Combined orthodontic-restorative management of maxillary central incisors lost following traumatic injury: A case report

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A history of traumatic dental injury to the maxillary central incisors during preadolescence or adolescence is common and may result in premature loss. Treatment options include prosthetic implant replacement, autotransplantation, and orthodontic space closure with direct composite recontouring. This case report describes the treatment of an adolescent girl who presented with a crowded Class I malocclusion complicated by a history of trauma to the maxillary central incisors. The treatment plan consisted of orthodontic space closure following loss of both maxillary central incisors and mandibular premolars. This case highlights that orthodontic space closure can be a valuable treatment option in selected Class I crowded and Class II uncrowded malocclusions, producing predictable and efficient results. ORTHODONTICS (CHIC) 2011;12:242–251.

Key words: central incisor, dental trauma, space closure

Trauma to the maxillary anterior segment is commonly reported, with at least 15% of 13-year-old children suffering some form of dental injury, of which more than 80% involve the maxillary central incisors.¹–³ Traumatic dental injuries are more prevalent in males¹ and are associated with increased overjet,⁴ incompetent lip patterns,⁵ and increased incisor display at rest. Injuries vary in severity from enamel infractions or uncomplicated crown fractures to severe intrusion or avulsion of the involved teeth with attendant poor prognosis.

Treatment options to address premature loss of maxillary central incisors include prosthetic or natural replacement of the incisors with fixed partial dentures, dental implants, or autotransplantation. In the adolescent patient, however, definitive prosthetic replacement is best deferred until cessation of vertical growth to prevent relative infraocclusion of implants and associated gingival height discrepancies.⁶ Consequently, an interim fixed or removable prosthesis is usually required. Furthermore, prosthetic space maintenance fails to preserve alveolar bone volume required to facilitate implant placement. While autotransplantation transcends these limitations, successful transplants are reliant on careful surgical technique and apical immaturity.⁷,⁸ In addition, autotransplantation is indicated only when removal of remote teeth is necessary.⁹

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A further option in the adolescent patient is orthodontic space closure with reshaping of the maxillary lateral incisors and canines simulating central incisors and lateral incisors, respectively. This approach obviates the need for prosthetic replacement, providing an alternative solution to a complex problem. The following case is a description of a Class I malocclusion complicated by trauma to the maxillary incisors and crowding treated with a combined orthodontic-restorative approach.

METHODS

History
A medically fit and well 13-year-old girl presented to the orthodontic department, Kent & Canterbury Hospital, following referral from her general dental practitioner. The patient had sustained trauma to the maxillary incisors 4 months prior, resulting in avulsion of both maxillary central incisors. Both teeth had been replanted more than 5 minutes after the initial displacement; a dry storage medium was used.

Diagnosis
On extraoral examination, a mild skeletal Class II discrepancy with increased vertical skeletal proportions, a convex profile, obtuse nasolabial angle, and incompetent lips were observed (Table 1, Fig 1). The patient had a Class I malocclusion with increased overjet (8 mm) related to proclined maxillary incisors. There was mild crowding of both dental arches—1 and 5 mm in the maxillary and mandibular arches, respectively. In occlusion, the molar relationships were Class I bilaterally, the overjet was increased, and there was an anterior open bite of 3 mm. With the exception of the third molars, all permanent teeth were erupted. Both maxillary central incisors were discolored and hyperresonant to percussion (Fig 2).

Periapical radiographs confirmed that both central incisors had undergone endodontic treatment, although there was no evidence of replacement resorption. However, a diagnosis of replacement resorption was made on percussion and clinical grounds. (Fig 3). Both maxillary central incisors were deemed to have poor long-term prognoses.

Cephalometric analysis confirmed the clinical impression of mild Class II anteroposterior discrepancy. Both lower anterior facial height and Frankfurt mandibular plane angle were increased, indicating a posterior mandibular growth rotation tendency. The maxillary incisors were proclined (120 degrees), and the mandibular incisors were of average inclination (92 degrees) relative to their respective dental bases (Fig 4, Table 1).
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The orthodontic aims and objectives were as follows:

- Maintenance of the facial profile camouflaging for the mild skeletal Class II discrepancy
- Relief of dental crowding
- Arch alignment and leveling
- Overjet reduction
- Creation of a positive overbite
- Preservation of Class I molar relationships
- Optimal buccal segment interdigitation
- Long-term maintenance of the treated result

