Autotransplantation of Premolars in a Patient with Multiple Congenitally Missing Teeth

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Autotransplantation of teeth can significantly reduce treatment time in cases of aplasia, tooth loss, or ectopia, provided a suitable tooth is available and the anatomical conditions are favorable. As a viable option for restoring edentulous areas in young patients whose alveolar growth is not yet complete, it can resolve complicated treatment problems in the dental arches. Moreover, this approach allows replacement of a missing tooth with a natural tooth rather than a prosthesis or osseointegrated implant.

Autotransplantation of premolars with partly formed roots is a predictable modality, because transplanted teeth have the capacity for preservation of the alveolar ridge and functional adaptation.

This article describes the treatment of a patient in the early mixed dentition using a combination of autotransplantation and orthodontics.

Diagnosis and Treatment Plan

A 10-year-old female presented with congenitally missing mandibular permanent central incisors and second premolars (Fig. 1). She was still in the early mixed dentition, indicating delayed development for her age. Clinical examination showed a convex profile, normal vertical facial proportions, and good facial symmetry, with a Class I molar...
Fig. 1 10-year-old female patient with Class I occlusion and congenitally missing mandibular central incisors and second premolars before treatment.
relationship, a 2mm overjet, and a 1mm overbite. The etiology of the missing teeth was presumed to be genetic, since there was no history of trauma or infection to the mouth, teeth, or jaws.

Panoramic radiographs confirmed the agenesis of the mandibular permanent central incisors and second premolars and showed no evidence of third molars. Cephalometric analysis indicated a Class I skeletal pattern with a normal growth pattern and proclination of both the maxillary and mandibular incisors (Table 1).

The treatment plan called for transplanting the maxillary right first premolar to the mandibular right second premolar region and transplanting the maxillary left second premolar to the mandibular left second premolar region. While we waited for the patient to progress further into the permanent dentition, we took a panoramic film with a metal ball in place to indicate the amount of magnification, and we calculated the appropriate sizes of the recipient sites (adjusted for magnification). The patient was seen every three months to monitor tooth eruption and root development.

### Treatment Progress

Autotransplantation was performed when the patient was 12 years old. Her deciduous mandibular second molars were removed under local anesthesia, with care taken to preserve the buccal and lingual alveolar bone during extraction, and the sockets were prepared to receive the transplanted maxillary premolars. The intra-alveolar septum was trimmed with a chisel, and the sockets were irrigated. The donor teeth—the maxillary right first premolar and maxillary left second premolar—were carefully removed, keeping their roots and remaining periodontal ligaments (PDLs) intact to avoid separation of Hertwig’s epithelial root sheath (Fig. 2). Root development of the donor teeth was about 75%.

As quickly as possible, each transplanted tooth germ was placed in its prepared socket with its occlusal surface slightly below the occlusal plane, thus avoiding premature contacts. The flaps were sutured with black silk, and the transplanted teeth were fixed in place by crossing the same suture material over the occlusal surfaces.

Chlorhexidine rinse and amoxicillin were prescribed for one week. The patient was instructed not to chew any foods during the first month of the postoperative period, after which she was permitted to chew a soft diet.

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**TABLE 1
CEPHALOMETRIC DATA**

<table>
<thead>
<tr>
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<th>Japanese Norm</th>
<th>Pretreatment</th>
<th>Post-Treatment</th>
<th>One-Year Follow-Up</th>
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<td>LFH (ANS-Me/N-Me)</td>
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<tr>
<td>Lower lip</td>
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<td>−1.8mm</td>
<td>−1.9mm</td>
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</table>
for one month, gradually increasing the chewing load to normal function within three months.

A day after surgery, the transplanted teeth had retained their positions; thereafter, the stability and position of the teeth were assessed weekly. Sutures were removed one week after transplantation, and flexible stabilization wires were bonded to connect the transplanted teeth to the adjacent teeth. Full clinical and radiographic examinations were performed one, four, and 12 weeks and six months after surgery to evaluate periodontal healing, root growth, tooth eruption, and pulpal healing and to check for any signs of pulp canal obliteration (PCO).

Six months after autotransplantation, full .018” edgewise appliances* were bonded in both arches. No PCO was observed on the pretreatment radiographs4–6 (Figure 3 shows records taken after two to three months of orthodontic treatment).

Fixed appliances were removed following 36 months of active treatment. A 4-4 .0175” twisted lingual wire was bonded in the mandibular arch, and an Essix** retainer was delivered for the maxillary arch.

**Treatment Results**

Post-treatment records showed proper midline alignment and an acceptable overbite and overjet (Fig. 4A). The panoramic radiograph indicated proper root parallelism, with no signs of bone or root resorption. Cephalometric superimpositions revealed no significant skeletal changes and confirmed the normal inclination of the anterior teeth (Fig. 4B, Table 1).

