Case Report

Orthodontic Treatment Including Autotransplantation of a Mature Tooth

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ABSTRACT

The patient was a 24-year-old Japanese female. The chief complaints were crowding and masticatory dysfunction due to the missing right first molar. Her maxillary first premolars had been extracted when she was a primary school student. We planned orthodontic treatment with extraction of the mandibular first premolars and transplantation of the mandibular left first premolar into the maxillary right first molar area. We made a diagnostic setup model to initiate an appropriate treatment plan for the discrepancy in tooth size ratio. Following the diagnostic setup model, the space in the maxillary right first molar area was closed by a small amount of tooth movement, and a good occlusion was achieved. The patient had been in retention for 7 years, and the occlusion has been maintained very well during this time. In the follow-up, 10 years after autotransplantation, no signs of inflammatory or replacement root resorption were found, and marginal bone support appeared similar to that of neighboring teeth. (*Angle Orthod.* 2009;00:387–393.)

KEY WORDS: Autotransplantation; Implant

INTRODUCTION

Some adult patients of orthodontic treatment have missing teeth owing to periodontal disease, caries, or trauma. Various treatment options for patients with missing teeth are considered. Treatment approaches include continued observation, orthodontic space closure, fixed or removable partial dentures, dental implants, and autotransplantation.

Because treatment plans are developed with consideration of the site and number of missing teeth, tooth extraction may be needed in some cases. In such patients, autotransplantation of the tooth extracted for orthodontic treatment not only prevents an increase in the number of missing teeth but also results in minimal tooth movement. This is considered an effective technique for a satisfactory prognosis. In recent years, application of autotransplantation to orthodontic treatment has been reported mainly in Scandinavian countries.^{2–4} Autotransplantation has become one of the standard treatments with validity similar to that of dental implants.^{5,6} Several studies have suggested autotransplantation of immature teeth. Only a few cases with combined orthodontic treatment and autotransplantation of mature teeth have been observed for longer than 10 years after active orthodontic treatment.⁷

The present case report demonstrates successful autotransplantation of a premolar in a patient with a missing maxillary right first molar due to caries. Good results have been maintained for longer than 10 years after completion of active orthodontic treatment.

CASE REPORT

The patient was a 24-year-old Japanese female with chief complaints of crowding and masticatory disorder due to a missing maxillary right first molar. She had no orthodontic history, but her maxillary first premolars had been extracted when she was a primary school student. Furthermore, her maxillary right first molar had been extracted 1 month earlier because of tooth fracture caused by dental caries.

Pretreatment facial photographs showed a symmetric facial pattern with a straight profile (Figure 1). Intraoral examination revealed an angle Class I molar relationship on the left and an unknown molar relationship on the right caused by the missing maxillary right first molar. She had 3 mm of overjet and 3.5 mm

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Figure 1. Pretreatment facial photographs.



Figure 2. Pretreatment intraoral photographs.



Figure 3. Pretreatment panoramic radiograph.

Measurement	Mean	SD	Pretreatment	Posttreatment	Postretention
SNA, degrees	82.3	3.5	83.7	83.3	83.3
SNB, degrees	78.9	3.5	81.9	81.8	81.5
ANB, degrees	3.4	1.8	1.8	1.5	1.8
FMA, degrees	28.8	5.2	23.5	24.2	23.7
Gonial angle, degrees	122.2	4.6	125.3	126.1	126.0
Ramus inclination, degrees	2.9	4.4	10.8	11.9	11.3
U1 to SN, degrees	104.5	5.6	99.3	97.3	97.6
FMIA, degrees	58.0		73.8	74.9	75.0
A'-Ptm', mm	48.3	2.5	48.6	48.3	48.5
Ptm'-Ms, mm	19.2	2.8	23.3	23.6	23.1
A′-Ms, mm	26.9	2.5	25.3	24.7	25.4
Gn-Cd, mm	119.3	4.4	121.9	121.8	121.7
Pog'-Go, mm	77.2	3.8	81.2	81.5	81.2
Cd-Go, mm	62.4	4.9	60.0	59.7	60.0

Table 1. Cephalometric Measurements

of overbite. The extraction space of the maxillary first premolars had closed, whereas the maxillary right first molar space was 11 mm. The arch length discrepancy was -3.6 mm in the maxillary arch and -8.7 mm in the mandibular arch. The maxillary teeth 22, 23, and 25 were in a cross-bite relation. The maxillary midline was shifted to the right of the facial midline by 1.0 mm, and the mandibular midline was shifted to the left by 1.5 mm (Figure 2).

