Autotransplantation of a displaced mandibular second premolar to its normal position

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The patient was a 13-year-old Korean girl who had a displaced mandibular second premolar. She was reluctant to undergo a lengthy orthodontic treatment and opted instead for transplantation of the premolar to its usual site. On the basis of computed tomography, a replica tooth model was manufactured to shorten the extraoral time, and a root canal treatment was performed because root formation was complete. No negative signs or symptoms were found during a 3-year follow up. Autotransplantation for this patient obviated the need for orthodontic traction and prosthetic therapy. (Am J Orthod Dentofacial Orthop 2013;143:274-80)

Transposing submerged or ectopically positioned permanent teeth to their correct positions poses diagnostic as well as treatment-planning dilemmas. Although orthodontic solutions might seem to be the simplest and most successful remedies, they sometimes have unfavorable results.1

After the third molars and the maxillary canines, the most commonly impacted tooth is the mandibular second premolar, with a reported impaction incidence of 2.1% to 2.7%.2 The frequency of intrabony distal migration for this tooth is 0.25%, and it occurs more often in females than in males. Distal displacement and intrabony migration of the mandibular second premolar are idiopathic and have been reported to occur only unilaterally.3 The mechanisms that cause migration of teeth are still obscure. A tooth is considered to have migrated only after its normal eruption has been prevented and it has left its normal site of development in the bone.4 Impaction can cause damage to the roots of neighboring teeth, and the damage can be so severe that these neighboring teeth are subsequently lost. Furthermore, the tissue around these impacted teeth might undergo cystic changes. The impaction of teeth can also lead to esthetic problems.

Orthodontic treatment options for impacted and migrated second premolars include open or closed surgical exposure and subsequent alignment, which aims to bring the tooth into occlusion.5 Management of this kind is both time-consuming and expensive. Attempts to rescue a deeply impacted and migrated second premolar can also cause substantial risks to the roots of adjacent teeth.6 Sometimes, interceptive extraction of the deciduous tooth is performed to encourage spontaneous eruption, although definitive evidence to support this procedure is still lacking. Observation and monitoring of these teeth are often performed in case they are grossly misplaced, and attempts to move or remove them could cause damage to adjacent structures.7 Needless to say, extraction of these teeth is often the treatment selected, whether by the recommendation of the clinician or the patient’s own choice.8

On the other hand, autotransplantation, which was originally introduced in Scandinavian countries more than 40 years ago, involves atraumatic surgical removal of a tooth from its impacted or ectopic site, the creation of a socket at the donor site, and reimplantation of the tooth into the correct position in the alveolus.9 This procedure is generally indicated for a missing tooth with hopeless prognosis in a mouth where an appropriate donor tooth can be used without negative effects because of its loss from its position in the arch.10 The 3 main indications suggested by Zachrisson et al11 for autotransplantation of developing premolars are unevenly distributed multiple agenesis, agenesis of the mandibular second premolars in low-angle face types with normal or...
weak facial profiles, and accidentally lost or congenitally missing maxillary central and lateral incisors. The autotransplantation of developing premolars for replacement of missing teeth, especially the maxillary incisors, is a well-established procedure and has been demonstrated to have a high survival rate.\(^{12-22}\) Although the available information regarding the long-term stability of autotransplanted teeth with complete root formation is not adequate, autotransplantation is a treatment modality that has received increasing attention in recent years because of its innate advantages.\(^{23,24}\)

This clinical example presents the successful autotransplantation of the mandibular second premolar to its normal position by using computed tomography and a computer-aided rapid prototyping model, consequently obviating the need for orthodontic treatment.

**CLINICAL EXAMPLE**

The patient was a 13-year-old Korean girl with a chief complaint of an ectopic mandibular right second premolar. She was referred from a local orthodontic clinic to our hospital for interdisciplinary treatment planning. Originally, she was referred to the orthodontist from a local general dentist, who found the malpositioned permanent tooth during a routine dental examination of her retained deciduous molar with secondary caries and an apical lesion. The patient had no peculiar predental history except for the fillings in both maxillary first permanent molars. She had a retained second deciduous molar with secondary caries under a stainless steel crown. She had no orthodontic history but had good occlusion and a good facial profile. The initial panoramic radiographs (Fig 1) showed that her right second permanent premolar was located deep under the root of the mandibular right first and second molars and could not be seen intraorally.