*3M Unitek, 2724 S. Peck Road, Monrovia, CA 91016; www.3mUnitek.com.
**Trademark of Dentsply Raintree Essix, 6448 Parkland Drive, Sarasota, FL 34243; www.essix.com.
Post-treatment radiographic examination of the transplanted teeth showed complete root growth with intact laminae durae and well-defined periodontal spaces. Both transplanted teeth, particularly the left second premolar, displayed partial PCO at this point. Alveolar ridge levels were similar to those of the adjacent teeth, and the final crown-to-root ratios were greater than 1:1. The response of the transplanted teeth to electric pulp testing was positive, their mobility was normal, and the sulcus depths were less than 3mm.

After one year of retention, the patient’s occlusion had remained fairly stable (Fig. 5).

Discussion

Autotransplantation, which has become an accepted modality in orthodontics, offers several benefits compared with alternatives such as dental implants. A successfully transplanted tooth recovers its normal periodontal health and proprioceptive function after a single surgical procedure. Transplantation allows natural biological response, including continued alveolar bone induction, and lets the patient feel a normal chewing sensation.

Although studies have reported survival rates as high as 90% for transplanted teeth, undesirable complications such as root resorption or dentoalveolar ankylosis can occur. If there is a residual Hertwig’s epithelial root sheath on the developing tooth, the capillaries and PDLs can proliferate through the apex, filling the pulp canal with vital tissues within a few months after autotransplantation. Calcification of the root canal may then result in a complete or partial obliteration—a common problem associated with autotransplantation.

While PCO can result in discoloration of the tooth, however, it does not affect the success of the procedure in vital pulp.

For successful autotransplantation, the following protocols should be observed:

1. Minimal handling during surgery. Minimal handling of the donor tooth is crucial to preserve an intact PDL and Hertwig’s epithelial root sheath and to prevent compromised root growth leading to resorption, ankylosis, or attachment loss.

2. Minimizing the time the donor tooth is out of the mouth. Kim and colleagues reported no root resorption or ankylosis within their experimental extraoral time of 7.8 minutes. These investigators applied a meticulous surgical technique to prevent damage of the PDL and Hertwig’s epithelial root sheath, transplanting the donor teeth to the recipient sites.
Fig. 4 A. Patient after 36 months of orthodontic treatment. B. Superimposition of pre- and post-treatment cephalometric tracings.
Fig. 5 A. Patient 12 months after end of treatment. B. Cone-beam computed tomography: multiplanar reconstruction (left and center) and panoramic rendering (right).
immediately after extraction.

3. **Root morphology.** The donor tooth should have a conical, smooth root to permit non-traumatic extraction, thus avoiding damage to the PDL. Successful periodontal healing, completed within two months in most patients, is marked by the presence of a lamina dura and absence of root resorption. The fate of a transplanted or reimplanted tooth depends on the viability of the PDL attached to the root.

4. **Condition of the recipient site.** The recipient site should provide enough space for the donor tooth, including adequate height and width of bone. If the buccolingual width is insufficient to accommodate the donor tooth, there is a risk of alveolar ridge resorption.

5. **Donor-tooth fixation.** Although fixation with sutures provides easy and effective stabilization of the transplanted tooth in the recipient site, occlusal adjustment must be completed before fixation. A splint can permit some movement of the tooth while immobilizing it enough to allow healing. Such minor tooth movement can reduce the incidence of ankylosis and minimize adverse effects on periodontal and pulpal healing.

6. **Attention to the growth stage of the donor tooth.** Because there is no root growth after transplantation, autotransplantation of tooth germs should be performed when root development has reached 75-100% (root development stages 3 to 4, on the scale of Moorrees and colleagues), with a wide-open apical foramen of at least 1mm. Andreasen and colleagues reported that the incidence of pulp necrosis and root resorption was greater in mature premolar transplants due to their closed apices. Transplantation of a fully formed root nullifies the potential for pulp regeneration, although endodontic therapy will still ensure high survival rates. In our patient, the donor teeth were transplanted when root development was about 75% complete. Pulpal healing was achieved because the immature transplanted teeth had wide apical openings.

7. **Force application.** Orthodontic forces should not be applied to a tooth during the first three to six months after the transplantation procedure; when force is eventually applied, the amount and duration should be minimized. According to Hamamoto and colleagues, orthodontic treatment may be initiated shortly after regeneration of the periodontal space and radiographic confirmation of the lamina dura. In our patient, active orthodontic treatment was begun six months after autotransplantation. At the end of treatment, the crown-to-root ratio of each tooth was acceptable, and the prognosis of the transplants was good.

Although the closure of our patient’s mandibular central incisor spaces prevented us from achieving canine guidance, studies of incisor space closure have found no difference in occlusal function between patients finishing with group function and those with canine guidance. Our patient also required occlusal adjustment to eliminate interferences and premature contacts of the lingual cusps of the transplanted teeth. Considering the mismatch in tooth morphology between the upper and lower arches, we believe a reasonable esthetic and functional outcome was achieved.

**Conclusion**

The addition of autotransplantation to the orthodontic armamentarium permits tooth movement to contralateral sides of the same dental arch, as well as to the opposite arch. Benefits include reestablishment of a normal alveolar process and bone induction. In young patients with missing permanent teeth, the permanent premolars are good candidates for donor teeth while still in their root-formation stage. Even if the transplant ultimately fails, the intact recipient site could subsequently be used for a dental implant.
REFERENCES


