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Root formation of an autotransplanted tooth

CASE REPORT

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Abstract – Traumatic injuries with loss of anterior teeth occur more frequently in children. Treatment of the dental trauma is complex and requires a comprehensive and accurate diagnostic and treatment plan. It is also important to consider the biological, functional, esthetic, and economic aspects. The purpose of this article is to show a case report with a successful root formation and periodontal healing after autotransplantation of maxillary second right premolar in place of maxillary right central incisor site. Tooth autotransplantation may be considered as a viable treatment option instead of a conventional prosthetic and implant rehabilitation.

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Most traumatic injuries with accidental loss of maxillary incisors occur in children between 7 and 10 years of age. At this age, the alveolar bone growth is not yet complete thus becoming a difficult problem to solve in the future treatment. Autotransplantation of immature premolars is a viable method of restoring edentulous areas in patients whose alveolar growth is not complete. This method provides the potential to replace a missing tooth with a natural tooth instead of a prosthesis or osseointegrated implant (1).

Autotransplantation is the term that is usually used to describe moving teeth surgically from one site to another in the same individual (2).

The three main indications for autotransplantation of developing premolars are unevenly distributed multiple agenesis, agenesis of the mandibular second premolars in low-angle facial types with normal or weak facial profiles, and accidentally lost or congenitally missing maxillary central and lateral incisors (3).

The optimal time and successful for autotransplantation of premolars to the maxillary anterior is when the root development has reached two-thirds to three-fourths of final root length, wide open apices and a careful surgical technique that preserves the periodontal ligament (4–6). The recipient alveolar bone area must be cut 1–2 mm larger and deeper than the measurements of the donor root to preserve the periodontal ligament (6) and optimal contact with the recipient site can improve the blood supply and the level of nutrition to the periodontal ligament cells, which can increase the success rate of autotransplantation (7).

Autotransplantation may be performed in an immediate or delayed approach. Immediate approach is used when the recipient site is free of pathologic processes. If a tooth in this region is abscessing or contributing to periodontal problems, it should be removed and enough time given for the area, especially the soft tissues, to become healthy. Use of antibiotics is necessary only when local problems have not been satisfactorily eradicated prior to the transplantation procedure, or when specifically indicated for particular systemic problems (8); then a delayed approach can be performed. First, the surgeon prepares the recipient site, thus making it healthy to receive the donor teeth. Then, the transplant surgery is performed.

The challenge to perform the autotransplantation of premolars to anterior site may be a realistic alternative for replacement of missing maxillary incisors.

Case report

A 10-year-old boy was referred to orthodontic consultation after upper right central incisor replantation failure (Fig. 1). This tooth was replanted 8 h after a domestic accident. After 9 months, the tooth showed a fistula (Fig. 1b) and extensive root resorption (Fig. 1c) suggesting replantation failure and hence its extraction was performed. Panoramic and periapical radiography (Fig. 1c, d) showed incomplete root formation of second

