Autogenous Premolar Transplantation into Artificial Socket in Maxillary Lateral Incisor Site

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Abstract

Introduction: Autogenous transplantation of a natural tooth to another site has significant advantages over dental implants, particularly in cases of agenesis, accidental tooth loss, or poor prognosis for the maintenance of tooth function. **Methods:** This report describes a case of autogenous premolar transplantation into an artificial socket in the site of a missing maxillary lateral incisor in a 13-year-old girl. Clinical examination and radiography revealed tooth agenesis (#4, #10, #13, and #20) and microdontia (#7). The occlusion and skeletal maxillomandibular relations were normal. **Results:** Tooth #29 was chosen for transplantation into the site of tooth #10 because of its size, stage of root formation, and possible closure of the spaces created by agenesis. **Conclusions:** Autogenous transplantation is a feasible alternative to dental implants in cases of tooth agenesis or tooth loss because of trauma. Autotransplantation was indicated in this case because it ensures the natural (facial) growth of the alveolar process and preserves the function of periodontal tissues. A multidisciplinary approach (ie, combining techniques from different dental specialties) was important for treatment success. Clinical and radiographic follow-up confirmed that the transplanted premolar was esthetically comparable with the lateral incisor and that root development and pulp canal obliteration were complete. *(J Endod 2014;40:1885–1890)*

Key Words

Agenesis, autogenous tooth transplantation, pulp regeneration, root canal treatment, tooth transplantation

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0099-2399/$ - see front matter

http://dx.doi.org/10.1016/j.joen.2014.07.008

Current rehabilitation strategies include autogenous transplantation to replace missing teeth or teeth with a poor prognosis (1, 2). Tooth transplantation has been a well-established procedure in dental practice for many years, and immature third molars have recently been used to replace carious first molars (1–6).

Teeth may be absent because of several reasons (eg, agenesis [the absence of teeth because of abnormal tooth germ development]) and dental trauma. Also, in some cases, teeth may require replacement because of a poor long-term prognosis for the maintenance of tooth function (5). Tooth autotransplantation is especially indicated to replace missing teeth in children and adolescents because autotransplanted teeth continue to participate in the normal development of the alveolar bone (6). On the contrary, osseointegrated dental implants are contraindicated in this group of patients because of their potential interference with the growth of the alveolar process. Other clinical situations that may benefit from autogenous transplants include partial agenesis, especially of lateral incisors and premolars, and impacted teeth (3, 6).

Some of the criteria used to classify a transplant as successful are the absence of progressive root resorption, the presence of normal hard and soft periodontal tissues adjacent to the transplanted tooth, and a crown-to-root ratio <1 (7). Positive outcomes depend on the integration of treatment protocols used in different specialties, such as endodontics, orthodontics, surgery, implants, and operative dentistry, as well as on careful planning and accurate techniques (5–8).

Autogenous tooth transplantations tend to be more successful when the roots are incompletely formed (9). The correct selection of cases, assessment of root development stage and recipient socket, and adoption of safety protocols are all essential to ensure success (9–12).

This report describes the autogenous transplantation of a mandibular premolar into an artificial socket in the site of a missing maxillary lateral incisor (tooth #7) in an adolescent patient.

Case Report

Clinical and radiographic examination of a 13-year-old girl who sought orthodontic care revealed multiple agenesis (teeth #4, #10, #13, and #20) and microdontia (tooth #7) (Fig. 1*A–E*). The occlusion and skeletal maxillomandibular relations were normal. The treatment plan was to perform autotransplantation of tooth #29 into the site corresponding to tooth #10 because of its size, stage of root formation, and the possibility of closing spaces left by other missing teeth.

The plan was carefully discussed and accepted, and all steps, benefits, and risks were explained to the patient and her parents, who provided written informed consent. Fixed appliances were placed in both arches and spaces distributed in the maxillary arch. Teeth #5 and #12 were moved distally using a strategy similar to the segmented arch technique, and titanium-molybdenum alloy T-loop springs were connected to a palatal bar (Fig. 2*A–D*) (13). Tooth #6, originally impacted, erupted spontaneously, and space was opened between teeth #9 and #11.

