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CASE REPORT

Autotransplantation of a maxillary first premolar to replace an ankylosed maxillary incisor: 7-year follow-up

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Abstract

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Aim To present the combined endodontic, surgical and orthodontic treatment of an autotransplanted maxillary first premolar for the replacement of an ankylosed maxillary incisor.

Summary This case report describes the autotransplantation of a maxillary premolar after the extraction of an ankylosed incisor in a 13-year-old boy. To allow better adaptation of the donor tooth, the buccal root of the first premolar was removed using a diamond bur and the denuded root site was filled with acid-etched composite resin. The palatal root canal was dressed with calcium hydroxide for 2 months before filling with gutta-percha. Autotransplantation of a remodelled maxillary first premolar was achieved to substitute for the ankylosed maxillary central incisor. Orthodontic treatment was performed to correct an Angle Class II malocclusion. Seven years after root canal treatment, the autotransplanted tooth and supporting tissues appeared healthy both clinically and radiographically and were functioning well.

Key learning points

• Autotransplantation is a viable option for the treatment of a missing tooth or for the replacement of a traumatized tooth when there is a donor tooth available.

• Autotransplantation of a premolar for replacement of a missing anterior tooth is sometimes a suitable alternative to conventional prosthetic rehabilitation or implant treatment in young individuals.

• Proper combined endodontic and orthodontic treatment of autotransplanted teeth might be possible without periodontal complications.

Keywords: ankylosis, autotransplantation, endodontic surgery, orthodontics, root canal treatment.

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Introduction

Autotransplantation has its applications in the repositioning of malpositioned teeth and in substitution for missing teeth (Slagsvold & Bjercke 1978). Autotransplantation is defined as the transplantation of teeth from one site to another in the same individual into extraction sockets or surgically prepared sites (Natiella *et al.* 1970). The prognosis of successful autotransplantation is influenced by a number of preoperative and postoperative factors including root development, position of the tooth and surgical technique (Schwartz *et al.* 1985, Lundberg & Isaksson 1996). Careful manipulation of the donor tooth and recipient site under favourable preoperative, surgical and postoperative conditions ensures survival of the cells of the periodontal ligament and promotes the reformation of a normal supporting apparatus. Recent advances in procedures and materials have resulted in the development of autotransplantation for the treatment of missing teeth. At present, autotransplantation is advised for a suitable alternative to conventional prosthetic rehabilitation or implant treatment (Mejare *et al.* 2004, Teixeira *et al.* 2006).

Autotransplantation of premolars to replace missing teeth in young individuals has been shown to be a predictable substitution method with potential for bone induction and reestablishment of a normal alveolar process (Czochrowska *et al.* 2002). The most successful procedure involves transplanting premolars before the root is fully formed. This way, pulp revascularization and health can be preserved, and the tooth retains the potential to erupt and induce alveolar bone growth (Czochrowska *et al.* 2000). Kristerson (1985) and Andreasen *et al.* (1990) showed the importance of transplanting premolars at a certain root formation stage to obtain an optimal prognosis of the transplants. In the period between the ages of 8 and 16 years, many patients have potential substitutes for any tooth in premolars for extraction in spite of the absence of teeth, premolars are the main source of transplants for the replacement of missing teeth. Successful case reports on premolar transplantation to the maxillary incisors have been presented in young individuals (Slagsvold & Bjercke 1978, Stenvik & Zachrisson 1993, Paulsen *et al.* 1995, Czochrowska *et al.* 2000, 2002, Mendoza Mendoza *et al.* 2010).

However, no previous reports have been made concerning the possible effect of surgical endodontic procedures upon autotransplanted premolars. The case presented here reports the successful autotransplantation of a developing first premolar that required non-surgical and surgical interventions for tooth adaptation and addresses the aesthetic issues involved in the remodelling of this tooth to resemble incisor morphology.

