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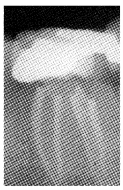

CASE REPORT

Autogenous transplantation of teeth with complete root formation: two case reports

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Abstract

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Aim Autotransplantation is an alternative treatment for replacing lost teeth when suitable donor teeth are available. This paper presents two cases of successful autogenous tooth transplantation.

Summary Two third molars with complete root development were autogenously transplanted from their original sockets into new recipient sites on the same side of the mouth, one in the maxilla and one in the mandible. In both cases, the third molars were transplanted immediately after the first molar extractions. To provide better adaptation of the donor teeth, the recipient alveolar sites were remodelled using surgical burs. Semi-rigid splints were maintained for 45 and 15 days, respectively. Root canal treatment commenced one a week after transplantation and the canals were medicated with a calcium hydroxide paste before they were filled. Clinical and radiographic findings after 5 and 3 years of follow-up, respectively, are discussed in relation to the literature.

Key learning points

- Autogenous transplantation of teeth with complete root formation may be considered as a viable treatment option to conventional prosthetic and implant rehabilitation for both therapeutic and economic reasons.
- Careful surgical and endodontic procedure, together with careful case selection may lead to satisfactory aesthetic and functional outcomes.

Keywords: autogenous tooth transplantation, autotransplantation, third molar.

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Introduction

Autogenous tooth transplantation or dental autotransplantation may be defined as the transplantation of teeth from one site to another in the same individual. The recipient site may be an extraction socket or surgically prepared site (Natiella *et al.* 1970).

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Autogenous tooth transplantation is advised generally for the replacement of teeth lost prematurely due to trauma, caries or periodontal disease (Thomas *et al.* 1998, Clokie *et al.* 2001, Mendes & Rocha 2004). Transplants may also be indicated in hypodontia and tooth loss due to cervical root fracture or apical periodontitis (Kahnberg 1987, Clokie *et al.* 2001).

Successful autotransplantation was first reported in the early 1950s (Miller 1951) and careful planning together with appropriate surgical technique can result in high levels of success (Kahnberg 1987, Andreasen *et al.* 1990, Nethander 1994, Lundberg & Isaksson 1996, Mejare *et al.* 2004, Kim *et al.* 2005). In very young patients, autotransplantation may allow osseous development to continue by avoiding alveolar bone resorption, and provide proprioceptive stimulation (Thomas *et al.* 1998). Teeth with one-third to three-quarter root formation are most frequently transplanted, though transplantation of teeth with complete root formation is well recognized (Mendes & Rocha 2004). Transplantation of mature teeth enjoys high levels of success and may be a viable treatment option in the absence of other suitable donor teeth (Lundberg & Isaksson 1996, Mejare *et al.* 2004).

The purpose of this article is to report two cases of successful autogenous transplantation of teeth with complete root formation. Clinical and radiographic post-transplantation findings are discussed in relation to the literature.

Reports

Case 1

A healthy 25-year-old Caucasian male was referred for dental treatment. Tooth 26 was grossly carious involving the furcation area with associated periodontal breakdown. The tooth was non-responsive to hot and cold pulp sensitivity tests. Periapical radiographs confirmed the clinical impression of an unrestorable tooth (Fig. 1). Apical periodontitis was evident, suggesting pulp necrosis and extraction was indicated. The same examinations showed that tooth 28 was healthy, amenable to root canal treatment, completely erupted and well positioned within the dental arch, making it suitable for tooth autotransplantation. The steps, benefits and risks of the technique were explained to the patient, who provided written informed consent for treatment.

As tooth 26 was infected, with apical periodontitis, prophylactic antibiotics (Amoxicillin 500 mg every 6 h) were initiated 48 h before surgery and maintained for 7 days after the intervention. Analgesic (Dipyrone/Metamizole, Boehringer Ingelheim do Brasil Química e

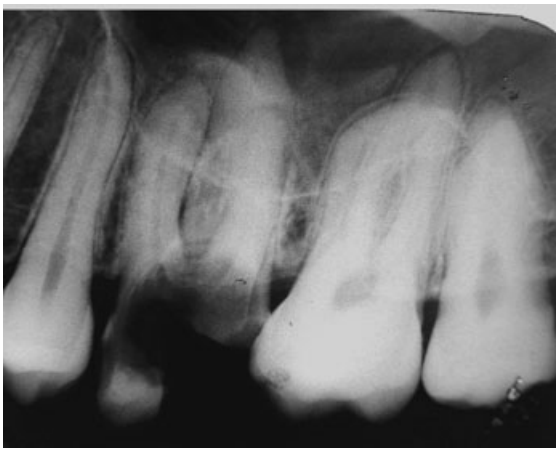

Figure 1 Initial periapical radiograph of case 1. Tooth 26 with an extensive carious lesion reaching the furcation area and apical periodontitis. Tooth 28 was healthy, completely erupted and well-positioned.