A treatment plan was established for the patient in thorough discussions between the Departments of Orthodontics, Oral and Maxillofacial Surgery, and Conservative Dentistry at Seoul National University in Korea. It was decided that the girl would not undergo orthodontic treatment for several reasons. First, her premolar was located so far from its original position and so deep in the buccal vestibule that it would be difficult to tract the tooth, although it was not impossible. In other words, traction of the premolar might harm the roots of the adjacent teeth, and the prolonged duration of the orthodontic treatment might cause considerable resorption of the tooth.\(^{25-27}\) Second, the patient and her parent were not enthusiastic about the potentially long duration of the orthodontic treatment since they thought that the patient already had a good profile.

For these reasons, autotransplantation was chosen for the patient as an alternative treatment plan. Because her displaced premolar showed almost complete root formation, the need for a root canal treatment and the possibility of failure for this procedure was described to the patient and her parent in detail before they gave consent.

Three-dimensional computed tomography data were used to fabricate a replica graft tooth, which enhanced the preparation procedure and shortened the extraoral time of the transplant (Fig 2). The computed tomography system, Somatom Sensation 10 (Siemens, Pforzheim, Germany), was used, and the 3-dimensional model was constructed by Vworks and OnDemand3D (Cybermed, Seoul, Korea). The computed tomography protocol used for this procedure involved a slit thickness of 0.5 mm. Before the autotransplantation, the deciduous second molar was extracted, and a healing period of 3 months was allowed because of the apical lesion.

On the day of the surgery, the recipient socket was prepared with copious saline solution irrigation and surgical burs for the implant (Friadent; Dentsply, Mannheim, Germany), which was the approximate size of the replica tooth (Fig 3). After confirming the recipient socket with the replica tooth, the displaced premolar was extracted carefully. The proximal surface

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**Fig 1.** Pretreatment panoramic radiograph and intraoral radiograph. The patient had a retained second deciduous molar and a severely displaced second permanent premolar in the right side of mandible. The crown of the displaced premolar was located nearly at the mesial root of the second molar.
of the extracted premolar was contoured slightly because there were interferences of the contact points of the adjacent teeth that tilted toward the extraction site. The premolar was fitted in the prepared transplantation site (Figs 4 and 5). The external exposure time of the premolar was about 3 minutes. No additional bone graft was needed. Tight and close adaptation of the flaps was achieved by sutures. A surgical dressing was applied to protect the transplant against infection. The transplant was fixed with a wire and resin splint, and the occlusal interference was corrected.

Fig 2. Pretreatment computed tomography image and computer-aided rapid prototyping model of the mandible and the premolar. From the computed tomography data, the target section of the patient's mandible was fabricated to identify the 3-dimensional location of the premolar, and the premolar model was fabricated separately to prepare the recipient site.

Fig 3. Preparation of the recipient site. A surgical bur of the approximate size of the replica tooth was chosen for preparation. After preparation, the recipient site was checked to accommodate the replica tooth properly.
Two weeks later, the root canal treatment was initiated. On the first day of the endodontic treatment, the canal was opened, cleaned, and filled with a creamy mix of calcium hydroxide spun into the canal with a lentulo spiral (Fig 6). At the next visit, the canal was filled with gutta-percha and sealer after complete canal instrumentation (Fig 7). Restorative treatment began 2 months after the root canal treatment. A definitive restoration was made of ceramic zirconia. During the treatment period, no specific symptoms were observed, except for pain on the day of surgery.

Follow-up appointments were made at 6, 18, and 36 months after the autotransplantation procedures (Figs 8 and 9). The transplant was evaluated by radiographs, periodontal probing, and visual inspections. The transplant met the success criteria adapted from Schwartz et al., Kristerson and Lagerström, and Kugelberg et al., up to the final follow-up visit.

