Autotransplantation combined with orthodontic treatment to restore an adult’s posttraumatic dentition

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This case report describes the successful treatment of an adult with a skeletal Class II Division 2 posttraumatic dentition with consequential restorations. The extracted maxillary premolar was autotransplanted to replace the hopeless mandibular first molar. The endodontically treated maxillary right canine was extracted instead of the premolar. A multidisciplinary approach including autotransplantation and orthodontic treatment provided a satisfactory outcome. (Am J Orthod Dentofacial Orthop 2013;144:268-77)

TRAUMA can result in fractures of the facial bones, alveolar bones, and the teeth, along with the loss of multiple teeth. During multidisciplinary reconstruction procedures, we sometimes confront unwanted iatrogenic complications, poor prognoses, or unsatisfying treatment outcomes.1,2

Here, we report the orthodontic treatment of an adult patient with a Class II malocclusion and severe crowding. Because of trauma and previous reconstruction therapy, there were multiple dental implants, tooth fractures, and endodontically treated teeth. In addition, a molar was hopeless as a result of periodontal problems. An unusual extraction regimen was applied by extracting the endodontically treated maxillary canine instead of the dental implant, and the other extracted premolar was autotransplanted to replace the extracted mandibular molar.

DIAGNOSIS AND ETIOLOGY

A 37-year-old woman was referred by her periodontist for evaluation and treatment of her malocclusion. After trauma 4 years previously, her maxillary right premolars were avulsed and replaced with dental implants. Her mandibular left first molar had a periodontal abscess, Class III furcation involvement, probing depths over 6 mm, a crack in the mesial root, and distal root caries with a periapical lesion. After diagnostic surgery, the first molar was diagnosed as hopeless by the periodontist. When the periodontist first met the patient, he was concerned that although implants and restorations were placed to restore the avulsed teeth, they were not functionally in contact with the mandibular dentition. Furthermore, the patient had an unesthetic smile caused by severe crowding, which was her chief complaint (Figs 1 and 2).

The patient had moderate to severe crowding. Both the skeletal and dental relationships were Class II, and the profile was straight (Figs 1 and 2). According to the panoramic radiograph, the mandibular left first molar had furcation involvement with a periapical lesion, and the maxillary right premolars were restored with dental implants. Although a malunion of the right condyle was noted, there was no restriction in mandibular motion. The cephalometric radiographs showed a retrusive mandible (SNB angle, 70.8°) compared with a relatively well-positioned maxilla (SNA angle, 76.2°), indicating a skeletal Class II malocclusion (ANB angle, 5.4°). The maxillary incisors were retroclined (U1-SN, 92.5°). Vertically, the patient was normodivergent (SN-MP, 35.3°). The mandible was slightly deviated to the right side (Figs 3 and 4; Table).
From her medical records, we learned that as a result of trauma 4 years previously, her right condyle and mandibular body were fractured, the maxillary right premolars were avulsed, the mandibular right canine was fractured, and the mandibular left canine was nonvital. The maxillary right canine had most likely been punctured with bone screws during the intermaxillary fixation procedure. Afterward, the premolars were restored with dental implants, and the maxillary right and mandibular left canines were endodontically treated. The mandibular right canine was left untreated because its vitality and mobility were within normal limits, with no specific symptoms. Unrelated to the trauma, the endodontic treatment of the mandibular left first molar was incomplete with a periapical lesion and furcation involvement (Fig 5).

According to our evaluation of the orthodontic records and her history, the patient was diagnosed with a skeletal Class II Division 2 malocclusion and severe crowding.

**TREATMENT OBJECTIVES**

The treatment objectives were to relieve the crowding, establish a functional occlusion, and maintain the soft-tissue profile.

**TREATMENT ALTERNATIVES**

Under normal circumstances, extraction of the 2 maxillary first premolars would have been considered to relieve the crowding. Afterward, the maxillary molars would be protracted, and the mandibular dentition would be distalized to finish with complete Class II molar and Class I canine relationships with no evident changes in the profile. However, because of the preexisting dental implants on the maxillary right side, premolar extraction and movement of the maxillary right molar segment was not an option. Therefore, we decided to extract the endodontically treated maxillary right canine instead of the maxillary right premolar in addition to the left first
Fig 2. Pretreatment study models.

Fig 3. Pretreatment radiographs.
After relieving the crowding, the remaining space on the right side would be restored with prosthetics for esthetic reasons. Meanwhile, the mandibular right molar region could be uprighted and distalized to relieve the premolar crowding.

The prognosis for movement of the mandibular right canine was questionable because of a fracture line, even though the tooth showed no signs or symptoms, and mobility was within normal limits. Fortunately, according to the treatment plan, major tooth movement in the mesiodistal or vertical direction was not necessary for the mandibular right canine, so we decided to level the canine under close monitoring. After orthodontic treatment, the hopeless left molar could be replaced with a dental implant.