The recipient site was defined after the maxillary arch was leveled using a rectangular stainless steel arch wire that bypassed the site of tooth #10. The size of the recipient site was defined according to computed tomographic images showing the exact dimensions of tooth #29, which was selected for transplantation. At the time of treatment, the root of the transplanted tooth showed three quarters of its final root length.

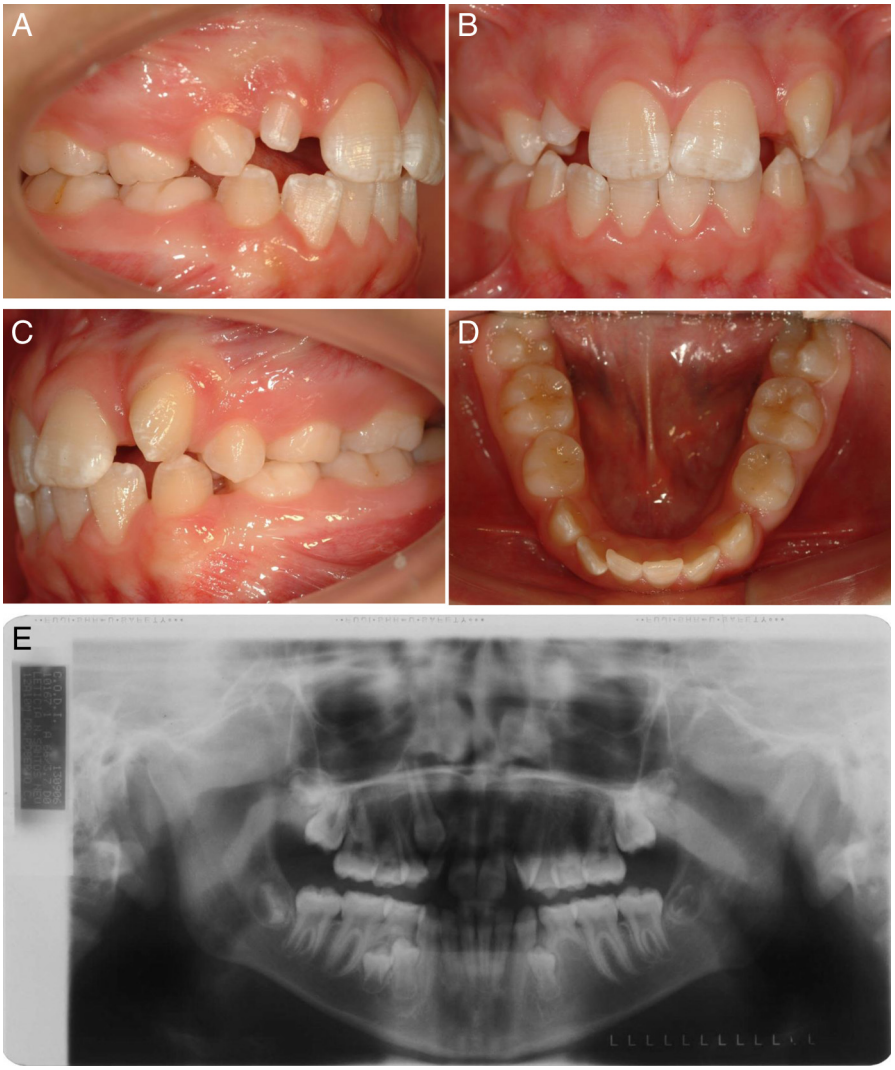

Figure 1. (*A–E*) Clinical examination and radiograph showing tooth agenesis (teeth #4, #10, #13, and #20) and microdontia (#7).

Surgery was carefully performed using an atraumatic aseptic technique. The artificial alveolus was prepared according to previously defined dimensions using the following sequence of drills: lance drill #2.0 and helical cylindrical drills #2.0, #3.15, and #4.3 (Neodent Comp, Curitiba, PR, Brazil). The procedure was performed under constant internal irrigation with saline solution (Fig. 2*E* and *F*). The donor tooth was extracted atraumatically using gentle luxation movements after gingival incision. Subsequently, it was introduced into the artificial socket and gently held in place until stabilization. The flap was sutured and the tooth splinted. After the autotransplantation procedure, monthly follow-up visits were scheduled to evaluate root development until the root was fully formed (Fig. 3*A–F*). At these visits, radiographs were obtained to monitor inflammatory root resorption or apical periodontitis arising from possible infection (10).