According to a lateral cephalogram (Fig 10) taken at the recall visit at 36 months, the tooth demonstrated clinically good occlusion, and the patient had an acceptable facial profile, although it was not perfect. Cephalometric analysis showed an SNA of 80.71°, an SNB of 79.79°, an ANB of 0.93°, a Björk sum of 395.91°, and an interincisal angle of 115.32°. The clinical
examination showed bilateral Angle Class II molar relationships and a 1-mm overbite and a 1.5-mm overjet.

DISCUSSION

In the clinical decision-making process, treatment planning should be established after considering every aspect of the resources from the clinical and basic science researchers, clinicians, and patient. In this way, the treatment will reflect patient-centered care. The questions confronting each clinician are when to apply each treatment modality and how to use these therapeutic approaches to their maximum benefit for the patient. Although our treatment planning was based on the concrete evidence, even the best evidence sometimes has different meanings to each interdisciplinary decision maker.  

Autotransplantation is a well-documented, evidence-based dental practice, and its efficiency has been internationally proven. For the patient described in this report, no other alternative treatment except orthodontics could be considered preferentially because the patient was too young to accommodate a single implant treatment. An osseointegrated implant is ankylosed to the bone; thus, it cannot follow the vertical movements of the neighboring teeth. In contrast, a transplanted tooth has a normal periodontal membrane. Therefore, it can not only erupt in synchrony with the others, but also be used in orthodontic treatment afterward. In addition, a transplanted tooth recovers its proprioceptive function, and the patient retains a natural chewing sensation. There have been numerous reports demonstrating the superiority of autotransplantation over resin-retained bridge or conventional fixed bridge treatment.

Transplantation is not usually the first line of treatment for patients with impacted teeth and should not be, because there are usually more predictable orthodontic treatments for most patients. However, transplantation could be an option in specific situations: for teeth that are markedly displaced or for patients who are reluctant to wear orthodontic appliances or undergo prolonged treatment. Other factors must be considered: adequate space for the transplant, the prognosis of the transplant, the potential for atraumatic removal, and so on. To our regret, the displaced premolar in our patient was discovered so late that its root development was complete. The pulp in fully developed transplants cannot regenerate. Therefore, we had no
choice but to perform root canal treatment. Watanabe et al.\(^{42}\) recommended that tooth transplantation should be performed before the completion of root development, since they demonstrated that the survival rate of transplants with complete root formation was inferior to that of transplants with incomplete root formation, although it was still as high as 86.8% for a mean observation time of 9.2 years. They also stated that the quality of root filling was important for the prognosis of a transplant, since inadequate root fillings were found in most failed transplants or in transplants with pathology.

Several reports have demonstrated the importance of limiting the extraoral time of donor teeth, especially mature teeth.\(^{24,43}\) Lee et al.\(^{43}\) introduced the computer-aided rapid prototyping model in autotransplantation. In addition to saving operation time, they underlined the importance of preventing unnecessary damage to a donor tooth that can occur during checking for fit in the prepared site. Honda et al.\(^{44}\) also explained the advantages of using a replica graft tooth to shorten the time of the procedure. For this reason, we used a replica tooth for our patient; this seemed to decrease the exposure time to about 3 minutes. Clear-cut segregation of the 3-dimensional donor tooth shell from the embedded jaw bone is important for the reproducibility of the model. Before surgery, the detailed position and the available bone volume of the recipient site were carefully assessed on the computer-aided rapid prototyping model of the mandible. This procedure also allowed the operator to practice real bone contouring of the recipient site before the actual surgery.

CONCLUSIONS

The treatment results for this patient indicate that autotransplantation of a displaced premolar obviated the need for orthodontic treatment, although the follow-up time was not sufficient for a definitive conclusion.

Andreasen et al.\(^{33}\) stated that autotransplantation appears to be the most biologic approach apart from orthodontic gap closure for missing teeth. Baviz.\(^{11}\) pointed out that this procedure is generally undervalued but not for good reasons. The lack of regard for autotransplantation might be due to the different experiences of dentists themselves or the biases of teachers or peers with whom orthodontists have discussed this procedure.\(^{43}\) However, autotransplantation should be considered as an option in specific cases of ectopic teeth, as shown by the clinical and experimental evidence for more than 40 years.

REFERENCES