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Farmacêutica, São Paulo, Brazil; 500 mg, 4/4 h) and anti-inflammatory drugs (Diclofenac potassium, Novartis Biociências S.A., São Paulo, Brazil; 50 mg 6/6 h) were prescribed for post-operative pain.

The surgical procedures were as follows: tooth 28 remained in its original socket until complete removal of tooth 26. The socket of tooth 26 was curetted for removal of granulation tissue (Fig. 1). Tooth 28 was then carefully extracted with periotomes and positioned into the recipient site to check its adaptation. Because of differences in root shape and length, tooth 28 was re-positioned back in its original socket and the recipient site was prepared with a round implant bur (centre punch bur, size 3 mm; Degussa, Dusseldorf, Germany). After adequate adaptation of tooth 28 into the recipient site, a semi-rigid splint was made with a 0.9 mm thick nylon thread and light-cured composite resin, fixing the tooth to the adjacent teeth. Surgical cement dressing (Perio Bond Dentsply, Petrópolis, Brazil) was placed on the buccal and palatal surfaces to improve early stability of the transplanted tooth. The post-surgical course was uneventful, and after 1 week, root canal treatment was initiated (Fig. 2). All endodontic procedures were carried out under a rubber dam and a strict aseptic technique. Fifteen days after the surgical procedure, the root canals were chemomechanically prepared and a calcium hydroxide intracanal dressing was placed. At the same appointment, the surgical cement was removed, but the semi-rigid splint was maintained. Forty-five days after transplantation, the splint was removed and the root canal treatment was completed (Fig. 3).

Figure 2 Control radiograph taken 1 week after autotransplantation. Root treatment initiated.

Figure 3 Final radiograph taken after the endodontic treatment was completed.

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Figure 4 Control radiograph taken $5\frac{1}{2}$ years after autotransplantation. Observe the preservation of periodontal ligament and no signs of external root resorption. Comparison with **Fig. 3** reveals reduction of the diastema between the transplanted tooth and the adjacent maxillary second premolar.

Figure 5 Clinical appearance of the autogenously transplanted maxillary third molar $5\frac{1}{2}$ years after surgery. Notice gingival and periodontal health.

Radiographic review was performed every 3 months for the first year and annually afterwards. Figures 4 and 5, respectively, show the radiographic and clinical conditions of the autotransplanted third molar $5\frac{1}{2}$ years after transplantation. Comparison of Figs 3 and 4 shows reduction of the diastema between the transplanted tooth and the adjacent maxillary second premolar. The tooth was in normal occlusion, with physiological mobility and masticatory function. Periodontal probing revealed no pockets or other pathological signs, and the patient was symptom-free.

Case 2

A healthy 21-year-old Caucasian male was referred for dental treatment. Tooth 36 had extensive caries reaching the furcation area with periodontal involvement and was non-responsive to thermal pulp testing. The patient reported pain during mastication. A periapical radiograph confirmed an unrestorable tooth with apical periodontitis (Fig. 6) and extraction was indicated. Clinically and radiographically, tooth 38 was sound, completely

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Figure 6 Initial periapical radiograph of case 2. Tooth 36 had an extensive carious lesion, reaching the furcation area and apical periodontitis. Tooth 38 was healthy, completely erupted and well-positioned.

erupted and amenable to root canal treatment, making it suitable for transplantation. Informed consent was secured and clinical management conducted as in case 1.

In this case, the autotransplanted tooth presented excellent stability in the bur-prepared socket and was fixed with a nylon and light-cured composite resin splint, as previously. The post-operative course was uneventful and root canal treatment was initiated 1 week post-operatively. Fifteen days after the autotransplantation, the semi-rigid splint was removed and the root canals were chemomechanically prepared and filled with a calcium hydroxide paste (Fig. 7a). The intracanal medication was maintained for a longer period because of the extensive radiolucency in the furcation area. Three months after transplantation, a radiograph revealed some areas suggestive of external root resorption. Therefore, in spite of new bone formation (Fig. 7b), the calcium hydroxide dressing was changed and maintained for an additional 3 months. Thereafter, the root canal treatment was concluded (Fig. 8a).