### Table 1  Pretreatment and posttreatment cephalometric values

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Normal value</th>
<th>Pretreatment (T1)</th>
<th>Near end treatment (T2)</th>
<th>T2–T1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA (degrees)</td>
<td>81 ± 3.0</td>
<td>82</td>
<td>79</td>
<td>-3</td>
</tr>
<tr>
<td>SNB (degrees)</td>
<td>78 ± 3.0</td>
<td>75</td>
<td>74</td>
<td>-1</td>
</tr>
<tr>
<td>ANB (degrees)</td>
<td>3 ± 2.0</td>
<td>6</td>
<td>5</td>
<td>-1</td>
</tr>
<tr>
<td>SN (maxillary plane) ANS–PNS</td>
<td>8 ± 3.0</td>
<td>8</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Wits appraisal (mm)</td>
<td>0 ± 1.7</td>
<td>2</td>
<td>0</td>
<td>-2</td>
</tr>
<tr>
<td>UI (maxillary plane) ANS–PNS</td>
<td>109 ± 6.0</td>
<td>120</td>
<td>106</td>
<td>-14</td>
</tr>
<tr>
<td>LI (mandibular plane) Menton–Go</td>
<td>93 ± 6.0</td>
<td>92</td>
<td>89</td>
<td>-3</td>
</tr>
<tr>
<td>UI–LI (interincisal angle)</td>
<td>133 ± 10.0</td>
<td>116</td>
<td>132</td>
<td>16</td>
</tr>
<tr>
<td>MMPA (maxillary mandibular planes angle)</td>
<td>27 ± 4.0</td>
<td>32</td>
<td>32</td>
<td>0</td>
</tr>
<tr>
<td>LAFH (%)</td>
<td>55 ± 2.0</td>
<td>57</td>
<td>58</td>
<td>1</td>
</tr>
<tr>
<td>LI–Apo (mm)</td>
<td>0–2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Lower lip to E-plane (mm)</td>
<td>-2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Fig 1  Pretreatment facial photographs.
The following treatment options were considered:

- Removal of both maxillary central incisors and prosthetic replacement with an intermediate adhesive prosthesis and implant replacements following cessation of vertical growth. This approach may have been performed with or without orthodontic treatment. Orthodontically, the anterior open bite would have been addressed with intrusion of the buccal segments.
- Removal of all second premolars in conjunction with maxillary and mandibular preadjusted edgewise appliances to relieve crowding and correct the anterior open bite. Both maxillary central incisors would be replaced prosthetically.
Orthodontic space closure with removal of maxillary central incisors and mandibular second premolars, followed by composite reshaping of both maxillary lateral incisors and canines.

During consent for orthodontic treatment, the patient indicated her preference to have efficient and comprehensive correction of the malocclusion. She was reluctant to have an interim prosthesis; therefore, the final approach was chosen.

Treatment plan and progress
Following extraction of both permanent maxillary central incisors and mandibular second premolars, self-ligating preadjusted edgewise appliances (InOvation R, GAC) were placed in both arches. Initially, 0.014-inch round nickel-titanium (Ni-Ti) archwires were ligated. Space closure was commenced on a 0.020-inch stainless steel archwire in the maxillary arch using elastic chain and elastomeric links in the mandibular arch (Fig 5). Once the maxillary lateral incisors had been situated in the central incisor positions and the maxillary canines in the lateral incisor positions, maxillary and mandibular 0.019 × 0.025-inch rectangular stainless steel archwires were ligated to correct the torque in both arches. A maxillary 0.021 × 0.025-inch beta-titanium alloy (TMA) archwire was placed for further torque control, supplemented by individual palatal root torque to both maxillary canines. The maxillary lateral incisors and canines were reshaped with Herculite XRV microhybrid composite resin Shade A2 (Kerr). The maxillary canines were also intermittently reduced throughout treatment.

RESULTS
Active orthodontic treatment was completed in 17 visits over the course of 21 months. The patient’s soft tissue profile remained balanced, lips were competent, and the lower lip was slightly in advance of the Ricketts E-line (Table 1, Fig 6). Further aims of treatment were met with good buccal interdigitation achieved and Class I molar relationships preserved. The overjet was reduced, and an ideal overbite attained (Fig 7). The dynamic occlusion was acceptable with group function on lateral mandibular excursions without nonworking side interferences.

A maxillary fixed retainer was placed following treatment and supplemented with maxillary and mandibular vacuum-formed retainers to maintain ideal alignment. Following removal of the appliances, both dental arches were bleached with 10% carbamide peroxide over 10 days to mask the color discrepancy between the maxillary lateral incisors and canines (Fig 8).
Near end of treatment panoramic radiograph and lateral cephalogram (Fig 9) and superimpositions (Fig 10) reveal that the substituted lateral incisors were at an ideal inclination (106 degrees) relative to the maxillary dental base. In conjunction with mesial movement of the posterior dentition and slight uprighting of the mandibular incisors, this contributed to the establishment of a positive overbite. The mild Class II skeletal pattern was maintained during treatment. The reduction in both SNA and SNB values can be attributed to alveolar remodeling.
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Fig 8  Frontal intraoral photograph following vital bleaching.

