Orthognathic treatment with autotransplantation of a third molar

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Autotransplantation is an option for tooth replacement when a suitable tooth is available and anatomic circumstances are favorable. This case report describes successful orthognathic treatment that was combined with autotransplantation of a maxillary third molar. A 20-year-old woman had mandibular protrusion and facial asymmetry. Five years previously, her mandibular right first molar had been extracted because of dental caries. After preoperative orthodontic treatment, we performed a LeFort I procedure and a bilateral intraoral vertical ramus osteotomy to correct the patient's mandibular protrusion and facial asymmetry. During the postoperative orthodontic treatment, the maxillary left third molar was autotransplanted into the mandibular right first molar site. The total treatment period was 24 months. As a result of these therapeutic treatments, the patient's facial appearance was improved, and an implant was unnecessary. The autotransplanted tooth effectively supported the adjacent teeth and maintained her chewing ability. (Am J Orthod Dentofacial Orthop 2013;144:737-47)

Teeth can be lost from periodontal disease, severe caries, agenesis, trauma, or endodontic failure. This problem can be treated in various ways, including orthodontic space closure, fixed or removable partial dentures, dental implants, or tooth autotransplantation. Among various treatment options, autotransplantation can lead to shorter treatment times and improved treatment results when a suitable tooth is available and anatomic circumstances permit.

In 1950, Apfel1 and Miller2 first described the transplantation of immature third molars to first molar positions. Since then, autotransplantation of immature third molars has become a common procedure for replacing missing teeth.3-5 Recently, several studies have reported that third molars with complete root formation can also be used as donor teeth. Watanabe et al6 reported a survival rate of 86.8% over a mean observation time of 9.2 years. Sugai et al7 reported an overall 5-year survival rate of 84%. Although the current success rates are lower than the rates with dental implants, autotransplanted teeth result in good utilization and maintenance of alveolar bone and attached gingiva. Furthermore, they provide superior esthetic results, are less expensive, and have the potential for orthodontic movement.

This case report demonstrates a successful orthognathic treatment that included autotransplantation of a maxillary left third molar in a patient with a missing mandibular right first molar, mandibular protrusion, and facial asymmetry.

DIAGNOSIS AND ETIOLOGY

A 20-year-old woman visited the orthodontic department at Yonsei University Dental Hospital in Seoul, Korea. Her chief complaint was mandibular prognathism and facial asymmetry. On the pretreatment questionnaire, the patient reported a strong desire to improve her facial appearance. She had received orthodontic camouflage treatment because of an anterior crossbite 3 years previously, and she had used a temporary denture after the extraction of her mandibular right first molar from dental caries 5 years previously. She had no serious medical history, and no habits were reported.

Pretreatment facial photographs showed a mandibular deviation toward the right, and the patient’s eyebrows were at noticeably different levels. Her lips were incompetent, and the incisor-stomion distance was 6.0 mm (Figs 1-3). Intraorally, she exhibited an Angle Class III malocclusion on the left side and an unknown...
molar relationship on the right side, caused by the missing mandibular first molar. The maxillary dental midline had a 1.0-mm deviation toward the left, and the mandibular dental midline had a 1.0-mm deviation toward the right. A lateral cephalometric analysis showed an SNA of 86.9°, an SNB of 86.2°, and an ANB of 0.7°. The mandibular plane angle was 35.3°, the ramus height was 58.3 mm, and the gonial angle was large, at 134.3°.

The maxillary incisors were labially inclined at an angle of 128.0° toward the SN plane, and the mandibular incisors were lingually inclined at an angle of 82.0° toward the mandibular plane. The lower lip was protrusive with respect to the E-line, and an acute nasolabial angle was noted. A posteroanterior cephalometric analysis indicated that the maxillary molars had extruded on the left side by 3.0 mm more than on the right side, and the chin was deviated by 5.0 mm toward the right. A panoramic radiograph showed that all 4 third molars had complete root formation and were fully erupted, and the periodontal tissues were healthy (Figs 1 and 3, Table).

**TREATMENT OBJECTIVES**

Based on the cephalometric findings, this patient was diagnosed with mandibular protrusion and facial asymmetry. The following treatment objectives were planned.

1. **Maxilla.** A total impaction of the maxilla was planned to correct the canted occlusal plane and the excessive display of gingivae and to create sagittal coordination with the mandible.