After surgery, the autotransplanted tooth was fixed in place by means of a wire bonded to the tooth and to adjacent teeth using composite resin and splinted for 2 months. Four months later, as recommended in the literature (14), movement of the autotransplanted tooth was initiated. First, composite resin was used to obtain the appearance of a lateral incisor. Subsequently, a bracket was bonded to the autotransplanted tooth, which was then moved using 0.14-in heat-activated nickel-titanium wire placed over a rectangular arch wire (Fig. 3*G* and *H*).

After full eruption of tooth #29, both arches were leveled again, and the remaining space was closed. Finally, 0.019 × 0.026-in rectangular arch wires were used to achieve optimal intercuspation of posterior teeth, correct positioning of roots in the bone, and esthetic positioning of anterior teeth. Orthodontic treatment lasted for 32 months throughout; 12 months were spent preparing the recipient site for transplantation. There was no tooth movement in the maxilla in the 6 months immediately after autotransplantation.

Upon appliance removal, the tooth that had been transplanted into the site of tooth #10 showed better periodontal quality than that of tooth #7, and root formation and pulp canal obliteration (PCO) were found to be complete (Fig. 4*A–E*).

Discussion

Transplantation of a natural tooth into the site of another tooth has significant advantages over dental implants, particularly for periodontal ligament (PDL) and alveolar bone development (1, 2, 15–19). Multiple

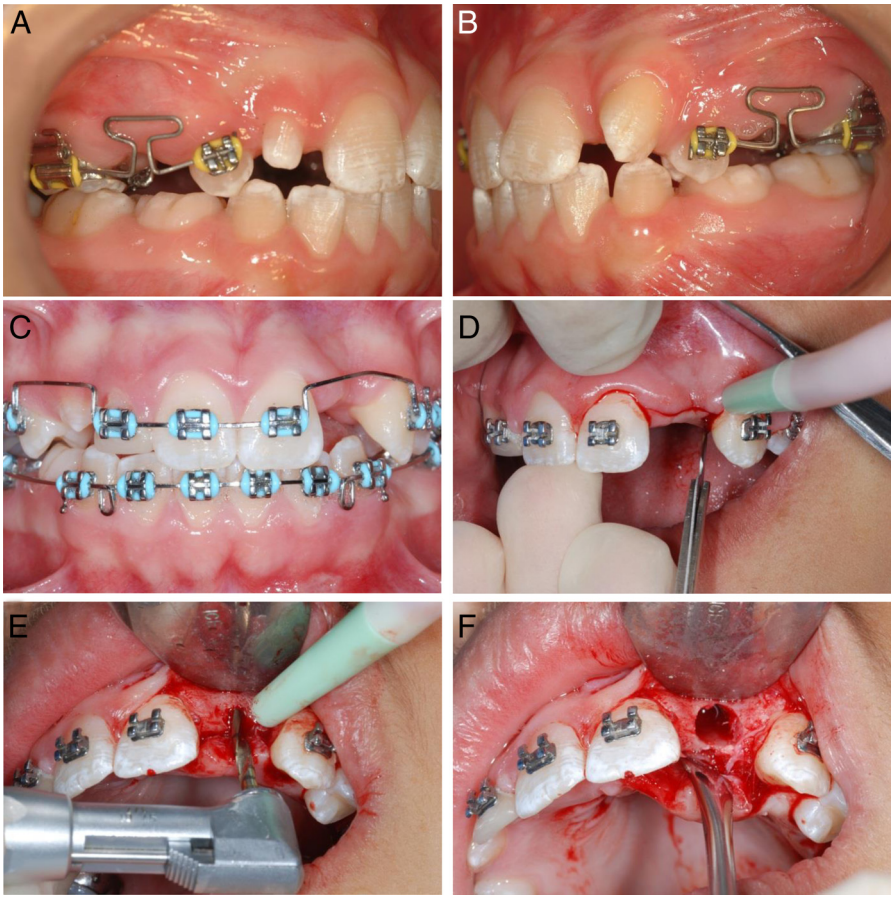

Figure 2. (*A–D*) Teeth #5 and #12 moved distally using a strategy similar to the segmented arch technique and titanium-molybdenum alloy T-loop springs connected to a palatal bar. (*E* and *F*) Preparation of artificial alveolus according to predetermined dimensions using drills of compatible size under constant internal irrigation with saline solution.