Fig 9  (Above and left) Near end of treatment (a) panoramic radiograph and (b) lateral cephalogram.

Fig 10  (Below) Pretreatment (black) and near end of treatment (red) cephalometric tracings, superimposed on sella-nasion plane at sella.
DISCUSSION

Management of the adolescent patient with maxillary central incisors of poor long-term outlook poses a significant diagnostic dilemma. While prosthetic replacement of maxillary incisors may offer excellent results, for predictable and esthetic outcomes, treatment should be deferred until vertical growth ceases. Additionally, while autotransplantation has proven highly successful and predictable in Swedish and Norwegian centers, it is highly operator-sensitive and rarely used in some regions.

Orthodontic space closure in the case described provided acceptable occlusal and esthetic outcomes. Treatment was very efficient, and dental esthetics may be further improved in the longer term with porcelain veneers. However, orthodontic space closure may not be appropriate in many cases; the decision to consider this approach is governed by the dictates of the associated malocclusion, lip-incisor relationships, and dental microesthetics, particularly color and morphology of the adjacent lateral incisors and canines.

Class I relationships with mandibular arch crowding necessitating removal of mandibular premolars or Class II malocclusions with uncrowded mandibular arches both lend themselves to this treatment approach. The illustrated case essentially had a Class I malocclusion complicated by mandibular arch crowding and an anterior open bite. The open bite was related to the increased vertical skeletal dimensions requiring buccal segment intrusion with anchorage devices or extraoral traction if nonextraction treatment was to be considered. Consequently, removal of the maxillary central incisors compensating for loss of the premolars was undertaken to preserve Class I relationships while also comprehensively addressing the malocclusion and vertical discrepancy. The increased vertical skeletal pattern may have contributed to the efficiency of space closure, although the biologic basis for this phenomenon remains unclear.

Dental esthetics were enhanced by selective incisal reduction of the maxillary canines; remodeling was performed sequentially and under cooling to avoid short-term sensitivity and long-term complications, including sclerosis. Selective reduction of the first premolars was considered unnecessary since the palatal cusps were not prominent. Mandibular excursions were also smooth without nonworking side interferences. The prevalence of nonworking side interferences and overall temporomandibular joint health is almost identical in subjects treated with orthodontic space closure or prosthetic replacement with absent lateral incisors. Therefore, central incisor substitution is also unlikely to have a prolonged influence on temporomandibular integrity.

Vital bleaching of the dentition was planned at the outset; the color mismatch between the maxillary canines and lateral incisors persisted following orthodontic space closure. This was addressed with vital bleaching after placement of the initial direct composite resin restorations, which were placed prior to complete space closure to enhance short-term esthetics and to guide final crown and root positioning. The shade of the restorations was chosen to mimic the projected final color following bleaching.

While it is possible that the rate of space closure may have been enhanced by use of self-ligating brackets, clinical research has failed to confirm an improvement in the rate of space closure or orthodontic alignment with these systems. The particular type of self-ligating appliance used has an active clip permitting optimal torque expression in the maxillary anterior region. This design may have been important in this case since more than 10 mm of anterior space closure was required; nevertheless, engagement of a 0.021 × 0.025-inch rectangular wire with supplementary palatal root torque was required to generate adequate torque for optimal dental esthetics.
A major challenge in both natural and prosthetic replacement of adjacent incisors is the re-creation of adequate gingival papillae and embrasures due to soft tissue and bone deficiency. To enhance the gingival architecture, excessive mesial angulation of the maxillary lateral incisors is unwanted during space closure. This was avoided in this case by placing central incisor brackets on the lateral incisors, thereby reducing mesial angulation while also allowing the propensity for enhanced torque delivery, proceeding slowly with space closure to achieve ideal root positioning, and using selective second-order archwire adjustments to promote mesial positioning of the lateral incisor roots. The emergence profile of maxillary central incisors is generally flat on the mesial surface; consequently, the lateral incisors were approximated to allow the restorations to be optimally contoured.

CONCLUSION

Comprehensive management of traumatized maxillary central incisors presents a difficult diagnostic dilemma. While prosthetic replacement or autotransplantation may be considered, these approaches are not without pitfalls. Consideration may occasionally be given to orthodontic space closure in Class I crowded or Class II uncrowded malocclusions with predictable and expedient results.

REFERENCES


