent. The options for conservative treatment should be prioritized in these patients, aiming to achieve a biologic response that might provide continuity of growth of the alveolus, to provide functional and esthetic development of the affected region. This case report describes a patient with a history of trauma during the deciduous dentition with consequent intrusion, root dilaceration, and retention of the maxillary left central incisor. The treatment involved extraction of the traumatized tooth and mesial movement of the lateral incisor and posterior segments. (Am J Orthod Dentofacial Orthop 2012;142:393-401)

Dentists must occasionally treat patients with a history of trauma to the maxillary anterior teeth. According to Zachrisson, the maxillary central incisor is the tooth most often affected by trauma, especially from 7 to 10 years of age. These years are considered to have the highest risk, because of the high-impact sports that children play during this period.

The high prevalence of trauma during the deciduous dentition and the close anatomic proximity to the permanent tooth buds might explain the high frequency of alterations that occur in developing permanent teeth. As mentioned by Andreasen and Ravn, Andreasen, and Andreasen and Andreasen, permanent tooth damage can occur simultaneously with the trauma, because of the direct impact of the deciduous tooth root on the developing permanent tooth bud or later as a consequence of posttraumatic complications. Mattisson et al believed that the trauma might result in minor alterations in enamel mineralization or produce displacement of the permanent tooth bud. The latter consequence could cause impaction, crown or root dilaceration, or both, ultimately leading to severe root resorption and tooth loss.

When trauma causes the loss of at least 1 maxillary central incisor, 4 treatment options have been proposed in the literature: autotransplantation, prosthetic replacement, replacement with endosseous implants, and space closure. Selection of the best option depends on several factors such as the patient’s age, skeletal and facial patterns, sagittal relationship between the dental arches, root integrity, coronal dimensions of the lateral incisors, and patient compliance.

In this article, we describe the treatment of a patient with a history of trauma during the deciduous dentition with subsequent intrusion, root dilaceration, and retention of the maxillary left central incisor. The treatment involved extraction of this tooth with biological replacement by mesial movement of the lateral incisor and posterior segments.

DIAGNOSIS AND ETIOLOGY

A girl, aged 11 years 7 months, came to our orthodontic clinic with the chief complaint of a missing maxillary left central incisor. During the anamnesis, the mother reported a history of trauma during the deciduous dentition. The extraoral photographs showed...
a harmonious face with proportional facial thirds and spontaneous lip seal. The profile view exhibited a good facial contour between the nose, lips, and chin, with balanced nasolabial and mentolabial angles (Fig 1).

The intraoral examination (Figs 1 and 2) showed an Angle Class II relationship for both the molars and the canines. The mesial aspect of the maxillary right central incisor was coincident with the facial midline, despite the clinical absence of the maxillary left central incisor. The mesial inclination of the maxillary left lateral incisor was invading the space of the unerupted adjacent tooth and alteration in the gingival contour of the maxillary anterior teeth. Overbite was 50%, and overjet was 3 mm.

The panoramic radiograph showed the unerupted maxillary left central incisor, positioned high in the alveolar process, with root dilaceration at the apical third (Fig 3).

**TREATMENT GOALS**

The treatment goals were to achieve a functional occlusion, establish satisfactory esthetics by replacing the maxillary left central incisor by mesial movement of the maxillary left lateral incisor, correct the occlusion by extracting the maxillary right first premolar to create a Class I canine relationship and a Class II molar relationship, and improve the overbite, overjet, and gingival contour of the teeth in the maxillary anterior region.

**TREATMENT OPTIONS**

The following treatment options were suggested.

1. Space opening followed by surgical access to bond an orthodontic attachment on the maxillary left central incisor and erupt the tooth orthodontically.
2. Space opening, extraction of the maxillary left central incisor, and autotransplantation of the maxillary right first premolar.
3. Allow the maxillary left central incisor to remain submerged, open the space, eventually extract the maxillary left central incisor, and place an implant after completion of skeletal growth.
4. Extract the maxillary left central incisor with space closure and mesial movement of the maxillary left lateral incisor.

The decision for space closure was chosen because of the mesial positioning of the maxillary left lateral incisor, the marked Class II relationship on the left side, and the potential to maintain the bone and the periodontium by the mesial movement of the adjacent teeth.