missing teeth, agenesis of mandibular second premolars in low-angle facial types with standard or weak facial profiles, and accidentally lost or congenitally missing maxillary central and lateral incisors are the main indications for autotransplantation of developing premolars when teeth are unevenly distributed (16, 17).

In the case described here, clinical examination revealed several missing teeth as well as microdontia (tooth #7). Conversely, occlusion and skeletal maxillomandibular relation were normal. Therefore, autotransplantation of tooth #29 into an artificial socket in the site of tooth #10 was indicated. The patient's age (13 years) and incomplete root development, with two thirds to three quarters of the final root length (1, 2), were indicative of a positive outcome.

The success of dental transplants is associated with several factors (eg, correct selection of cases, early stage of root development, and use of aseptic and atraumatic techniques) (1–3, 15–19). In 1985, Kristerson (20) evaluated 100 transplanted human premolars in a group of 87 patients. The author found a relationship between the stage of root development and periodontal healing without root resorption, with 93% of success in teeth with three quarters of root development compared with 37% in teeth with fully developed roots. Pulp revascularization was also inversely proportional to root development, with 100% in teeth at initial/middle stages of root development versus 0% in teeth with fully developed roots. Pulp obliteration was observed in all cases with revascularized pulp tissue. The author concluded that transplantation of premolars with one half to three quarters of root development provides a good chance of pulp survival, a limited risk of root resorption, and sufficient final root length.

In our case, root development followed by PCO continued after transplantation. Revascularization occurs because of the growth of vascularized connective tissue into the pulp space or anastomosis of blood vessels already present in the pulp of the transplanted tooth and periodontal blood vessels (21–24). In turn, PCO results from the formation of mineralized tissue on the root canal walls, a physiological process characteristic of aging and defense mechanisms of the vital pulp. PCO is frequently confirmed after tooth transplantation procedures (25–27) and seems to accelerate after dental trauma, autotransplantation, and orthodontic treatment (27).

PCO is believed to be a consequence of the pulp repair process after injury to the apical neurovascular bundle (25–31). However, it is more clearly associated with teeth with incomplete root development; therefore, prophylactic endodontic treatment is not recommended in these cases (27). In fact, endodontic treatment is recommended only when pulp infection is suspected; when no signs of infection are present, continued root development and pulp canal closure should be followed up radiographically (10).

Viability of periodontal cells and preparation of the recipient site may also pose risks to the healing process after autogenous transplants (3–5, 10, 27, 32). In the case reported here, an artificial socket was

