CASE REPORT

Closure of Central Incisor Spaces: A 16-Year Follow-Up

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Permanent teeth, most often the maxillary central incisors, are lost in .5-16% of trauma cases.[1] Incisor avulsion occurs most commonly among children age 7-9, when the permanent maxillary incisors have barely erupted. In cases of single- or multiple-tooth avulsion, the alveolar process may also be fractured, and rapid bone resorption may occur.

If only a thin layer of bone remains beneath a vertical or horizontal depression, replacement of a lost incisor will be problematic. Implants cannot be placed in children of this age due to insufficient bone quantity, and the situation will deteriorate further as time passes, with continued resorption and relative growth of the alveolar bone around the neighboring teeth.[2]

This article describes the treatment and 16-year follow-up of a preadolescent girl who suffered orofacial trauma, leading to avulsion of both maxillary central incisors.

Diagnosis

A 10-year-old female presented with missing maxillary central incisors (Fig. 1). Following trauma-induced avulsion about a year earlier, the incisors had been replanted by another practitioner, but this attempt had failed due to ensuing root resorption. Our initial examination revealed considerable sagittal bone deficiency in the central maxillary segment, with a gap of 14mm between the two lateral incisors.


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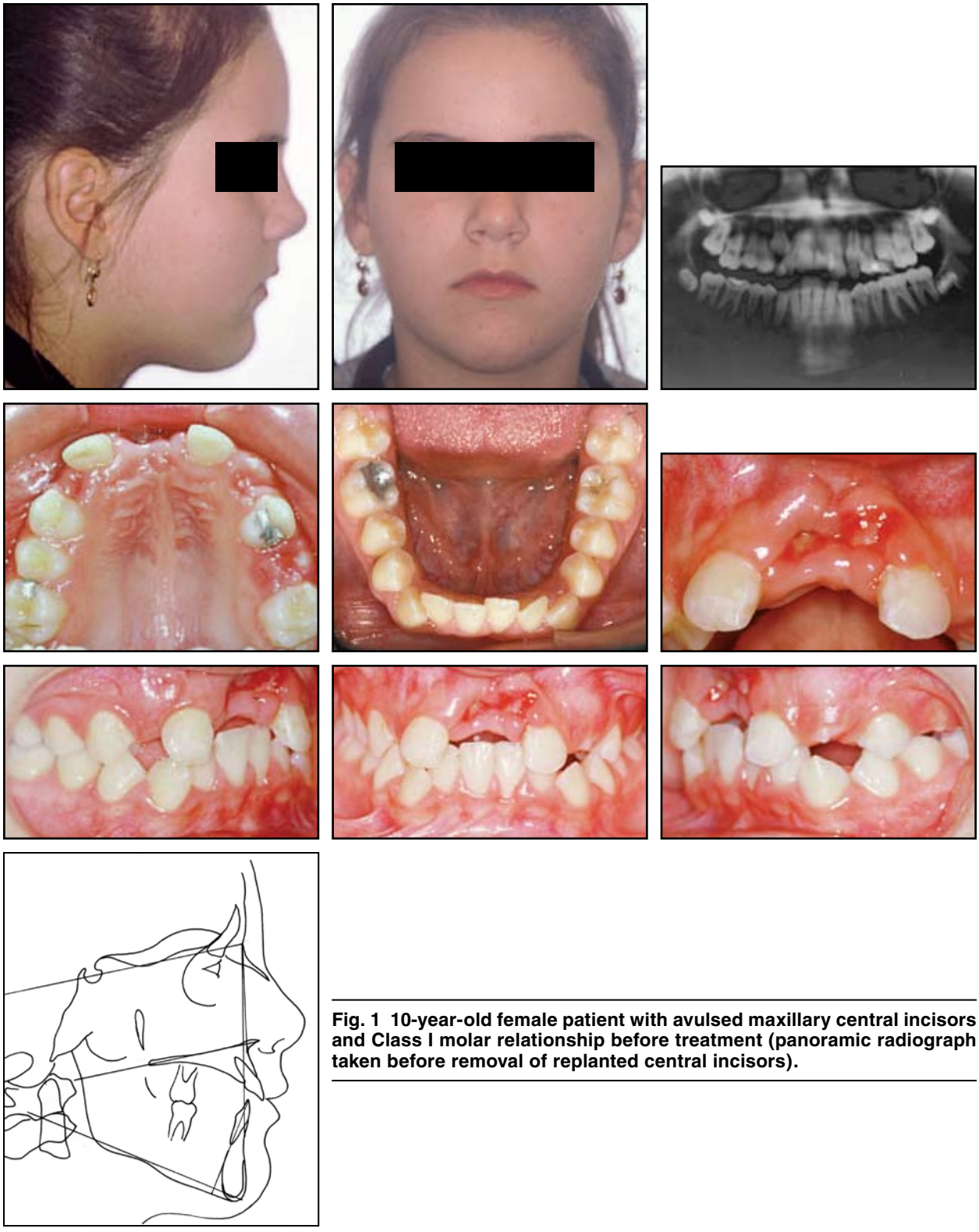