An alternative treatment option would be to replace the hopeless mandibular molar with an extracted maxillary first premolar via autotransplantation, and the maxillary arch would be treated in the same fashion as the first option. In this case, an additional dental implant would not be necessary to restore the mandibular molar. Since the recipient site had enough space, extraction and autotransplantation could be done on the same day, thereby reducing treatment time rather than finishing with a dental implant after orthodontic treatment. Using 3-dimensional imaging and a diagnostic setup, we planned to rotate the autotransplant 90° during transplantation to gain a mesiodistal dimension similar to the extracted first molar (Fig 6).

Both options were discussed with the patient. She strongly preferred autotransplantation over dental implants, and the orthodontist was also aware of the positive benefits of autotransplantation. Therefore, the second treatment option was selected.

**TREATMENT PROGRESS**

Roth prescription 0.022-in slot self-ligating brackets (Clippy C; Tomy, Tokyo, Japan) were bonded on the mandibular arch for alignment. Meanwhile, the maxillary left first premolar (donor tooth) was endodontically treated for autotransplantation. The alveolar socket of the first molar region (recipient site) (Fig 7, A) was evaluated with 3-dimensional imaging, and a rapid prototyping model was used to fabricate a replica of the donor tooth (Fig 7, B). Reducing the donor tooth’s extraoral time and adjusting the recipient site’s morphology for the best adaptation of the donor tooth are considered critical factors for successful autotransplantation.\(^1\)\(^2\) The tooth replica was used during recipient site preparation and adjustment. After the recipient site was ready, the donor tooth was extracted and rotated 90° during placement in the recipient site (Fig 7, C). The donor tooth was held in position with wire fixation during the healing period for 6 weeks. After 7 weeks, a bracket was also bonded to the transplant,
Fig 6. Occlusogram and diagnostic setup (*, transplant).

Fig 7. Three-dimensional imaging and intraoral photographs before and after autotransplantation: 
A, recipient site; B, rapid prototyping model and the replica of the donor tooth (arrow; dotted line, alveolar bone margin); C, intraoral adaptation of the transplant; D–F, 1 week after autotransplantation; G–I, 8 weeks after autotransplantation.
and the arch was aligned with 0.016-in copper-nickel-titanium and 0.016 × 0.022-in low-hysteresis nickel-titanium wires (Tomy) (Fig 7, D-F). In the maxillary arch, the left segment was aligned, and partial canine retraction was carried out until space was created to relieve the crowding. After extraction of the maxillary right canine, high-torque brackets were bonded on the maxillary anterior segment, and leveling of the entire arch was continued. Maxillary space closure followed, and the mandibular arch was distalized with orthodontic miniscrews (Fig 7, G-I).

After 21 months of active treatment, the brackets were removed. The space distal to the maxillary right lateral incisors was closed with a newly fabricated pontic attached to the implant crown. In the final restoration, the transplanted premolar was shaped as a first molar. Lingual fixed retainers were bonded from lateral incisor to premolar in the maxillary arch and from canine to canine in the mandibular arch. The mandibular right canine was still vital, and no specific symptoms were noted during treatment. Although there were limitations to finishing the right side to an ideal occlusion because of the implants, the occlusion was functionally acceptable. Additional circumferential retainers were delivered and used full time for 6 months. The patient was fully satisfied with the functional and esthetic outcome (Figs 8-11).

According to the cephalometric superimposition, the maxillary anterior torque was improved, the maxillary left molars were protracted, and the mandibular molars were distalized, while the soft-tissue profile was maintained (Fig 12). From the serial periapical radiographs, the alveolar bone of the recipient site appeared to remodel after autotransplantation and orthodontic treatment. There were no signs or symptoms of ankylosis or replacement resorption throughout the evaluation period (Fig 13).

**DISCUSSION**

The success and prognosis after autotransplantation of a tooth with complete root formation is affected by
Fig 9. Posttreatment study models.

Fig 10. Posttreatment radiographs.
the amount of intact and viable periodontal ligament cells, the quality of root filling, the pocket depth, the donor tooth’s extraoral time, the distance between the recipient site tissue and the transplant root surface, and the patient’s age.4-8 In our patient, the maxillary left premolar was functional with sufficient occlusal contact that provided intact and viable periodontal ligament cells, did not have a history of root canal filling, and had periodontal pocket depths under 3 mm, and the patient’s age was less than 40 years.9 All of these factors fit the selection criteria of a successful donor tooth as described above.