Case report

A 13-year-old boy was referred to the Endodontic Department at Nihon University School of Dentistry by the orthodontic department for evaluation of an ankylosed maxillary central incisor (tooth 21). The medical history was non-contributory. The patient's dental history revealed a traumatic injury as a result of a fall 4 years previously. Soon after the accident, he had been to a general dentist for emergency care where tooth 21 was replanted and splinted. Clinical examination revealed that tooth 21 was tilted lingually in position. The surrounding soft tissue was healthy and intact (Fig. 1). Orthodontic treatment planning was carried out in consultation with an orthodontist regarding the ankylosed tooth 21. Pre-treatment facial photographs revealed a symmetric facial pattern with a convex soft tissue profile. The patient had an Angle Class II malocclusion with 4 mm of overbite and 7 mm of overjet. Periradicular radiographic examination of tooth 21 revealed a root filling and severe replacement root resorption (Fig. 2). The patient was informed about the ankylosed tooth and extraction was advised. Clinically and radiographically, the maxillary



Figure 1 Preoperative intra-oral view of the ankylosed tooth 21.



Figure 2 Preoperative radiograph of tooth 21 showing broad root canal filling and severe replacement root resorption.

first premolar (tooth 24) was completely erupted and positioned within the dental arch, making it possible for tooth autotransplantation (Figs 3 and 4). Thereafter, pre-application of orthodontic forces was applied to both teeth 21 and 24 for 4 weeks.

In the present surgical procedure, autotransplantation was performed in a one-stage operation (Nethander *et al.* 2003). First, the ankylosed tooth 21 was removed with an elevator and the socket was irrigated with normal saline solution (Figs 5 and 6). The first premolar was then carefully extracted (Figs 7 and 8) and positioned into the recipient site to check its adaptation. Because of differences in root shape, the buccal root was removed with a high-speed turbine using copious water. The premolar was held gently by



Figure 3 Preoperative palatal view of the maxillary first premolar.



Figure 4 Preoperative radiograph of the first premolar.

the crown with wet gauze during the procedure. The denuded root site was then filled with composite resin (Fig. 9). Before transplantation, the blood clot was aspirated from the socket, and the replanted tooth was rinsed with saline to remove all debris. The transplanted premolar was seated in the recipient site with firm finger pressure and secured with an orthodontic appliance (0.016-inch stainless steel arch wire) (Figs 10 and 11). The patient was seen 1 week after operation for a postoperative check-up and suture removed. The replanted tooth was splinted to adjacent teeth for 3 weeks. Root canal treatment was performed within 2 weeks of transplantation. Under rubber dam isolation, working length was established and chemomechanical preparation performed with 2.6% sodium hypochlorite solution as the irrigant. After drying the root canal with paper points, a calcium hydroxide paste was applied and the access cavity temporarily sealed with Cavit (3M ESPE, Seefeld, Germany). The patient returned after 2 months, the calcium hydroxide paste was removed and the root canal was filled with gutta-percha and zinc oxide-eugenol sealer (Canals; Showa Yakuhin, Tokyo, Japan) using lateral condensation. A postoperative radiograph was taken (Fig. 12). Further orthodontic treatment was commenced 6 months after transplantation. Two years after transplantation, an acrylic resin crown was made on the transplanted premolar. The total period of active orthodontic treatment was 2 years and 6 months. The patient was recalled for periodic check-ups and healing was uneventful (Figs 13 and 14). Approximately 6 years after transplantation, the transplanted tooth was restored with a full-coverage crown. The recall examination after 7 years revealed asymptomatic and healthy periodontal conditions (Figs 15 and 16).



Figure 5 The extracted ankylosed tooth 21.



Figure 6 Buccal view of the extraction socket.

Discussion

The ankylosed tooth 21 was planned for extraction to solve the orthodontic problems. The space of missing anterior tooth is traditionally solved by prosthetic substitution. Such an approach can be functionally and aesthetically acceptable. However, in a long-term perspective, prosthetic substitution is not an ideal solution to the problem of missing anterior tooth, particular in young individuals. Recently, single-standing implants have been found to be a reliable substitute for missing teeth. However, because of osseous integration, jaw growth could be disturbed if the implants are placed before termination of alveolar growth. The suitable vision is substitution by autotransplantation (Paulsen *et al.* 1995). Slagsvold & Bjercke (1978) suggested that premolars are particularly suitable for



Figure 7 Buccal view of the transplanted tooth.



Figure 8 The extracted first premolar with two roots.



Figure 9 Buccal root was removed and filled with composite resin.



Figure 10 Transplanted tooth was splinted to adjacent teeth with wire.

autotransplantation to the maxillary anterior region as they are available in the younger patients. The crucial questions are whether transplanted teeth become and remain healthy and functional, and to what extent suitable transplants are available. In the present case, autotransplantation combined with orthodontic treatment was considered the treatment alternative for the ankylosed anterior tooth.