Fig. 1 10-year-old female patient with avulsed maxillary central incisors and Class I molar relationship before treatment (panoramic radiograph taken before removal of replanted central incisors).

TABLE 1
CEPHALOMETRIC DATA

	Pretreatment	Post-Treatment	16-Year Follow-Up
SNA	80.0°	77.0°	78.0°
SN/Pg	78.0°	79.0°	80.0°
ANB	2.0°	–2.0°	–2.0°
SN/ANS-PNS	0.5°	1.0°	1.0°
SN/Go-Gn	33.0°	31.0°	29.0°
ANS-PNS/Go-Gn	34.0°	29.0°	30.0°
U1/ANS-PNS		120.5°	119.0°
L1/Go-Gn	89.0°	92.0°	93.0°
Overjet		3.0mm	2.5mm
Overbite		3.0mm	2.5mm
U1/L1		121.0°	121.0°

The patient had a relatively flat profile with a slightly open nasolabial angle, competent lips, a Class I molar relationship, proclined maxillary lateral incisors, upright mandibular incisors, 5mm of crowding in the lower arch, and an accentuated curve of Spee. Cephalometric analysis (Table 1) indicated a potential Class III, non-divergent facial type (ANB = 2°, SN/Go-Gn = 33°).

Treatment Plan

The goal of treatment was to restore satisfactory esthetics and proper oral function. Three treatment plans were considered:
1. Restoration and maintenance of the central incisor spaces for eventual placement of prosthetics or implants. This approach would conserve the transverse and sagittal arch dimensions, which is important for profile esthetics and, in this patient, would counterbalance the Class III growth tendency. An exceptionally long wait would be required before the end of the growth period, however, and either bridgework or implants would involve a costly commitment for the patient.[2-4] Another consideration was the need for surgical grafting to restore sufficient bone depth for insertion of implants and the uncertain esthetic outcome of the gingival margins.[4]
2. Space closure by mesial movement of the entire maxillary arch. This would require the mandibular third molars to be extracted while their maxillary counterparts were maintained to balance the upper and lower arches. A definitive, permanent outcome would be possible to achieve within a reasonable time period, and with a lesser financial burden for the patient. Recovery from the initial bone loss—a key functional and esthetic factor—could also be expected.[5-9] Orthodontic treatment would be significantly more challenging, however: all maxillary teeth would need to be mesialized while taking care not to worsen the profile, given the patient's Class III growth potential. Since maintenance of the mandibular premolars was preferred, the patient would finish with a Class II molar relationship and group-function anterior guidance. Reshaping of the anterior teeth would be required after orthodontic treatment.[10-14]
3. Movement of the lateral incisors into the central incisor spaces. This alternative would offer the advantages of shorter treatment and simpler anchorage management compared to the second option, and would likely result in Class I molar and canine relationships.[15] Prosthetic work would be performed in an esthetically less sensitive position, and as with the second option, mesial tooth movement would allow some restoration of the resorbed bone.[5-9] On the other hand, the anterior region would require not only esthetic recontouring, but temporary prosthetic treatment. The spaces would have to be kept open until the end of the patient's growth period, and as with the first option, the patient would require lifetime maintenance of the implants.