2. **Mandible.** We planned to set back the mandible to correct the prognathism and the midline deviation. In addition, rotation of the maxillomandibular complex would reshape the bilateral gonial angle because of the bony ledge.

3. **Maxillary dentition.** We planned to coordinate the facial and maxillary dental midlines, relieve the
Fig 2. Pretreatment cast models.

Fig 3. Pretreatment cephalometric and panoramic radiographs.
4. Mandibular dentition. We planned to relieve the November 2013 TREATMENT ALTERNATIVES 740 Choi and Hwang 10 mm mesially. Furthermore, it was assumed that the edentulous space left by the missing tooth, would have been necessary for placing a fixed partial denture. A dental implant, and autotransplantation. A single-jaw surgery would not have fulfilled her expectations.

Various treatment options for the missing mandibular right first molar were considered, including orthodontic space closure, a fixed or a removable partial denture, a dental implant, and autotransplantation. A removable partial denture was not ideal because of the patient’s age; also, adjacent abutment tooth reduction would have been necessary for placing a fixed partial denture.

An orthodontic treatment approach, such as closing the edentulous space left by the missing tooth, would have been difficult and would have involved a long treatment time because it would have required protracting the mandibular right second molar by approximately 10 mm mesially. Furthermore, it was assumed that the antagonist tooth of the maxillary right second molar had disappeared. In contrast, an implant or autotransplantation was considered advantageous because it could improve the occlusion by prosthesis alone. In this patient, the maxillary left third molar had an appropriate crown size, and we expected that root canal treatment would not be difficult because the root shape was not abnormal. The patient agreed to transplantation of the maxillary left third molar into the mandibular right first molar space.

TREATMENT PROGRESS

The preoperative orthodontic preparation was performed with preadjusted 0.018-in edgewise appliances. Before the leveling and alignment procedures, the maxillary first premolars were extracted to decompensate the maxillary incisor inclination and to reduce the acute nasolabial angle. The extraction spaces were closed in the maxillary arch with a 0.016 × 0.022-in stainless steel archwire and miniscrew anchorage. The mandibular incisors were decompensated labially, and the mandibular right second molar was straightened to an upright position. The preoperative orthodontic treatment was completed in 16 months and required 2 stainless steel surgical archwires (0.017 × 0.025 in) for the maxillary and mandibular arches (Fig 4).

The orthognathic surgery involved a 1-piece LeFort I procedure with a horseshoe osteotomy, with 4.5 mm of anterior and posterior impaction. The maxillary left molars were further impacted by about 3.0 mm to correct the occlusal canting. Both sides of the mandible were set back with a bilateral intraoral vertical ramus osteotomy. This was performed to improve the mandibular protrusion and establish an Angle Class I canine position with ideal overbite and overjet. The chin was reduced in height by 2.0 mm and advanced by 4.0 mm with a genioplasty. Additionally, the right parasymphyseal area was shaved to shape the bony edges. After 2 jaw surgeries, the patient was placed in intermaxillary fixation for 2 weeks. The surgical splint was wired to the maxillary arch for 4 weeks. Four weeks after surgery, finishing was performed with a maxillary 0.016 × 0.022-in titanium-molybdenum alloy and mandibular 0.016-in stainless steel archwires.

At 20 months after treatment, the maxillary left third molar was transplanted to the site of the mandibular right first molar. We prepared a model of the maxillary left third molar based on 3-dimensional data that were converted to a DICOM format file (Fig 5, B). Then a resin model tooth was prepared with computer-aided rapid prototyping (Fig 5, C). The mandibular right first molar socket was prepared with a surgical round bur and

proclined incisor position, and achieve an ideal overbite and overjet relationship.

**TREATMENT ALTERNATIVES**

One treatment option for correcting the skeletal problems was single-jaw surgery, with only a mandibular setback. However, this would have compromised the facial esthetics. The patient had maxillary occlusal canting and excessive maxillary incisor exposure. A single-jaw surgery would not have fulfilled her expectations.

