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Orthodontic rehabilitation for anterior teeth lost due to trauma with crowding malocclusion

CASE REPORT

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Abstract – Herein, we describe orthodontic management for an adolescent girl with traumatic loss of the upper central incisors and maxillary protrusion. The central incisors were immediately replaced and fixed with application of a semi-rigid splint for 12 days, then endodontically treated. Severe root resorption and degeneration of periodontal tissue were noted after 4 years and the teeth were extracted, while the patient had also developed maxillary protrusion with severe crowding in the lower arch. The treatment objectives were to close the spaces by mesial movement of the buccal segment in the upper arch and eliminate crowding by extraction of the lower bicuspids. Favorable occlusion was achieved as was substitution with the lateral incisors for the lost central teeth.

Avulsion of the maxillary incisors following traumatic injury is a serious and challenging clinical situation (1). Even in cases with immediate replacement of a dislodged tooth, the prognosis for replantation is dependent on the storage condition of the teeth and period of time after injury. Pulp necrosis and internal and external resorption of the root can often occur, which result in tooth loss (2). Although dental implant placement is the favored treatment procedure, there are risks associated with that procedure in patients during the active preadolescent and teenage years. In addition, the timing of implant surgery is influenced by bone resorption that occurs after the trauma and with patient growth. An orthodontist often becomes involved in managing the injuries because of the requirement of space closure and restoration of the missing tooth (3). Furthermore, if malocclusion is present, orthodontic treatment should be considered for occlusal rehabilitation with or without implant restoration. Herein, we describe a case of orthodontic rehabilitation for severe crowding malocclusion following preadolescent traumatic tooth loss.

Case report

A 7-year-old girl suffered a fracture of the upper alveolar bone and avulsion of the left and right upper central incisors after a traumatic accident. Her lacerated upper lip was immediately repaired and the teeth were replaced and immobilized with wire figures for 14 days (Fig. 1). After removing the figures, a pulpectomy was performed in both incisors and the root canals were filled with calcium hydroxide.

A panoramic radiograph obtained 4 years 6 months after the injury showed external progressive root resorption of the replaced teeth (Fig. 1). Since they were not stabilized due to degeneration of the periodontal tissue, we decided to extract the replaced incisors. Thereafter, the treatment objectives were restoration of the spaces and space closure by mesial movement of the buccal segment in the upper arch. The patient and her parents were referred to orthodontic treatment.

The patient had an Angle Class I molar relationship with severe crowding in both the upper and lower arches. The maxillary incisors were protruding and both upper and lower midlines were coincident with the facial midline (Fig. 2). A functional assessment showed that mouth opening and exercise were within normal functional limits, with no sequelae indicating temporomandibular joint dysfunction from the trauma. Cephalometric analysis showed a skeletal Class I anteroposterior relationship with a low mandibular plane angle. In addition, the soft tissue profile exhibited a bimaxillary protrusion with inclinated upper front teeth. Overall Bolton Index was 87.8%, indicating a tooth size ratio was within the normal (87.5–94.8%) (4). We confirmed the index would be improved to 89.4% when the upper central incisors and both lower bicuspids were removed.

Treatment objectives

The main objective for patient treatment was space closure for the missing maxillary central incisors by restoration with a fixed bridge between the bilateral incisors and substitution with the lateral incisors for the missing incisors concurrently with correction of the lower arch crowding. It was also considered that the protrusive profile and overjet needed to be eliminated.

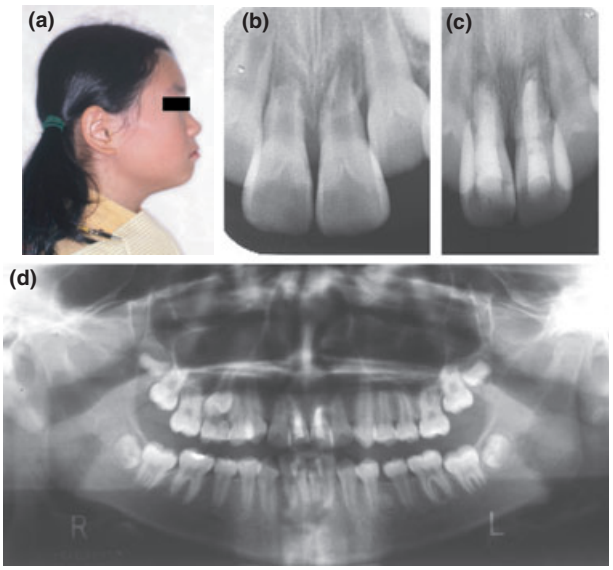

Fig. 1. (a) Pretreatment facial photographs. (b) Dental radiograph obtained immediately after replacement of central incisors. (c) Dental radiograph obtained 4 years 6 months after replacement. (d) Panoramic radiograph obtained just prior to orthodontic treatment.

Treatment alternatives

The following two treatment alternatives were considered after extraction of the maxillary incisors:

1. Use of a fixed bridge between the right and left lateral incisors for the missing teeth, or replace with two single tooth implants.
2. Space closure by mesial movements of the lateral incisors and subsequent lateral segments. We considered that crowding in the lower arch should be eliminated and corrected after extraction of both bicuspids.
3. Extraction of upper and lower first premolars for correction of the arch crowding and the eventual placement of upper central implants after orthodontic treatment.