Considering the patient's age, the presence of healthy maxillary third molar buds, the adequate size of the lateral incisors, and the family's preference to avoid prosthetics, the second treatment option was chosen.

Treatment Progress

After some necessary dental fillings and oral hygiene, orthodontic treatment began with an

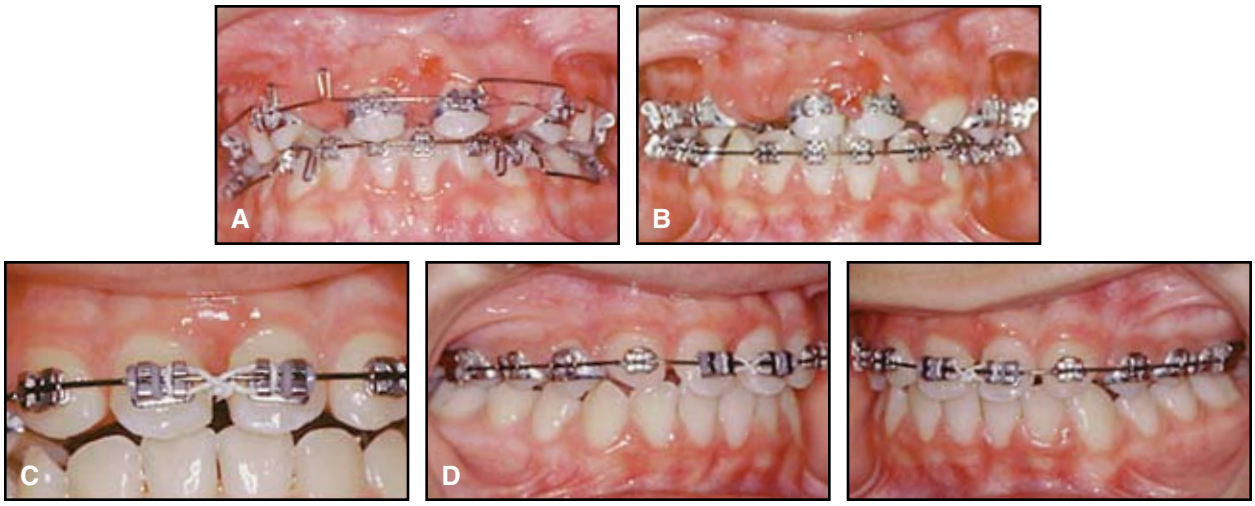

Fig. 2 A. .020" stainless steel archwires in both arches, with loops added for elasticity. B. Maxillary archwire removed to allow better hygiene. C. After space closure, gingival margins of new "central incisors" surgically recontoured for better esthetics. D. Mandibular crowding resolved with interproximal stripping and minor distalization.

.022" × .028" standard edgewise appliance in the upper arch. Once initial alignment was completed, .020" stainless steel archwires were placed to enhance mesial sliding; later, .021" × .025" stainless steel wires with longer anteroposterior segments and mesial first-molar stops were inserted to increase maxillary arch length.

Bodily movement of the lateral incisors was critical to prevent shrinking of the epithelial margins, with particular attention paid to buccal root control. To move the lateral-incisor crowns through an area with depleted bone tissue, single forces must be avoided; consequently, 2nd- and 3rd-order bends were applied to achieve mesial and buccal root movement, respectively (Fig. 2A,B). Maximum intra-arch anchorage for mesial movement was obtained by using torque from the rectangular archwires, placing 2nd-order bends, and ligating groups of teeth as anchors. The maxillary teeth were mesialized in contralateral pairs, using a combination of wire bends, elastics, and compressed-coil springs.