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**Table. Cephalometric analysis before and after treatment**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Norm Pretreatment</th>
<th>Posttreatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(19 y 8 mo)</td>
<td>(21 y 8 mo)</td>
</tr>
<tr>
<td>Skeletal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNA (°)</td>
<td>81.6 ± 3.2</td>
<td>86.9</td>
</tr>
<tr>
<td>SNB (°)</td>
<td>79.2 ± 3.0</td>
<td>86.2</td>
</tr>
<tr>
<td>ANB (°)</td>
<td>2.5 ± 1.8</td>
<td>0.7</td>
</tr>
<tr>
<td>SN-GoGn (°)</td>
<td>33.4 ± 5.0</td>
<td>35.3</td>
</tr>
<tr>
<td>Gonial angle (°)</td>
<td>118.6 ± 5.8</td>
<td>134.3</td>
</tr>
<tr>
<td>Ramus height (mm)</td>
<td>51.6 ± 4.2</td>
<td>58.3</td>
</tr>
<tr>
<td>Go-Me (mm)</td>
<td>76.0 ± 4.0</td>
<td>85.3</td>
</tr>
<tr>
<td>Dental factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U1-SN (°)</td>
<td>106.0 ± 5.0</td>
<td>128</td>
</tr>
<tr>
<td>U1-NA (/mm)</td>
<td>24.0/6.0</td>
<td>35.4/12.1</td>
</tr>
<tr>
<td>L1-NB (/mm)</td>
<td>27.0/6.0</td>
<td>25.3/8.3</td>
</tr>
<tr>
<td>L1-GoGn (°)</td>
<td>94.0 ± 5.0</td>
<td>82</td>
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<tr>
<td>Soft tissues</td>
<td></td>
<td></td>
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<tr>
<td>Nasolabial angle (°)</td>
<td>92.9 ± 7.4</td>
<td>80</td>
</tr>
<tr>
<td>E-line (mm)</td>
<td>−1.0 ± 2.0</td>
<td>−1.5</td>
</tr>
<tr>
<td>Upper lip/lower lip (mm)</td>
<td>1.0 ± 2.0</td>
<td>3.2</td>
</tr>
</tbody>
</table>

proclined incisor position, and achieve an ideal overbite and overjet relationship.

**TREATMENT PROGRESS**

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saline-solution irrigation. To minimize trauma, the maxillary left third molar was extracted carefully. To reduce the injury to the periodontal ligament, the tooth was wrapped in wet gauze, and an apicoectomy was performed with a diamond point. A cavity was formed for retrograde filling and filled with super-ethoxybenzoic acid under a microscope. The donor tooth was rotated and cut down to a mesiodistal width of 10 mm to fit the recipient site. The transplant surgery took a total of 22 minutes. The transplanted tooth was fixed in place and splinted with a wire for 2 weeks, and any occlusal interference was removed (Fig 6).
Fig 6. Periapical radiographs of the transplanted tooth: A, immediately before transplantation; B, immediately after transplantation; C, 4 weeks after transplantation; D, 3 months after transplantation.

Fig 7. Posttreatment facial and intraoral photographs.
Fig 8. Posttreatment cast models.

Fig 9. Posttreatment cephalometric and panoramic radiographs.
The appliances were removed after 24 months of active treatment (Figs 7 and 8). Fixed lingual retainers were bonded to the lingual surfaces of the anterior teeth in both arches, and the mandibular right first molar was restored with resin. Maxillary and mandibular circumferential retainers were delivered with instructions to use them for 24 hours per day for the next 6 months.

TREATMENT RESULTS

The posttreatment photographs showed that facial symmetry was achieved, and ideal occlusion was established with proper overjet and overbite. The maxillary dental midline coincided with the facial and mandibular midlines. The superimposition of the cephalometric tracings showed that the anterior and posterior maxillary teeth were moved upward, and the mandible had rotated clockwise and was set back (Fig 10). The cephalometric changes included an increase in the ANB angle. The mandibular incisor to mandibular plane angle increased from 82.0° to 90.2°. The maxillary incisors were uprighted from 128° to 112.5° with respect to the SN plane. A considerable increase in the nasolabial angle was observed. Maxillary incisor exposure was decreased at rest. The occlusion was finished to an Angle Class I canine relationship (Figs 9 and 10, Table).