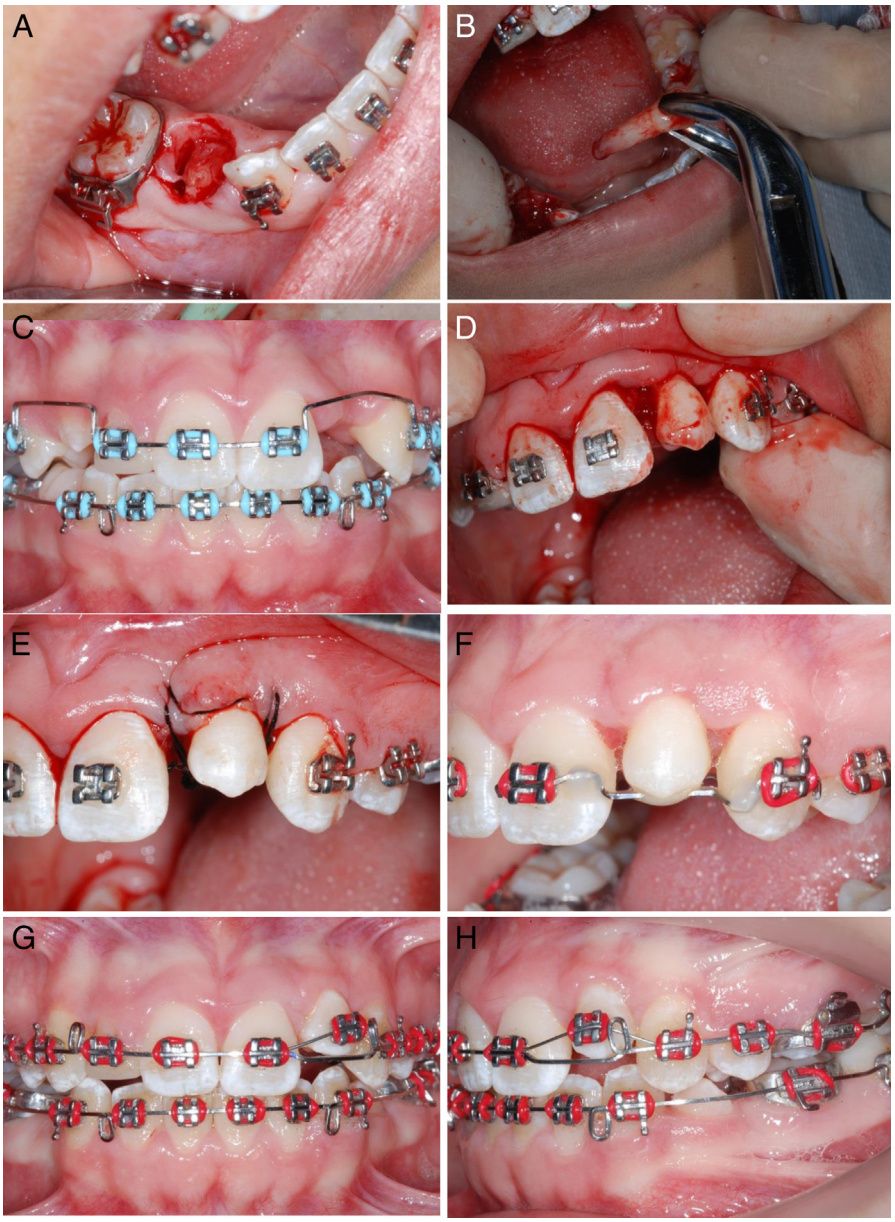

Figure 3. (*A–F*) A donor tooth placed into an artificial socket and held gently until stabilization. Flap suturing and tooth splinting. (*G* and *H*) An autotransplanted tooth fixed in place with a wire bonded to the tooth and to adjacent teeth using composite resin and splinted for 2 months. Tooth movement initiated 4 months later.

prepared to receive the transplanted tooth. Preparation should be carefully performed to avoid bone trauma. Wang et al (32) examined the effect of delayed autotransplantation combined with periodontal tissue engineering using autologous PDL cells on periodontal healing. Premolar teeth were extracted from dogs and maintained in a dry environment for 1 month after isolation and proliferation of PDL cells. Tooth roots coated with 1×10^6 cultured autologous PDL cells were autotransplanted into artificial sockets created in the mandible. The dogs were killed 60 days after transplantation. Histologic analysis showed a root-PDL-bone complex in all samples loaded with PDL cells versus no PDL-like tissue and frequent ankylosis in control specimens. The new PDL-like connective tissue was located between the alveolar bone and the transplanted roots, with fibers inserted into the newly formed cementum in 1 end and the alveolar bone in the other. The results suggest that PDL cells can potentially regenerate periodontal tissues in artificial alveolar sockets. In our case report, bone structures and gingival esthetics confirmed that autotransplantation had a clinically positive outcome. Also, radiographs showed that root growth and PCO were complete, as expected.

Endodontics has shared extraordinary advances with tissue engineering, creating new prognostic expectations in cases of dental trauma and developmental abnormalities. Treatment strategies based on current scientific knowledge can be used for the regeneration of a functional pulp-dentin complex and periodontal tissues, and conservative treatments can ensure continued root development, an increase in dentinal wall thickness, and apical closure (33–35).