Radiographic examination revealed mild horizontal resorption of the maxillary and mandibular alveolar bone. Root canal treatment had been performed on the bilateral maxillary central incisors (Figure 3).

In the lateral cephalometric radiograph, the mandible and the maxilla were positioned normally relative to Japanese standards (SNA, 83.7 degrees; SNB, 81.9 degrees; ANB, 1.8 degrees) and showed a skeletal Class I relationship. The inclination of the upper incisors was also normal, but the mandibular incisors showed a marked lingual inclination. The maxillary left first molar revealed mesioversion (Table 1).

Diagnosis

From these findings, the patient was given the diagnosis of an Angle Class I malocclusion with a slight tendency to Class III, severe crowding, and missing bilateral maxillary first premolars and right maxillary first molar.

Treatment Plan

On the basis of diagnostic records, the following treatment plan was developed: (1) lateral expansion of the maxillary dental arch, (2) extraction of the bilateral mandibular first premolars, autotransplantation of one of two lower first premolars (which was in better condition) into the maxillary first molar area, (3) placement of fixed appliances, and (4) establishment of a stable occlusion.

Treatment Alternatives

Various treatment options for the missing maxillary right first molar were considered. Treatment approaches included continued observation, orthodontic space closure, fixed or removable partial dentures, dental implants, and autotransplantation. Selecting a removable denture was not ideal because of the patient's age and oral environment. If we applied a fixed partial denture, the abutment teeth had to be reduced. According to Gary et al,⁸ patients who had missing teeth spaces closed were significantly healthier periodontally than patients with prosthetic teeth. However, it was predicted that the orthodontic space closure would be difficult because it would require moving the maxillary right second molar approximately 10 mm mesially.

Even if it had been possible to close this space, it was assumed that the antagonistic tooth of the mandible right second molar disappeared from a diagnostic setup model (Figure 4A). Therefore, a prosthesis would have been required to connect the mandibular first molar to the second, or a cantilever bridge of maxillary right molars would have been required. Closing of space by orthodontic treatment only would not reduce aggressive treatment of the abutment teeth. We thought the cantilever bridge would be a disadvantage.

On the other hand, use of an implant or autotransplantation was considered advantageous. Occlusion would improve by prosthesis alone for the implant and the autotransplanted tooth, and by only a small amount of tooth movement. In the present case, all four third molars were present, and we had to extract the bilateral mandibular first premolars. Because an autotransplanted tooth (a donor tooth) was present, we chose an autotransplantation instead of an implant. It was thought that the maxillary right third molar was too small to adapt, and that the maxillary left third molar had an appropriate crown size, but it was difficult to apply because it was impacted in a high position



Figure 4. (A) Diagnostic setup model (orthodontic space closure). (B) Diagnostic setup model (autotransplantation).

and required amputation for extraction. The mandibular third molar was considered better as a tooth for autotransplantation.

However, there was a strong possibility that it would have to be sectioned for extraction because a mesial root curved markedly. Even if we would have been able to extract the tooth intact, we thought that the root canal treatment would be difficult. The crown width diameters of these options were small, but we chose the mandibular first premolar, which had a single root, as an autotransplantation tooth. In addition to the provisional prosthesis after autotransplantation, we decided to make a setup model for reference (Figure 4B).

Treatment Progress

After adequate expansion was obtained with a Quad Helix appliance, edgewise appliances (0.018 \times 0.025 inch) were placed on the maxillary teeth. To decrease the risk of root damage, edgewise appliances were placed on the mandibular premolar teeth before autotransplantation.9 Root canal treatment of the mandibular first premolars by the patient's family dentist was completed before transplantation.⁶ Two months later, we performed autotransplantation of the mandibular left first premolar into the maxillary right first molar area. Because an abundance of periodontal ligament fibers was present around the mandibular left first premolar, we transplanted the left one. Surgical sutures were placed after autotransplantation, and periodontal packing was applied. The surgical sutures were removed 1 week postoperatively. The occlusion had been adjusted for 3 months from removal of fixation until placement of the interim prosthesis, so that nat-



Figure 5. Periapical radiographs after autotransplantation. (A) Pretreatment. (B) One-month follow-up. (C) One-year follow-up. (D) Three-year follow-up (posttreatment). (E) Ten-year follow-up.

ural extrusion of the transplanted tooth would not be disturbed. The interim prosthesis allowed the antagonistic teeth to occlude, and it was aligned with the edgewise appliances about 3 months later. No gingival inflammation was observed around the autotransplanted tooth at 1 month.