Along with a proper diagnosis, the multidisciplinary team also followed several clinical principles during treatment. In general, endodontic treatment of the transplant is recommended after autotransplantation but before tooth movement. However, in our patient, primary endodontic treatment of the transplant was done before autotransplantation surgery. This allowed the endodontist to fully understand the root morphology before the transplant surgery and gave the patient sufficient healing time between the transplant surgery and the initiation of orthodontic treatment, which was around 6 weeks. During surgery, secondary apical sealing by the retro-filling method was also performed extraorally to reduce the possibility of apical inflammation after transplantation. In addition, using 3-dimensional imaging, a replica of the donor tooth was fabricated with rapid prototyping. Because this replica was used to prepare the recipient site, an ideal contact of the recipient site and the transplant was created while minimizing trauma to the periodontal ligament cells of the donor tooth.3 This procedure also reduced the extraoral time to less than 5 minutes and minimized the damage to the periodontal ligament of the donor tooth during surgery.4

Although the success rate of autotransplantation is reported to be fairly high, between 63.1% and 100%,6,10,11 the most common complications mentioned in the literature are ankylosis of the transplant and replacement resorption after ankylosis.4,10 For orthodontic treatment, tooth movement after transplantation is mandatory in most cases. Therefore, several postoperative procedures were considered to reduce the chances of ankylosis. Since long-term rigid splinting has been shown to increase the risk of ankylosis, splinting was only applied during the initial healing period of 6 weeks.1,12-14 Furthermore, the lack of occlusal stimuli is considered to be a factor in ankylosis.12 Therefore, the transplant was splinted out of occlusion during the initial healing period to prevent excessive occlusal contacts; thereafter, the segment was leveled by orthodontic tooth movement.

Conventionally, orthodontic treatment begins 3 to 6 months after transplantation, but recently the application of stable biological loading just after the initial healing period has been reported to have positive effects in preventing ankylosis.14,15 Thus, the transplant was leveled using a light continuous improved nickel-titanium archwire starting at 7 weeks. This wire has high superelasticity, low hysteresis, high dumping capacity, and a shock-absorbing property.16 Those properties enabled us to deliver light constant forces and to preserve the transplant from excessive occlusal stimuli.

A posttraumatic dentition is challenging to treat orthodontically because of fractured teeth or bone, missing teeth replaced with prosthodontics or dental implants, and unstable mandibular positioning when a
condylar fracture or scar tissue is involved. From the patient’s recollected panoramic radiograph, anterior displacement of the proximal segment of the fractured right condyle was noted, but it united with the distal segment spontaneously during the 4 years after the accident with no restrictions in motion. The patient recalled that physical therapy was advised after the trauma, and there was no change in her occlusion other than the missing teeth, indicating that the mandibular position was not affected by the trauma.

The fractured mandibular right canine was quite challenging. Even though tooth vitality was normal and there were no specific symptoms, the fracture line was evident. According to the model setup and the occlusogram, approximately 1.0 mm of distal movement of the fractured canine was needed to relieve the mild anterior crowding without flaring. Since major tooth movement could jeopardize the vitality and separate the coronal and apical parts of the tooth, we restricted movement and allowed minor flaring of the anterior teeth during leveling, rather than distalizing the canine. Fortunately, the tooth was still vital after orthodontic treatment without specific symptoms, but it is still being monitored carefully.

Loss of several premolars after trauma is traditionally treated with prosthetics or dental implants. However, when severe crowding is noted, orthodontic treatment might help to reduce the number of prosthetic replacements and result in more favorable outcomes. If this patient had visited the orthodontist at the proper time before the dental implants were placed, the treatment of choice would have been to extract the left second premolar and to recycle this tooth as a right premolar. This way, conventional orthodontic treatment for a Class II malocclusion with severe crowding could have been continued without additional implants or restorations. However, according to the patient, after a tragically traumatic incident, orthodontic treatment, which is usually considered time-consuming and done for esthetic reasons, was not an affordable option. Proper patient counseling by an orthodontist might have changed her thoughts, but it was unfortunate that proper orthodontic diagnosis was not combined with the initial stages of treatment before the reconstruction therapy was started.

With increases in multidisciplinary treatment, orthodontists now face many adults who already have dental implants in place before seeking orthodontic treatment, as seen in this patient. Because of the restriction of tooth movement in the region of the implant, there can be limitations in treatment planning. However, in some patients, an implant can be advantageous because absolute anchorage can be achieved. In this patient, the periodontist was the first to notice the nonfunctional occlusion and referred her for an orthodontic evaluation. Bone augmentation of the implant site after orthodontic treatment was performed by the periodontist, the remaining space on the maxillary right side was closed with prosthetic treatment, and endodontic treatment and autotransplantation were completed by the endodontist. All of this treatment occurred under the orchestration of the orthodontist with a complete treatment plan, which resulted in successful improvement of the occlusion.

**Fig 13.** Serial periapical radiographs of the recipient site (*, transplant; dotted line, alveolar bone margin).
CONCLUSIONS

This case report illustrates the diagnosis and treatment process of a patient with a skeletal Class II posttraumatic dentition. Multidisciplinary treatment, including the recycling of an extracted premolar by autotransplantation, successfully improved esthetics and established a functional occlusion for the patient.

REFERENCES