**TREATMENT PROGRESS**

After explaining the options, we decided on space closure and mesial movement of the maxillary left lateral incisor and posterior segments. Initially, we placed bands on the maxillary and mandibular first molars and bonded
brackets on the remaining teeth. The bracket on the maxillary left lateral incisor was bonded with a slight mesio-cervical inclination to allow mesial movement of the root. The patient was referred for extraction of the maxillary right first premolar and left central incisor soon after placement of the maxillary appliances.

Fig 2. Pretreatment dental models.

Fig 3. Pretreatment radiographs. Note the root dilaceration and the close relationship with the root of the adjacent lateral incisor.
Alignment and leveling were performed by using 0.014-, 0.016-, and 0.018-in nickel-titanium archwires, followed by 0.018- and 0.020-in stainless steel archwires. The canine relationship on the right side was corrected by distal movement of the maxillary right canine with elastomeric chains. Open coils were placed between the maxillary left lateral incisor and the canine, and between the maxillary left canine and the first premolar for anterior space closure, combined with Class II elastics on the right side and Class III elastics on the left side. After closure of the anterior space, the residual space mesial to the molar on the left side was reduced by using chain elastics and a protraction facemask.

A lingual arch was placed in the mandibular arch, followed by interproximal stripping of the mandibular anterior teeth. Alignment and leveling were then performed with 0.014-, 0.016-, and 0.018-in nickel-titanium archwires and a 0.020-in stainless steel archwire. The treatment was finalized by using 0.019 × 0.025-in rectangular stainless steel archwires.

After treatment completion, the maxillary appliances were removed, and the patient was referred for esthetic restoration of the maxillary anterior teeth with composite resin. Since we believed that gingival recontouring would be required after reconstruction of the maxillary left lateral incisor, gingival surgery was not immediately recommended. The gingival margin level would change after the tooth was recontoured.

**TREATMENT RESULTS**

The treatment response was considered excellent because of maintenance of facial harmony and good dental leveling with an acceptable gingival contour (Fig 4). Class II molar and Class I canine relationships were maintained on both sides. On the left side, occlusal adjustment was performed by grinding the palatal cusp of the maxillary left first premolar that functioned as a canine. The incisal edge and the buccal convexity of the maxillary left canine were reduced to favor the function of a lateral incisor. The patient was referred for restoration of the maxillary left lateral incisor, by adding composite resin on the mesial, distal, and incisal aspects to achieve the esthetic appearance of the contralateral maxillary right central incisor (Figs 4 and 5).

The posttreatment panoramic and periapical radiographs show good root parallelism, root integrity, and apparently healthy supporting tissues (Fig 6). The final cephalometric evaluation showed good inclination of the anterior teeth and a pleasant facial profile (Fig 6).

Analysis of the treatment outcome 5 years after treatment showed an optimal facial pattern with balance of
the facial thirds and the soft-tissue profile (Fig 7). The occlusion was stable, with normal overbite and overjet, and coincidence of the maxillary and mandibular dental midlines (Fig 8). The gingival levels of the incisors were balanced and esthetically pleasant, and had good periodontal support (Fig 7). It was not necessary to perform periodontal surgery for gingival leveling. There was good integrity of the periodontium and root structure (Fig 9).

**DISCUSSION**

Facial trauma is common in childhood and mainly affects the maxillary anterior region of the oral
According to Profit,16 1 child in 3 suffers some type of trauma to the anterior deciduous teeth. In Brazil, the studies of Mestrinho et al,17 Yared,18 and Kramer et al19 showed high prevalences of tooth trauma in young children, with approximately 14%, 30%, and 36%, respectively, affected. Our article...
corroborates these statistics and demonstrates the treatment of a patient with a history of trauma to the deciduous dentition with subsequent intrusion, dilaceration, and retention of the permanent central incisor.

The sequelae of trauma to the deciduous dentition can affect the permanent dentition, causing relatively significant problems. According to Andreasen and Ravn, intrusive luxation in deciduous teeth might cause anomalies in the permanent dentition. The proximity between the apex of the deciduous tooth and the permanent tooth bud is a factor that predisposes such anomalies, due to either direct contact in case of intrusion or periapical inflammation from the traumatized deciduous tooth. Andreasen further stated that tooth intrusion is a complex lesion that causes rupture of the gingival marginal seal, contusion of the alveolar bone, and rupture of periodontal ligament fibers, cementum, and the blood and nerve supply to the pulp. This author also stated that the sequelae affecting the permanent tooth bud might cause damage to the coronal portion (hypocalcification, enamel hypoplasia, and crown dilaceration), to the tooth root (duplication, root dilaceration, and interruption of root formation), or even to the tooth bud, including eruption disturbances, malformations similar to odontomas, and sequestrum of the tooth bud.