Periapical radiographs showed no inflammatory root resorption similar to that reported by Andreasen et al.¹⁰ We confirmed these findings 1 to 2 months postoperatively. Bone induction around the autotransplanted tooth was not observed at 1 month but was observed at 4 months. Periodontal space also was confirmed. Radiographic follow-up revealed satisfactory bone healing around the autotransplanted tooth with a normal periodontal space and lamina dura at 1 year. No replacement root resorption was observed at the 10year follow-up after autotransplantation (Figure 5). Three years later, all edgewise appliances were removed, and wraparound retainers were fabricated to maintain the alignment.

Treatment Results

A good occlusion was achieved, and these results have been maintained for 7 years after completion of active treatment. Posttreatment facial photographs showed an acceptable facial profile (Figure 6). The space created by the missing upper right first molar was closed by autotransplantation, and satisfactory occlusion was achieved (Figure 7).

The gingiva of the autotransplanted tooth showed no signs of inflammation. Interproximal sulcus depth was approximately 2 millimeters. Radiographic examination showed parallelism of dental roots and no root resorption of the autotransplanted tooth and other teeth, but a slight increase in horizontal resorption of the alveolar bone was observed (Figure 8). The final



Figure 6. Posttreatment facial photographs.



Figure 7. Posttreatment intraoral photographs.



Figure 8. Posttreatment panoramic radiograph.

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Figure 9. Pretreatment, posttreatment, and posttreatment superimposed cephalometric tracings.

prosthesis was applied to the autotransplanted tooth 6 months after removal of the fixed appliance. The lateral cephalometric radiograph showed slight lingual inclination of the maxillary and mandibular incisors (Table 1; Figure 9). The occlusion remains stable about 10 years after autotransplantation and 7 years after removal of the fixed appliance (Figures 10 and 11).

DISCUSSION

As the number of adult dental patients has increased, the number of patients with missing teeth due to periodontal disease or dental caries has increased. This patient presented with missing maxillary first premolars and a missing maxillary right first molar. Recently, a high success rate and good prognoses have been reported when dental implants were used to replace missing teeth. Implants can be applied to almost any patient. If we had used a dental implant for this patient, a good result would have been predicted.^{11–13} However, it is reported that changes in craniofacial structures continually occur during the adult period.

Behrents¹⁴ reported that the magnitude of the adult growth change, assessed on a millimeter per year basis, was quite small, but the cumulative effect over decades was surprisingly large. The data also revealed that the rotation of both jaws continued into adult life, in concert with vertical changes and eruption of teeth. In other words, even in an adult, we cannot deny that these changes may result in a lack of vertical occlusion or malposition of adjacent natural teeth relative to the implant.

This patient was 24 years old, and changes in the jaws and teeth with aging and adult growth were predicted. Autotransplanted teeth erupt in harmony with a change in alveolar bone because a periodontal ligament is present. However, many limits are applied because autotransplantation does not have standard characteristics, as dental implants do. Autotransplantation requires consideration of the state of the periodontal ligament, pulp, diameter, length of the donor tooth, and alveolar bone.^{6,15} In the present case, the maxillary right first molar had been extracted 1 month previously, and socket healing was insufficient. Because there was a risk of poor adaptation of the tooth within its socket, we decided to perform autotransplantation after sufficient socket healing had occurred.

According to Andreasen,¹⁵ results of histometric analysis in green vervet monkeys indicated that the



Figure 10. Postretention intraoral photographs.



Figure 11. Postretention panoramic radiograph.

major decisive factor in determining appropriate periodontal repair without root resorption is the condition of the cemental part of the periodontal ligament. Furthermore, Berglund et al⁹ reported that the orthodontic force (jiggling force) employed to prepare for autotransplantation decreased the risk of damage to the periodontal membrane.

Therefore, we placed an edgewise appliance onto the autotransplanted tooth, and the plan was to autotransplant it after adding the jiggling force. Through this process, sufficient periodontal ligament support was provided for the donor tooth, and an excellent result was obtained. Furthermore, we made a diagnostic setup model before beginning treatment and decided to consider methods of autotransplantation after having predicted a posttreatment occlusion.

Autotransplantation of teeth offers an effective treatment option, particularly when combined with a sufficient plan of orthodontic therapy. Placement of dental implants is a valid method. However, with the availability of a donor tooth, we should consider autotransplantation before using dental implants.

CONCLUSION

 Autotransplantation is an effective method for achieving the reconstruction and stability of occlusion.

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