Figures 7(a,b) and 8(a,b) show the radiographic and clinical appearance of the autogenously transplanted tooth 6 months and 3 years after surgery, respectively. Although signs of ankylosis (Fig. 7b) could still be seen in the 3-year radiograph, the external resorption was stable or progressing slowly. Clinically, the tooth showed no sensitivity to percussion and presented normal occlusion, periodontal conditions and masticatory function (Fig. 9).

Figure 7 (a) Radiographic image 15 days after transplantation. The semi-rigid splint was removed, the root canals were chemomechanically prepared and filled with a calcium hydroxide dressing. (b) Control radiograph taken 3 months after transplantation, revealed several areas suggestive of external root resorption. Despite new bone (arrows), the calcium hydroxide intracanal medication was changed and maintained for an additional 3 months.

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Figure 8 (a) Six months after autotransplantation, bone repair was observed in the furcation area and the root canals were obturated. Resorption areas were observed on the mesial root of the autotransplanted mandibular third molar (arrows). (b) Control radiograph taken 3 years after transplantation. Despite the signs of ankylosis, external root resorption seemed to be stabilized or progressing slowly.

Figure 9 Clinical appearance of case 2, 3 years after transplantation. Clinically, the tooth showed no sensitivity to percussion and presented normal occlusion, periodontal conditions and masticatory function.

Discussion

Careful planning is essential for successful autotransplantation. The donor tooth and recipient site should be examined with care to ensure adequate fit and that root canal treatment is possible (Clokie *et al.* 2001). The patients reported were compliant with pre-operative and post-operative directions, and were young, although this apparently has no impact on the final outcome (Nethander 1994). Most cases of autogenous tooth transplants reported in literature have, however, involved young individuals (Pogrel 1987, Andreasen *et al.* 1990, Lundberg & Isaksson 1996, Bauss *et al.* 2002).

The recipient sites had adequate bony support in all dimensions and sufficient keratinized mucosa to enhance post-operative stability (Clokie *et al.* 2001). The teeth to be transplanted had uncomplicated and atraumatic extractions, which minimized damage to the periodontal ligament and cementum. This is one of the most important factors for a successful prognosis. Teeth with accentuated root curvatures and other anomalies of form or position are generally contraindicated for transplantation because there is an increased risk of damage to the periodontal ligament during the extraction (Cohen *et al.* 1995). Indeed, teeth in which root canal treatment will be impossible or compromised are not good candidates (Kahnberg 1987).

Preservation of healthy periodontal ligament cells defines the healing pattern of the autotransplanted tooth (Andreasen 1981, Kim *et al.* 2005). Increased extra-alveolar time of

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the donor tooth affects significantly the viability of periodontal ligament cells and may lead to unfavourable results, such as periradicular inflammation and root resorption (Hupp *et al.* 1998). In both cases reported in this article, the extra-alveolar time of the transplanted teeth was kept to a minimum as they remained in their original sockets during extraction of the first molars and preparation of the recipient sites. Kim *et al.* (2005) analysing the prognosis and causes of failure in 182 cases of autogenous tooth transplantation, reported 4.5% of failures, but did not find statistical correlation between extra-alveolar periods of up to 25 min and occurrence of external inflammatory resorption or ankylosis.

Another important factor for a successful autotransplantation is proper adaptation between the root surface of the transplanted tooth and the bony walls of the recipient site. In both cases presented in this paper, the recipient socket was remodelled with surgical burs under sterile saline irrigation to obtain adequate depth and width, which has been reported to improve case prognosis (Mejare *et al.* 2004). Close contact of the autotransplanted tooth with the alveolar bone of the recipient site might provide better blood supply and adequate nutrition to the periodontal ligament cells, thereby increasing the number of viable cells (Kallu *et al.* 2005). In case 1, the transplanted tooth was poorly adapted to the recipient site and exhibited great mobility, which demanded a longer period of semi-rigid splinting (45 days). Even so, wound healing and absence of clinical signs of ankylosis or sensitivity to percussion were confirmed clinically and radiographically at all follow-up visits. Control radiographs suggested the presence of periodontal ligament along almost the whole root surface and absence of radiolucent areas associated with the roots of the autotransplanted tooth (Fig. 4).