The first option involved a shorter treatment time, though the cost was more expensive, while it also carried risk associated with the use of dental implants during the preadolescent period. The third plan required a period of temporary prosthetic central incisors for the orthodontic treatment until the final restorations and would reduce the overall Bolton index to 86.9%. The second option was finally adopted because it offered superior occlusal and esthetic outcomes.

Treatment progress

First, the upper central incisors were extracted, then a preadjusted fixed appliance with 0.022×0.028-inch slots was bonded to both arches prior to extracting the lower bicuspids. After initial leveling of the upper arch, mesial movement of the right and left lateral incisors was started with chain elastics to close the central space. The bilateral upper canines were substituted with the lateral incisors and the bicuspids with the canines. Leveling and alignment of the teeth in the upper and lower arches including the second molars was completed after 4 years. Following removal of the fixed appliances the patient was introduced to a wrap-around retainer for the maxillary arch and a spring retainer for the lower arch.

Treatment results

The profile showed improvement and was not adversely affected by growth or the above treatments (Fig. 3). Furthermore, crowding was resolved and optimal overbite and overjet relationships were achieved. A bilateral Class I molar relationship was also obtained with a well interdigitated buccal occlusion (Fig. 4). The posttreatment cephalogram with superimposed tracing showed forward facial growth with a slightly skeletal Class III relationship (Fig. 4). In addition, the maxillary and mandibular incisors were upright, which resulted in improvement of the facial profile.

Discussion

The maxillary central incisor is the tooth most often injured or lost due to an accident, with immediate replacement shown to be potentially successful. As for the incisor replacements in the present case, degeneration of periodontal tissue occurred, resulting in their extraction, even though the teeth had been stabilized for a period of 4 years. Following the extractions, different approaches for the lost teeth were proposed, e.g., a fixed bridge and two single dental implants. Immediate implantation was not feasible, as the patient was 12 years

Fig. 2. Pretreatment intraoral photographs.

Fig. 3. Posttreatment intraoral photographs.

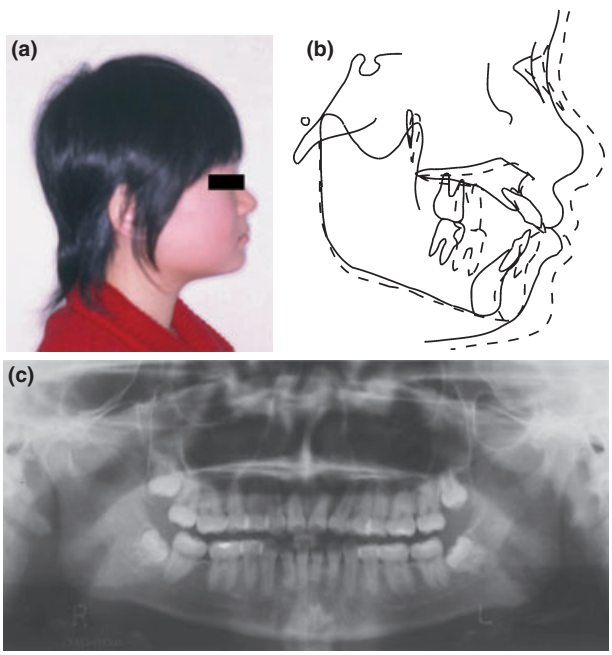

Fig. 4. (a) Posttreatment facial photograph. (b) Cephalometric superimpose. Solid line pretreatment; dotted line posttreatment. (c) Panoramic radiograph obtained after treatment.

old. Another available option was use of a temporary denture or fixed bridge between the right and left lateral incisors until patient growth had completed, after which final restoration using another fixed bridge or osseointergated implant placement could be performed (1). Alternatively, transplantation of the mandibular bicuspids was another option to achieve sufficient functions and esthetics (5). The patient had complained about bimaxillary protrusion and severe crowding in the lower arch, and autotransplantation was considered not likely to resolve her maxillary protrusion. Orthodontic treatment was preferable to those prosthodontics procedures because space from the lost central incisors was available to use for retraction of the upper anterior teeth. Thus, the orthodontic plan was space closure by mesial movement of the bilateral incisors and correction of crowding in the lower arch with bilateral extraction of the lower bicuspids.

The alternative treatment of extracting upper and lower first premolars for correction of arch crowding and the eventual implants of the upper incisors were included. The overall Bolton index resulted in an incorrect ratio to 86.9%. The implants and ultimate prosthetic restorations would be delayed until the patient was a young adult.

An orthodontist focused on positioning the lateral incisors to satisfy the functional and esthetic requirements of the patient. In this case, we used the tooth size discrepancy between the central and lateral incisors to make the upper anterior teeth more upright for improvement of bimaxillary protrusion. Following tooth alignment, it is important to evaluate the angle and torque of the canine, as well as its gingival contour, color size, and crown form. It is also necessary to reshape the lateral incisors and reform both canines on the cusp as well as labial to the lateral incisor.

A disadvantage of orthodontic treatment for dental injury is the long period of time required. The present orthodontic intervention required nearly 4 years because we monitored the mandibular growth of the patient, as she had a potential for skeletal Class III. A significant amount of time was also needed to upright the left lateral incisor and canine following their mesial movements. A prosthodontic approach including dental implantation is generally performed for cases of traumatic tooth loss. However, for a young adolescent patient with traumatic tooth loss and malocclusion, an orthodontic approach may be more practical, because concomitant malocclusion can be treated simultaneously and the treatment results are permanent (6).

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