In sum, autotransplantation stands out as a feasible alternative to dental implants in cases of tooth agenesis or tooth loss because of trauma, with the advantage of not affecting the natural (facial) growth of the alveolar process and the function of periodontal tissues. Rather,

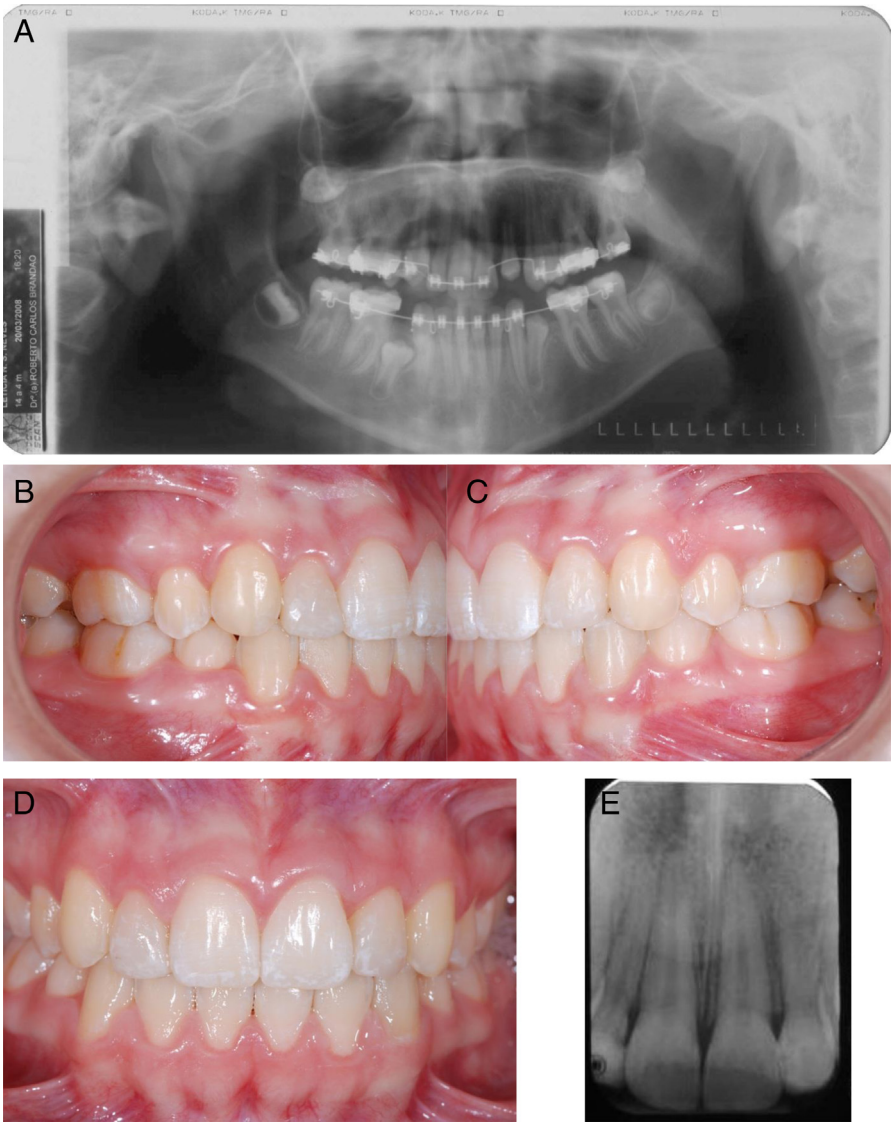

Figure 4. (*A–E*) A follow-up panoramic radiograph obtained 4 months after transplantation. Upon appliance removal, the tooth transplanted into the site of tooth #10 showed better periodontal quality than tooth #7. Root formation and pulp canal obliteration were complete.

it allows the preservation of alveolar bone volume and the height of the attached gingival, 2 structures closely associated with continued facial growth. The multidisciplinary approach adopted in our case (ie, combining techniques from different dental specialties) and the regular clinical and radiographic follow-up were important for treatment success and corroborate the positive outcomes that can be obtained with this technique.

Acknowledgments

The authors deny any conflicts of interest related to this study.

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