The dilaceration observed in this patient can be defined as increased angulation of the tooth root or the crown. Since this disorder occurs in the period of tooth formation, there is a change in position of the mineralized portion in relation to the remaining tooth structure. This curvature can occur at any site along the developing tooth, depending on the stage of formation when the trauma occurred. According to Guedes Pinto, Moss, and Shafer et al, the trauma can affect the root of the developing permanent tooth when it occurs at 4 to 6 years of age. At earlier ages, the crown would be affected. Dilacerations might impair tooth eruption as in our patient, in which the root dilaceration caused impaction of the maxillary left central incisor.

The esthetic and emotional impact of a missing anterior tooth in a teenager is challenging. We discussed with the patient the treatment options and the management of a retained maxillary central incisor caused by intrusive trauma to the deciduous tooth. The options included space opening and surgical access to bond an orthodontic attachment on the central incisor to induce tooth eruption orthodontically. However, the application of force on this tooth could have caused resorption of the mesially displaced maxillary left lateral incisor, since the apical dilaceration was directed toward this tooth. Also, the maxillary permanent central incisor could have been ankylosed because of the trauma to the deciduous tooth.

Another option was autotransplantation of the maxillary right first premolar to the site of the maxillary left central incisor. This option was ruled out because of the
degree of root formation of the maxillary right first premolar, which did not meet the necessary requirements for successful autotransplantation.

The third option was space opening in the area of the maxillary left central incisor and retention of this tooth until completion of skeletal maturation, followed by extraction of the central incisor and placement of an implant. This option was refused by the parents because of the extensive length of treatment. As mentioned by Tallgren and Östler and Kokich, when space is opened for future placement of prostheses or implants, there might be alveolar bone resorption in the site. These authors also stated that implant placement in growing patients is not a viable treatment alternative.

Finally, the alternative of space closure with mesial movement of the maxillary left lateral incisor and posterior segments seemed to be the most viable. This treatment option provided a biologic replacement for the missing tooth, and the orthodontic movement established adequate alveolar bone in the site, with long-term stability. Treatment planning requires analysis of factors such as space to be closed, root integrity, dimension of the crown of the lateral incisor, and the patient's age, facial characteristics, and favorable growth pattern.

According to Kokich and Crabill, when a lateral incisor is used to replace a missing maxillary central incisor, several important steps will ensure an esthetic result. During orthodontic treatment, the maxillary canines must be extruded to move their gingival margins incisally to resemble the usual gingival margin position of the lateral incisors. The lateral incisor must be intruded significantly so that its gingival margin matches the adjacent central incisor. An additional benefit of this procedure is to facilitate restoration of this tooth into the shape of a central incisor. Because the lateral incisor must be grossly overcontoured, this type of restoration is easier when the clinician has a longer rather than a shorter tooth to restore. Additionally, when a lateral incisor is substituted for a central incisor, the provisional restoration should have a shape on the mesial surface that matches the adjacent central incisor. The orthodontist must move the lateral incisor close enough to the central incisor to allow the restorative dentist to contour the tooth properly.

In this patient, to achieve a good esthetic and functional outcome, equilibration was performed on the canines and premolars, as previously described. Thordarson et al demonstrated that extensive grinding of cusps, and buccal and interproximal surfaces, can be performed without causing discomfort to the patient, with minimum or no clinical and radiographic reaction in the long term.

CONCLUSIONS

The clinical outcome obtained by space closure comprising mesial movement of the lateral incisor and the posterior segments was esthetically and functionally successful, considering that the esthetic appearance of the gingival contour and the periodontal health were similar to those of the contralateral teeth. For this biologic treatment option, the clinician must take into account various clinical criteria such as facial pattern, occlusion, space available, clinical and periodontal conditions of the lateral incisor, mechanics applied, and period of tooth loss. The favorable outcome observed over the long term in this patient confirms the stability of this treatment option in young patients with active alveolar growth.

REFERENCES