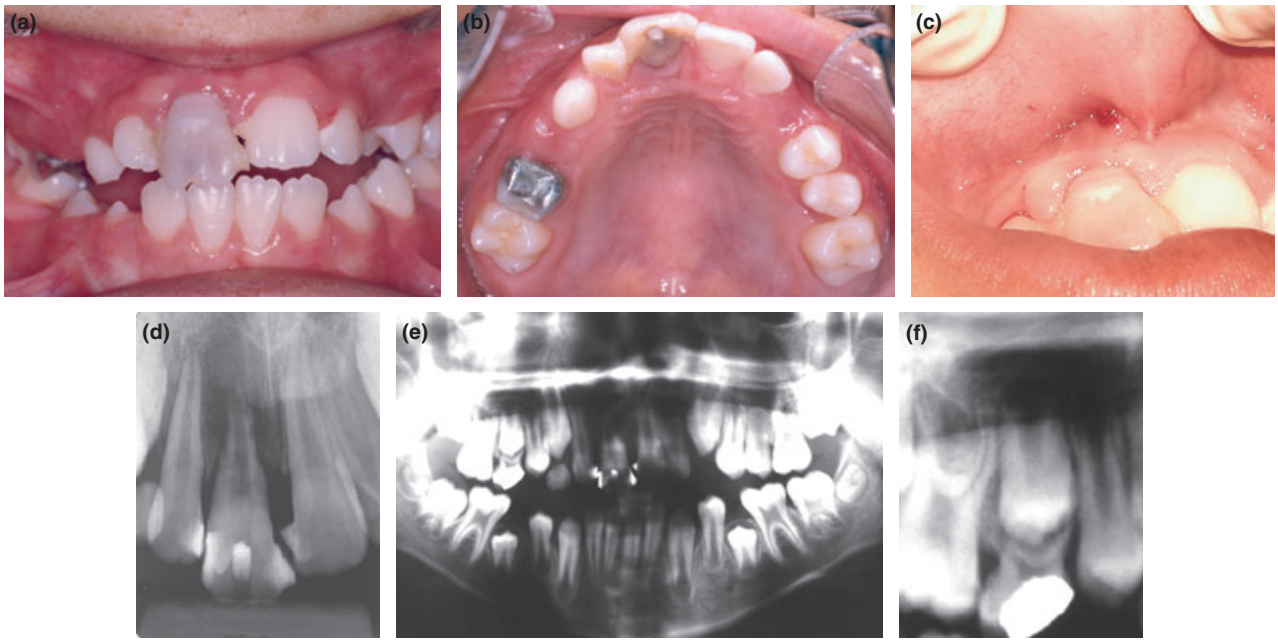

Fig. 1. Intra-oral view of replantation failure of maxillary right central incisor (a, b), fistula (c), intra-oral radiography showing root resorption of injured tooth (d). Incomplete root formation of second right premolar (e, f).

upper right premolar, making it suitable for tooth autotransplantation.

The treatment options for this case were (1) tooth autotransplantation, (2) total orthodontic space closure, followed by prosthodontic modification of the lateral incisors to simulate the central incisors, and (3) space maintenance with a prosthetic bridge for a future implant replacement. Implants at this age were contraindicated.

The treatment plan, accepted by parents, was the autotransplantation. Steps, benefits and risks of the technique were explained to the patient and parents, who provided written informed consent for treatment.

Because of apical infection, delayed approach autotransplantation was chosen. First, prophylactic systematic antibiotics were initiated 48 h before surgery and maintained for 7 days after the intervention. The upper right central incisor was extracted (Fig. 2a, b, d), and the socket was curetted for removal of granulation tissue (Fig. 2c). Two weeks later (Fig. 2a–c), the recipient socket was prepared a little larger than the donor tooth using surgical round bars at low speed and cooling with saline. Maxillary right deciduous second molar and upper right second premolar was then carefully extracted with periotomes (Fig. 3c, d) and then correctly positioned into the recipient site (Fig. 3e, f); the tooth splinting was made with gingival flaps sutures (Fig. 3g). No endodontic treatment had been performed.

Figures 4 and 5 shows the radiographic and clinical appearance of the autogenously transplanted tooth at 6, 18, 30, and 36 months after surgery, showing the success of root formation and periodontal healing. Orthodontic treatment was indicated (9) as shown in Fig. 6. Then the premolar composite was reshaped into central incisor (Fig. 6a–c). Periapical radiograph of the final result, after 40 months follow up, shows pulpal, periodontal healing, and complete root development (Fig. 6d).

Discussion

It is clear that children undergo marked alveolar resorption following loss of a permanent maxillary incisor. Reduction in alveolar bone mass may then have considerable impact on future treatment options. Implants, resin bonded bridges and dentures all require adequate bone mass for the successful and esthetic replacement of missing anterior teeth (10).

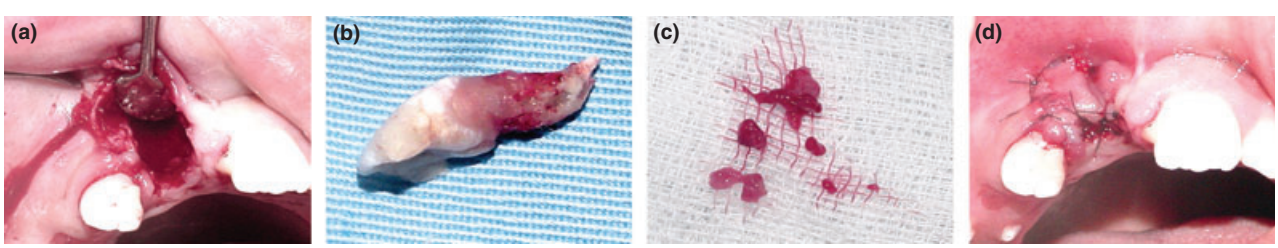

Fig. 2. First surgical step. Extraction site (a), tooth with extensive root resorption (b) of maxillary right central incisor. (c) Curetted granulation tissue. (d) Suture of recipient site.