Periapical radiographs taken immediately after transplantation showed that the tooth was in a wide extraction socket (Fig 6, B). One week after the transplantation, percussion was negative, but the tooth mobility was grade 2. One month after transplantation, the morphology of the transplanted tooth and the surrounding gingiva was similar to that of the adjacent teeth. However, bone induction was not observed around the transplanted tooth, and the probing depth was 6.0 mm in the mesiobuccal sulcus (Fig 6, C). Three months after the transplantation, the mobility of the transplanted tooth had stabilized to grade 1, and the periodontal condition was good. No pain, discomfort, or other side effects were noted. No pathologic radiolucency or root resorption (like that reported by Andreasen et al) was observed (Fig 6, D). At 1 year after transplantation, radiography showed a continuous periodontal space and normal lamina dura around the transplanted tooth. The results were stable at 8 months after debonding (1 year after autotransplantation) (Figs 11 and 12). A 2-year periapical radiograph of the autotransplanted tooth shows a successful, healthy situation (Fig 13).
DISCUSSION

The decision for surgical orthodontic treatment for this patient was based on the fact that her primary concern was her facial profile, particularly the lower third of her face. Her chin was deviated 5.0 mm toward the right, and this deviation was related to the cant of the maxillary occlusal plane. The maxillary molars on the left side were extruded 3 mm more than on the right side. Therefore, 2-jaw surgery, including correction of the maxillary occlusal plane, was chosen to meet her expectations.

Before 2-jaw surgery, preoperative orthodontic treatment, including decompensation of the malocclusion, is necessary. The dental decompensation we performed was intended to retract the proclined maxillary incisors with miniscrews to avoid losing anchorage and to procline the retroclined mandibular incisors to a normal axial inclination. Lack of optimal dental decompensation compromises the quality and quantity of an orthognathic correction. This patient’s teeth were decompensated by closing the residual space in the maxillary arch and leveling the mandibular arch. This was achieved after 16 months.

To increase the success rate of autogenous tooth transplantation, the tooth to be transplanted should have a healthy, vital periodontal membrane attached, and the root morphology should be simple. In addition, the recipient site should be free of infection; during surgery, the extraoral period should be short, and trauma should be minimized. In this patient, 3-dimensional computed tomography data indicated that the root shape of the maxillary left third molar was normal. The tooth was wrapped with gauze soaked in sterile saline solution during the preparation of the recipient site to maintain the vitality of the periodontal ligament attached to the transplanted tooth.

The probability of pulp healing is increased when the tooth to be transplanted has an immature root.
Conversely, the pulp of a completely mature tooth cannot regenerate.\textsuperscript{5,10,12} In this patient, the tooth had complete root formation; therefore, an apicoectomy with extraoral endodontic treatment was performed on the maxillary left third molar. In most cases, a long time is required to create a bone socket at the recipient site after extracting the tooth to be transplanted because the socket must conform to the shape of the extracted tooth. In addition, while fitting the extracted tooth to the bone socket, the root surface might be injured. To prevent injury, we prepared a resin model of the donor tooth by computer prototyping. The use of a resin model could shorten the bone preparation time, and injury to the root surface was avoided.

Tooth transplantation is judged to be successful when the tooth is fixed in the socket without discomfort, chewing is satisfactory, the tooth is immobile, no pathological conditions are detected radiographically, and the sulcus depth, gingival contour, and gingival color are normal.\textsuperscript{11} With autogenous tooth transplantation, long-term, firm fixation can have negative effects on healing. In contrast, nonrigid fixation for 7 to 10 days

\textbf{Fig 12.} Posttreatment cephalometric and panoramic radiographs at 8 months after debonding (1 year after autotransplantation).

\textbf{Fig 13.} A 2-year periapical radiograph of the autotransplanted tooth.
stimulates the alveolar ligament cells and bone healing.\textsuperscript{14,15} In our patient, fixation was removed after 2 weeks, when all vertical mobility had disappeared.

This study showed that tooth autotransplantation was an effective treatment option, combined with a comprehensive plan that included orthodontic and orthognathic treatments. The alternative option was placement of dental implants, also a valid method. However, this patient was 20 years old, and we expected changes in the jaws and teeth with aging and adult growth.\textsuperscript{16} In this patient, autotransplantation was the optimal choice because autotransplanted teeth will erupt in concert with vertical changes in the alveolar bone because of the presence of a periodontal ligament.

**CONCLUSIONS**

This case report demonstrates that orthognathic surgery combined with autotransplantation of a third molar can be an effective approach for patients with mandibular protrusion, facial asymmetry, and missing teeth. The therapeutic results showed improvement in the patient’s facial appearance, with no need for a dental implant. In addition, the autotransplanted tooth effectively supported the adjacent teeth and maintained chewing ability. We recommend autotransplantation when a suitable tooth is available and anatomic circumstances permit.

**REFERENCES**