Esthetic recontouring was performed on the upper first premolars and canines in stages throughout treatment. Once the two lateral incisors had been closed together, the periodontal tissues were surgically reshaped (Fig. 2C). The new "central incisor" crowns were recontoured when tooth movement was nearing completion.

The mandibular crowding was resolved with interproximal stripping and minor distalization (Fig. 2D). Minimizing buccal movement of the lower incisors helped avoid any aggravation of the patient's Class III tendency.

Appliances were removed three years and six months after the start of treatment. Lingual retainer wires were bonded to the new maxillary central incisors and to all four mandibular incisors.

Treatment Results

A definite facial improvement was noted (Fig. 3). Soft-tissue analysis showed that the nasolabial angle had not opened further and that the profile had not deteriorated, thanks both to the aggressive transverse and sagittal expansion of the maxillary arch and the good fortune of less mandibular development than had been predicted. Closure of the anterior spaces through mesial movement of the entire maxillary arch resulted in dental and facial symmetry, as indicated by the centered and coincident dental and facial midlines. A small maxillary central diastema was deliberately left to allow subsequent

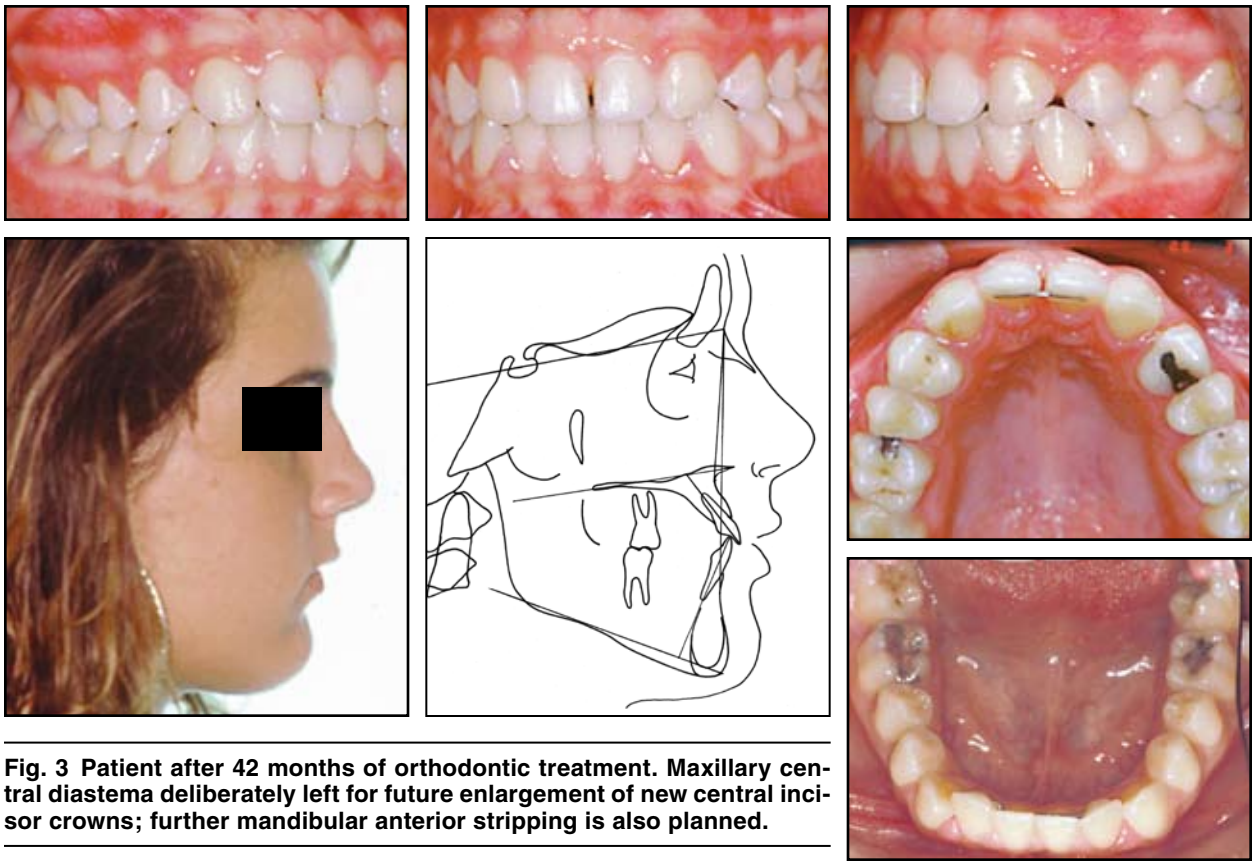

Fig. 3 Patient after 42 months of orthodontic treatment. Maxillary central diastema deliberately left for future enlargement of new central incisor crowns; further mandibular anterior stripping is also planned.

cosmetic enlargement of the relocated lateral incisor crowns. Proper overjet and overbite had been achieved, as well as satisfactory intercuspation and bilateral Class II molar and Class I canine relationships. The mandibular crowding was reduced, although the patient was scheduled for follow-up mandibular anterior stripping. The mandibular third molars would be extracted at a later date.

Cephalometric analysis (Table 1) confirmed the mandibular growth (ANB = –2°), a good axial relationship between the upper and lower incisors, and an improved skeletal relationship.

16-Year Follow-Up

The patient presented for a follow-up visit 16 years later. In the intervening years, her general dentist had performed some maxillary anterior composite recontouring (Fig. 4). Nearly two decades after the start of her treatment, her functional condition was unaltered, with good intercuspation, archform, overbite, and overjet, and no signs of muscular or articular pathology. The panoramic radiograph showed subsequent extraction of the mandibular third molars. The cephalometric measurements were almost unchanged (Table 1).