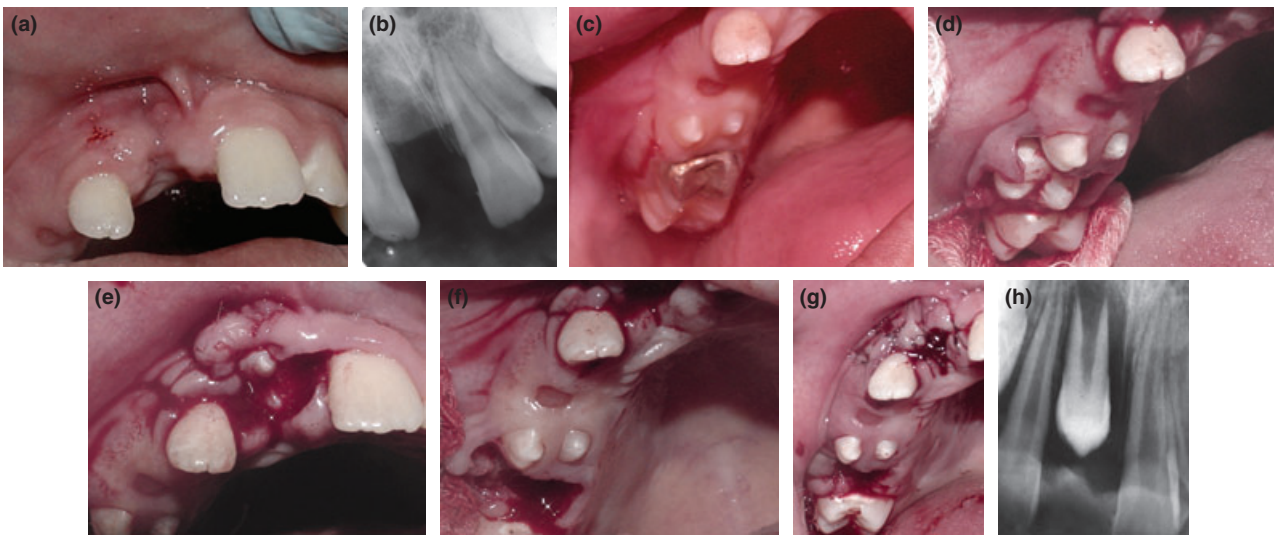

Fig. 3. Second surgical step. (a) Two weeks after extraction of central incisor. (b) Intra-oral radiograph of the recipient site. (c, d) Maxillary right deciduous second molar and premolar extraction. (e, f) Donor tooth in the recipient site. (g) Tooth splinting by gingival flaps sutures. (h) Immediate intra-oral radiography of autotransplanted tooth.

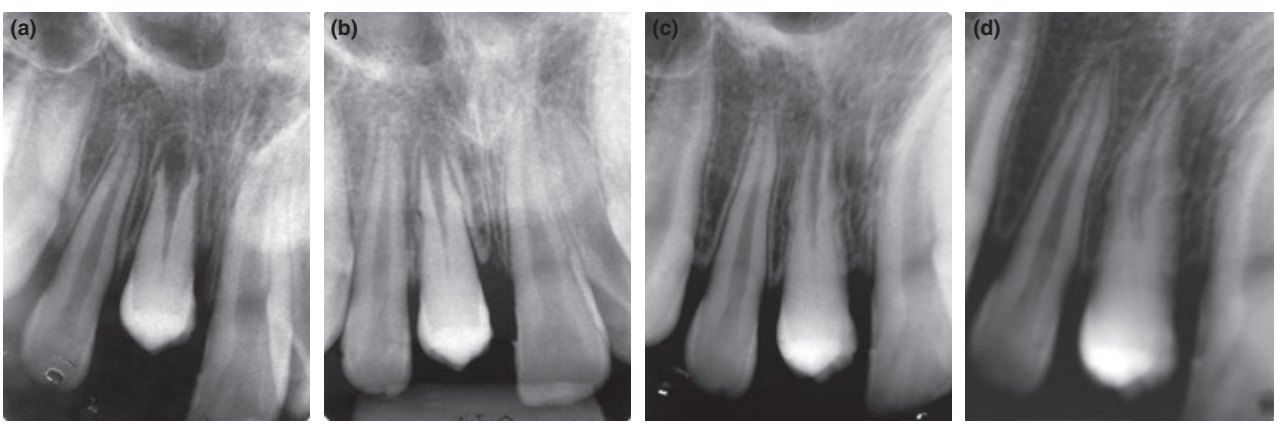

Fig. 4. Intra-oral radiograph taken (a) 6 months, (b) 18 months, (c) 30 months, (d) 36 months, postsurgery. No signs of root resorption in the autotransplanted tooth.

Fig. 5. Intra-oral photograph after 36 months follow up. (a) Frontal view, (b) close up view, (c) occlusal view.

Total orthodontic space closure followed by prosthodontic modification of the lateral incisors to simulate the central incisors dictates that lateral incisors take over the functional and esthetic role of central incisors; the canines assume the same for the lateral incisors and the first premolars that for the canines, with all the prosthetic camouflage that such positional alterations entail (11).

