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Orthodontic Treatment Combined with Autotransplantation in Adults

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INTRODUCTION

It is common that orthodontic treatment in adult patients may be complicated by their existing dental problems such as severe dental caries, periodontal disease, prosthetically restored teeth, or missing teeth. Treatment approaches for missing teeth space include orthodontic space closure, fixed bridges, removable partial dentures, dental implants, and tooth autotransplantation.

More and more adults, nowadays, are willing to consider using orthodontic approach, in conjunction with other dental treatments, to re-establish their dental health. Orthodontic treatment combined with autotransplantation not only reduces the number of missing teeth but also minimizes teeth movement. Several studies have demonstrated acceptable survival rates of autotransplanted teeth with completed roots formation.

This present case report demonstrates a successful orthodontic treatment combined with autotransplantation of two mature teeth in an adult patient.
CASE REPORT

A 28-year-old female with complex dental problems came to our hospital for treatment. Her chief complaint was dental crowding and poor esthetics. The patient denied any major systemic disease. She had no trauma history and no apparent signs or symptoms of temporomandibular disorders.

Clinical findings

The patient had a symmetric facial pattern with a convex profile and long face. The intraoral molar relationships were Angle Class I on both right and left sides, whereas canine was in Class I on the right side and Class II on the left side. The arch length discrepancy was -6.5 mm in the maxillary arch and -7.5 mm in the mandibular arch. The maxillary and mandibular dental midlines were deviated to the left of the facial midline by 1.0 mm. The maxillary right first premolar and mandibular right second premolar were in crossbite. Overjet and overbite were 9 mm and 2 mm, respectively. The maxillary right first and second molars and the mandibular left second molar had severe dental caries (Figure 1).

Lateral cephalometric analysis showed a mild skeletal Class II relationship with the ANB angle of 5.0° and the Wits appraisal of 2.8 mm. The patient demonstrated a high-angle tendency (SN-MP, 44.4°) and bimaxillary dentoalveolar protrusion (U1-NA, 8.6 mm; L1-NB, 7.5 mm; interincisal angle, 114.7°) (Figure 2, Table 1). The panoramic radiograph revealed prior root canal treatment on the maxillary right first molar, mandibular left first premolar, second premolar, and second molar. The mandibular left first and second premolars had ill-fitting porcelain-fused-to-metal crowns. The mandibular left third molar was horizontally impacted with an axial inclination of 90°. The maxillary right and left third molars were vertically impacted (Figure 3).

Diagnosis

From these findings, the patient was diagnosed as mild skeletal Class II malocclusion with a high mandibular plane angle. Extra-orally, she had a convex profile with retrusive chin and lip incompetence. Intra-orally, she had dental Class I malocclusion, protrusive maxillary incisors, severe crowding, and multiple dental caries.

Treatment objectives and plan

The treatment goals were: (1) improve facial profile by retracting the maxillary incisors; (2) maintain the vertical facial height without clockwise rotation of the mandible; (3) extract eight teeth (16, 17, 24, 28, 34, 35, 37, 44), autotransplantation of 24 into the 16 region, and 44 into the 34 region; (4) relieve crowding and align maxillary and mandibular dentitions, including uprighting and mesialising 38 and 18; and (5) establish a stable occlusion with proper overjet and overbite.

Treatment progress

Before full mouth bonding, 17, 28, 35, and 37 were extracted, and the carious cavities on 15, 25, 26, 27, 36, 46, and 47 were restored. Orthodontic treatment objectives were explained to the patient and informed consent was obtained. Roth system with 0.022 self-ligating brackets were bonded, except for 16, 18, 34, and 38, followed by proper oral hygiene instructions. To decrease the risk of root damage, brackets were placed on 44 and 24 before autotransplantation. Six weeks later, 34 and 44 were extracted at the same time, then 44 was transplanted to the 34 extraction site. Two months later, 16 and 24 were extracted at the same time, then 24 was transplanted to the 16 extraction site. Transplantations were performed according to the procedure described by Andreasen and et al. The key factors to maximize the chance of successful results including preservation of the periodontal membrane to the maximum extent, tight sutures, and rests for the transplanted tooth with sufficient clearance from the opposite teeth. Within 3 weeks after autotransplantation, root canal treatments were initiated with calcium hydroxide temporary root filling placed in the transplanted teeth. Postoperative
Figure 1. Pre-treatment extraoral and intraoral photographs.