Careful examination of the patient's smile esthetics revealed some flaws. More careful recontouring of the maxillary anterior crowns would have improved her facial appearance; the gingival scallops were uneven, with the lateral incisors' gingival margins higher than the central incisors'.

Discussion

Robertsson and Mohlin found in a retrospective study that patients treated with space

Fig. 4 Patient 16 years after treatment.

closure are happier with their appearance than those treated with restorations.[16] Our initial assessment of treatment alternatives considered potentially negative outcomes of exclusively orthodontic treatment, including the risk of ruining the patient's profile, the possibility of being unable to ensure proper group function, and the concern that the mandible might grow considerably. Still, with careful anchorage management and three-dimensional control of individual teeth, an acceptable esthetic and functional outcome was achieved while safeguarding the patient's natural tissues.

A shortcoming of this patient's treatment—not fully taken into account at the time, but certainly more noticeable today—was the failure to account for all aspects of smile esthetics, including the shape, size, and color of the teeth, in addition to proper root torque and gingival margins. With hindsight based on what we have learned over the past 16 years, we would now aim for greater accuracy in the height of the gingival margins to create natural contours for the relocated teeth. More careful control of intrusion and extrusion would be planned, as well as root torquing-in of the canines replacing the lateral incisors to reduce their crown eminences, and torquing-out of the first premolar roots to increase their eminences in the canine positions. A step further toward perfection would be the application of porcelain veneers combined with periodontal treatment.

Conclusion

The decision to close up the central incisor spaces and mesialize all the maxillary teeth, although risky in some aspects, turned out to be a good one both esthetically and functionally for this patient. The occlusion has remained stable for 16 years after completion of therapy, to the satisfaction of both the patient and her family, as well as our own. In addition, the patient received a permanent esthetic improvement much sooner than would have been possible with implant replacements, while avoiding a commitment to a lifetime of maintaining implants or prosthetics.

In light of the attention currently being paid to esthetics as a primary treatment goal for both practitioner and patient, today's treatment plans for patients with missing central incisors must consider more than the orthodontic outcome. All planning and treatment must be based on a multidisciplinary approach to achieve a fully satisfactory result.

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