From a combined treatment viewpoint, it emphasizes that there must be a close relationship between specialists and that consultations and specific planning for treatment modalities must be considered carefully. The transplant was removed from the maxillary premolar positions, because orthodontic treatment planning commonly included extractions in the maxillary arch to reduce arch length or relieve crowding. Maxillary first



Figure 11 Radiograph taken immediately after transplantation.



Figure 12 Radiograph taken 2 weeks after root canal filling.





Figure 14 Two-year follow-up clinical view during orthodontic treatment.

premolars are often the choice for extraction in patients who have an Angle Class II division 1 malocclusion. Unlike other organ transplants, tooth transplant requires size compatibility between the transplanted tooth and recipient site. In this case, the first premolar had one buccal and one palatal roots. Thus, extraoral removal of the buccal root was performed to achieve adaptation to the narrower recipient site. Root removal was a less invasive and quicker than modification of the recipient bone site (Tsurumachi & Kakehashi 2007). On the other hand, the denuded root surface was expected to be subject to ankylosis or root resorption because of the lack of periodontal membrane (Andreasen 1981b). Optimal contact of the autotransplanted tooth with the alveolar bone of the recipient site may provide better blood supply and adequate nutrition to the periodontal ligament cells and may be one of the most important factors for a successful prognosis (Nethander *et al.* 2003, Kallu *et al.* 2005). Inadequate single root width of the second premolar made it necessary to prepare for the transplant factors by removing the



Figure 15 Seven-year follow-up radiograph of transplanted tooth.

cancellous intracortical bone with bone burs. The most relevant complications in autotransplantation of teeth are inflammatory or replacement resorption. Inflammatory resorption could lead to tooth loss without proper endodontic treatment. Replaced tooth ankylosis is visible on radiographic examination as disappearance of periodontal membrane space, with or without resorption of the root, and clinically as a high metallic sound with the percussion test. This complication, although considered untreatable, can be symptomless, and the tooth can function normally for many years, often 10–15 years. It could disturb jaw growth if alveolar growth is not complete. However, if not present within the first 2 years after transplantation, this complication seems to occur infrequently (Schwartz *et al.* 1985). Fortunately, ankylotic and root resorptive symptoms were not observed clinically or radiographically 7 years after the transplantation; this seems to indicate a good long-term prognosis. The presence of intact and viable periodontal ligament cells and good tissue adaptation on the palatal root surface is the critical factor that determines a successful tooth transplant (Andreasen 1981a, Lee *et al.* 2001, Tsukiboshi 2002).

After the removal of the buccal root, root canal treatment was essential and calcium hydroxide medication was employed before the gutta-percha filling was placed. The critical factor for inflammatory root resorption after transplantation is the presence of an infected root canal system. The use of a calcium hydroxide medication is expected to favour bone repair and inhibit root resorption because of its high pH, providing an antimicrobial effect and stimulating the healing process (Byström *et al.* 1985, Siqueira & Lopes 1999). Also, long-term root canal treatment with calcium hydroxide is the method of choice in preventing and treating inflammatory resorption (Tronstad 1988). Therefore, the combination of chemomechanical instrumentation and the use of calcium hydroxide appear to have been sufficient.

Autotransplantation of teeth has evolved as an accepted treatment option in orthodontics over the last 3 or 4 decades (Slagsvold & Bjercke 1978, Andreasen et al.



Figure 16 Postoperative intra-oral buccal and lateral views 7 years after transplantation.

1990, Stenvik & Zachrisson 1993, Paulsen *et al.* 1995, Czochrowska *et al.* 2000, 2002). These studies defined the protocol, the proper technique, and many peripheral considerations of autogenous tooth transplants. In this case, pre-application of orthodontic forces may provide better moving to the ankylosed tooth and ease the extraction. Also, the application of jiggling force on the transplanted tooth may ease the extraction and reduce root resorption after autotransplantation (Suzaki *et al.* 2008). The orthodontic movement of the transplanted tooth can optimize the position before restoring the crown and at same time be used to level the hard and soft periodontal tissues.

Conclusions

This case demonstrates that autotransplantation of a maxillary premolar may provide the potential to replace an ankylosed anterior tooth with a natural tooth instead of a prosthesis or osseointegrated implant even following the removal of the buccal root. At a 7-year follow-up, the transplanted first premolar was clinically healthy and continued to satisfy aesthetic and functional demands.

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