Figure 2. Pre-treatment lateral cephalometric radiograph.
Table 1. Cephalometric measurements at pre-treatment and post-treatment.

<table>
<thead>
<tr>
<th></th>
<th>Pre-treatment</th>
<th>Post-treatment</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skeletal analysis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNA (°)</td>
<td>75.8</td>
<td>75.6</td>
<td>82</td>
</tr>
<tr>
<td>SNB (°)</td>
<td>70.9</td>
<td>72.5</td>
<td>77.7</td>
</tr>
<tr>
<td>ANB (°)</td>
<td>5.0</td>
<td>3.1</td>
<td>4</td>
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<tr>
<td>Wits appraisal (mm)</td>
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<td>-3.8</td>
<td>0</td>
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<tr>
<td>SN-MP (°)</td>
<td>44.4</td>
<td>45.4</td>
<td>33</td>
</tr>
<tr>
<td><strong>Dental analysis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U1-SN (°)</td>
<td>110.3</td>
<td>92.1</td>
<td>103.8</td>
</tr>
<tr>
<td>U1-NA (mm)</td>
<td>8.6</td>
<td>4.0</td>
<td>4.3</td>
</tr>
<tr>
<td>L1-NB (mm)</td>
<td>7.5</td>
<td>5.3</td>
<td>4</td>
</tr>
<tr>
<td>L1-MP (°)</td>
<td>90.6</td>
<td>82.0</td>
<td>90.0</td>
</tr>
<tr>
<td>Interincisal angle (°)</td>
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<td>140.5</td>
<td>130.0</td>
</tr>
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<td><strong>Soft tissue analysis</strong></td>
<td></td>
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<tr>
<td>U lip-E line (mm)</td>
<td>0.4</td>
<td>-1.6</td>
<td>1</td>
</tr>
<tr>
<td>L lip-E line (mm)</td>
<td>2.6</td>
<td>0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Figure 3. Pre-treatment panoramic radiograph.
fixation was carried out with composites and cobalt-chromium wires for 4 weeks. During the stabilizing stage, we continued leveling and aligning the whole dentition and tracking 18 and 38 into occlusion at the same time. Composite resin restoration was performed on 45 after it being uprighted. After leveling and aligning stage, 0.017x0.025-in titanium-molybdenum alloy wires with closing loops, along with Class II elastics were used in the maxillary and mandibular arches to retract incisors and close the extraction spaces. During the finishing and detailing stages, we used 0.018x0.025-in stainless steel wires for the maxillary and mandibular arches. After 21 months of active treatment, we removed the appliances, finished the endodontic treatment, and restored the two autotransplanted teeth with composite resin. Removable vacuum-form retainers were the choice of retainers for the maxillary and mandibular arches here.

**Treatment result**

Post-treatment facial photographs showed an acceptable facial profile. Intra-orally, the dental midline was almost coincident with the facial midline and ideal intraoral interdigitation with Class I canine relationships were also achieved (Figure 4). Comparison of the pre- and post-treatment lateral cephalometric analysis demonstrated positive changes in the ANB angle (5.0° to 3.1°), Wits appraisal (2.8 mm to -3.8 mm), and U1-SN angle (110.3° to 92.1°) from retraction of maxillary incisors. Vertically, there was no increased in facial height. Both the maxillary and mandibular incisors showed lingual inclinations with an increase of 25.8° in the interincisal angle (Figures 5 and 6, and Table 1). There is no abnormality found at the periodontal regions both radiographically and clinically on the autotransplanted teeth at 2 years 6 months follow-up (Figures 7 and 8).
Figure 5. Post-treatment lateral cephalometric radiograph.

Figure 6. Cephalometric superimpositions of the pre-treatment (black lines) and post-treatment (green lines) stages.
Figure 7. Post-treatment panoramic radiograph.

Figure 8. Periapical radiographs of the autotransplantation: 
A pre-treatment of the recipient sites; 
B pre-treatment of the donor sites; 
C 2 years 6 months after transplantation of the recipient sites.
DISCUSSION

Autotransplantation is considered an effective technique with a satisfactory prognosis. In recent years, while the survival rate of implants has been reported to be as high as 91% at 20 years, the survival rates of autotransplanted teeth with complete root formation have been reported as 96.4% at 5 years and 89.5% at 10 years. Autotransplantation has become a standard treatment with validity similar to dental implants. Dental implants may also been a viable treatment option in this case, but incompatibility at the gingival margins and the incisal edges between dental implants and adjacent teeth in adults has been reported in long-term follow up. Behrents reported that the magnitude of adult growth changes, 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 continues into adult life, consisting of vertical changes and eruption of teeth. In other words, even if in an adult, we cannot deny that these changes may result in a lack of vertical occlusion or malpositioning of adjacent natural teeth in relative to the implant. This patient was 28 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 the alveolar bone because a periodontal ligament (PDL) is present. Transplanted teeth recover their proprioceptive function and normal periodontal healing ability to allow the patient has a natural chewing sensation and biologic stimuli response.