In case 2 on the other hand, despite the greater stability of the donor tooth in the recipient site, the control radiographs provided evidence of ankylosis and external resorption (Figs 7 and 8). Nevertheless, the clinical percussion test did not produce the characteristic metallic sound of an ankylosed tooth. In this case, it may be assumed that the resorption areas stemmed from periodontal ligament damage during extraction or during attempts to adapt the donor tooth into the recipient site. While intimate contact of the transplanted tooth with the bone of the recipient site can be beneficial for blood supply, a contact with excess pressure could injure the periodontal ligament. It is well-known that excessive pressure, as occurs in intrusive luxation may promote root resorption in some areas due to irreversible damage to the periodontal ligament (Tronstad 1988).

A semi-rigid splint was used in the present cases. The nylon-composite resin splints provided the necessary stability but also adequate mobility to reduce the probability of ankylosis. Periodontal ligament cell activity and bone repair are stimulated when the functional movements of the transplanted tooth are preserved (Pohl *et al.* 2000). Moreover, the duration of splinting may positively influence the prognosis of the transplantation procedure. Most studies advise the use of flexible splints for 7–10 days and, in many cases, a suture across the occlusal surface is enough for stabilizing the transplanted tooth (Bauss *et al.* 2005).

The American Association of Endodontists recommends that teeth with closed apexes have their pulps extirpated between 7 and 14 days after transplantation (Cohen *et al.* 1995) to avoid the infected necrotic pulp inducing inflammatory resorption and early loss (Cohen *et al.* 1995, Mejare *et al.* 2004, Mendes & Rocha 2004). This seems to be justified by the fact that only 15% of teeth with complete root development are revitalized after transplantation, in contrast with 96% of teeth with incomplete root formation (Andreasen *et al.* 1990).

In the reported cases, pulp tissues were extirpated 1 week after transplantation, with the subsequent placement of a calcium hydroxide dressing. The use of a calcium hydroxide medication is expected to favour bone repair and inhibit root resorption (Gregoriou *et al.* 1994) due to its high pH, providing an antimicrobial effect and stimulating the healing process (Tronstad *et al.* 1980, Estrela *et al.* 1995, Felippe *et al.* 2005). The

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alkaline environment stimulates the action of alkaline phosphatase and subsequent hard tissue deposition around the tooth. Some authors have recommended that a calcium hydroxide intracanal dressing should remain in place for 3–6 months, after which the endodontic procedure is concluded (Nethander 1994, Clokie *et al.* 2001). In case 2, the calcium hydroxide dressing was maintained for an extended period because of the furcal radiolucency and signs of external root resorption. This procedure may have allowed arrest or stabilization of the resorption process, as observed in the 3-year control radiograph (Fig. 8b), thus increasing the chances of greater longevity.

The literature suggested that transplantation of teeth with complete roots is highly successful. Lundberg & Isaksson (1996), in a follow-up study of 278 autotransplanted teeth concluded that this was a reliable method with a good prognosis for donor teeth with both open and closed apices. Higher percentages of loss were however noted in transplanted teeth with complete root development.

In both cases, clinical and radiographic outcomes were considered satisfactory, despite the evidence of resorption in case 2. It is important to highlight that in this type of pathology, the rate of root replacement by bone may vary and the resorption process is generally slow. It may take years or even decades for the root to be completely replaced (Tronstad 1988). In spite of this, the benefits and potential risks involved in autogenous tooth transplantation should be fully explained to patients before a decision is made. The patients in these case reports were aware of the possibility of losing the transplanted teeth after some time and both were satisfied with the results.

Autotransplantation is not a common procedure in clinical dental practice, but should be considered as a viable alternative to conventional prosthetic and implant rehabilitation from both therapeutic and economic standpoints. It is a relatively simple procedure with high success rates (Kahnberg 1987, Andreasen *et al.* 1990, Nethander 1994, Lundberg & Isaksson 1996). Although its long-term prognosis is not predictable, autogenous transplantation of teeth with both complete and incomplete root formation appears to be a sound treatment option for replacement of a lost or hopeless tooth, usually providing satisfactory clinical, aesthetic and functional outcomes. In addition, autotransplanted teeth can preserve the amount and quality of alveolar bone, thus permitting later insertion of a metallic implant, if this should be necessary.

Conclusions

- Autogenous transplantation of teeth with complete root formation may be considered as a viable treatment option to conventional prosthetic and implant rehabilitation for both therapeutic and economic reasons.
- Careful surgical and endodontic procedures, together with careful case selection may lead to satisfactory aesthetic and functional outcomes.

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