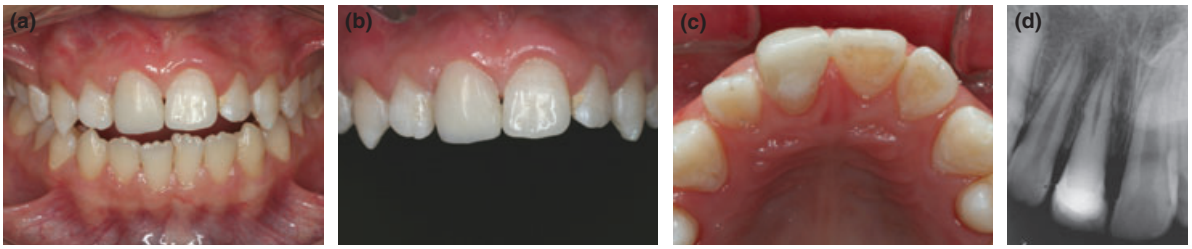

Fig. 6. Intra-oral photograph after premolar composite restoration (a–c) and periapical radiograph showing complete root development (d).

Placement of oral implants in adolescent or in growing children must be avoided, or they will remain in infraocclusion because of adjacent alveolar bone growth (12, 13). Other authors (14–16) have reported implant uses in children and adolescents with ectodermal dysplasia.

Autotransplantation combined with orthodontic treatment should be considered the first treatment alternative for missing teeth when a suitable donor tooth is available (17).

In young patients, autotransplantation may allow bone development, provide proprioceptive stimulation reestablishing a normal alveolar process (17–19).

Transplanting premolars before fully formed roots is indicated for pulp revascularization and vitality preservation. The tooth retains the potential to erupt and induce alveolar bone growth, as the case presented. Periodontal healing without root resorption is related to the stage of root development and actually decreased from 93% in the teeth with three-quarter developed roots to 37% in the teeth with fully developed roots (4–6).

Autotransplantation of premolars with fully formed roots reduces the success rates (20, 21) and introduces an element of unpredictability regarding the long-term outcome. Lundberg and Isaksson (21) reported that autotransplantation was a reliable method with a good prognosis for donor teeth with both open and closed apices.

Failures such as ankylosis or progressive root resorption of the donor tooth are strongly correlated with damage to the root surface during the operation (22).

Autotransplantation in this case report was carefully planned. First, the recipient site was prepared, so that the second premolar would remain minimum time out of alveolar bone during procedure.

Another important factor for a successful autotransplantation is a proper adaptation between the root surface of the transplanted tooth and the bony walls of the recipient site (23), which might provide better blood supply and adequate nutrition to the periodontal ligament cells, thereby increasing the number of viable cells (24). The healing pattern of the autotransplanted tooth is devoted to preservation of healthy periodontal ligament cells (24). But even in case of excellent adaptation of transplanted tooth, periapical inflammation can be noticed (25).

The upper second premolar, which was most often transplanted, was chosen because this tooth, unlike the first premolar, is often single-rooted. This simplifies the surgical technique and, therefore, increases the chance of success (26). The success rate of autotransplantation is influenced by the case selection, a number of preoperative and postoperative factors like age of the patient, developmental stage of the graft, type of tooth transplanted, surgical trauma during graft removal, storage after removing the graft, recipient site, surgical technique, and skill of the surgeon (24, 27).

When evaluating success of the treatment, it is important to observe pulp obliteration in autotransplanted tooth that is more an indication of pulp vitality than complication. Pulp healing can be monitored with either pulp sensitivity or radiographic signs of pulp canal obliteration (6, 28). Subsequent healing processes usually restore the content of the pulp canal including the nervous supply (29). Pulpal sensitivity without pulp canal obliteration may take place in rare cases; likewise, pulp canal obliteration without pulp sensitivity may occur where the nerve regeneration fails (30).

Frenken et al.(26) demonstrated a 97.5% success rate for autotransplanted teeth. Other authors reported success rates varying from 80% to 100% (4, 5, 18, 21, 22, 31). Long-term studies of auto transplanted teeth to anterior site, showed a success rate of 98–99% within 5 years and 87–95% within 10 years (32), and 79% within 26.4 years (33).

In the present case, the tooth autotransplantation was performed as a two-step surgery. First, the resorbed right upper central incisor was extracted, its socket cleaned and the patient received systemic antibiotics because of periapical infection. In the second step, the recipient site was prepared, the donor tooth extracted and transplanted to incisor area. The upper right second premolar as donor tooth was chosen as it was single rooted and root length development was incomplete, which increase the success ratio.

Conclusion

Tooth autotransplantation may be considered as a viable treatment option, when carefully planning is combined with an appropriate surgical technique. In selected cases, this method should be preferred over conventional prosthetic and implant rehabilitation for therapeutic, esthetic and economic reasons.

Acknowledgement

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