However, the most common complications associated with autotransplantation are ankylosis and root resorption. Because long-term rigid splinting has been showed to increase the risk of ankylosis, splinting was only applied during the initial 4 weeks of the healing period in this case. It has been reported that application of occlusal stimuli promotes the regeneration of the PDL and reduces the risk of ankylosis. Pohl et al. mentioned that adequate mobility reduces the probability of ankylosis since bone repair is stimulated when functional movement of the transplanted tooth is preserved. However, early excessive force increases severe root resorption and alveolar bone resorption. Therefore, we rested the transplanted teeth out of occlusion during the initial healing period to prevent excessive occlusal contact, then began exerting a light continuous force with a superelastic nickel-titanium archwire at 4 weeks after transplantation. This early application of light orthodontic force may help prevent ankylosis and increase the success rate of autotransplantation.

According to Andreasen, results of histometric analysis in green vert monkeys indicated that the major decisive factor in determining appropriate periodontal repair without root resorption is the condition of the cemental part of the PDL. Berglund et al. reported that the orthodontic force (jiggling force) employed to prepare for autotransplantation decreases the risk of damage to the periodontal membrane. Therefore, we placed brackets on the donor teeth and planned to let the force of leveling and aligning jiggled on them, and then transplanted them to the recipient sites. We extracted the teeth without preparation of the recipient sockets and transplanted the donor teeth at the same time; this process provided sufficient PDL support from the donor teeth and extracted sockets, and hence an excellent result was obtained. Preserving the periodontal membrane and minimizing the time that the tooth is out of the mouth during transplantation tremendously affect the quality of the transplantation. We believe that the preservation and regeneration of the PDL is the keys to the success of this treatment.

In addition, hypofunctional teeth (teeth not in intercusption), such as impacted teeth, are reportedly likely to develop ankylosis. Donor teeth without occlusal contacts are significantly predisposed to resorption, ankylosis, pocket formation, and inflammation after transplantation. Previous studies have indicated that hypofunctional teeth have a narrower PDL, less PDL matrix protein, and less blood circulation than other teeth. Teeth with an atrophic PDL are more easily
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Damaged during transplantation and have a higher risk of root resorption. Furthermore, extraction, preparation of the recipient socket, management of a healthy periodontium, and complete endodontic treatment are all thought to be difficult for multirooted teeth such as molars. It has been reported that, when a maxillary tooth is moved to the mandible, the buccolingual width of the maxillary tooth is often greater than the recipient area in the mandible. Thus, excessive bone must be removed in most cases. Tooth autotransplantation to the opposite jaw has been shown to negatively influence the success rate, so we did not choose the impacted maxillary left third molar as a donor tooth and autotransplanted the two mature teeth in the same jaws.

Autotransplantation of teeth can an effective treatment option, particularly when combined with a comprehensive orthodontic treatment plan. Patel et al. reported the use of autotransplantation as part of orthodontic treatment plan. Several cases with combined orthodontic treatment and autotransplantation of mature teeth have been observed for longer than 10 years after active orthodontic treatment. Although dental implant is often considered as easy options for replacing missing teeth, we once again demonstrated that, with the availability of a proper donor tooth, autotransplantation could be considered as a viable option as dental implants.

In this patient, full mouth reconstruction, including endodontic treatment, orthodontic treatment, autotransplantation without using dental implants was successfully carried out. We significantly improved the dental health, masticatory function, facial esthetics, and quality of life for this patient. Long-term follow up is indispensable for both the orthodontic treatment and the autotransplanted teeth.

CONCLUSION

Orthodontic treatment combined with autotransplantation is an effective method for achieving full mouth reconstruction in the adult patient. When a donor tooth is available, tooth autotransplantation is a viable treatment option to maintain a good alveolar bone condition and avoid prosthetic rehabilitation.

REFERENCES

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