Vertical Bone Growth after Autotransplantation of Mature Third Molars: 2 Case Reports with Long-term Follow-up

Sunil Kim, DDS, MSD, Seung-Jong Lee, DDS, MSD, PhD, Yooseok Shin, DDS, MSD, PhD, and Euiseong Kim, DDS, MSD, PhD

Abstract

Tooth autotransplantation is a viable treatment option for tooth replacement when a suitable donor tooth is available. These case reports described significant vertical bone growth after autotransplantation of a mature third molar. The left mandible third molars (n = 2) were transplanted to the missing tooth in the left mandible. The patient follow-up period was 10 years after transplantation. Clinical examination revealed no mobility of the transplanted tooth. Radiographic examination indicated that bone regeneration occurred around the transplanted tooth. Vertical bone growth was observed in the cervical area of the root surface and the recipient bone. In autotransplantation of mature teeth, long-term follow-up results indicate that vertical bone growth can be expected if viability of the periodontal ligament cells is maintained. *(J Endod 2015;41:1371–1374)*

Key Words

Autotransplantation, mature third molar, periodontal ligament cell, vertical bone growth

From the Microscope Center, Department of Conservative Dentistry and Oral Science Research Center, College of Dentistry, Yonsei University, Seoul, Korea.

Address requests for reprints to Dr Euiseong Kim, Microscope Center, Department of Conservative Dentistry and Oral Science Research Center, College of Dentistry, Yonsei University, 50 Yonsei-Ro, Seodaemun-Gu, Seoul 120-752, South Korea. E-mail address: andyendo@yuhs.ac

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Current options for single tooth replacement because of dental loss include dental implantation, a fixed partial denture, and tooth autotransplantation. Of these options, most clinicians first consider a dental implant or fixed partial denture (1). However, tooth autotransplantation is a useful treatment option for young patients who are still experiencing periods of growth. The autotransplanted tooth can erupt in harmony with the neighboring teeth during continued facial growth and eruption of the teeth, whereas the implant will not follow the neighboring teeth vertically during tooth eruption (2).

Immature teeth with an open apex have adequate blood supply and stem cells to promote pulp revascularization after transplantation (3). Pulp revascularization enables continuous root development and maintenance of tooth vitality and also can induce the normal growth of alveolar bones, which is impossible in fixed prosthesis. Given the advantages, autotransplantation has a high success rate in immature teeth and is frequently performed in young patients (4, 5).

Previous studies determined no large difference in the success rate of autotransplantation between mature and immature teeth (4, 6, 7). Mature tooth autotransplantation has a high success rate but is rarely performed for several reasons. Most donor teeth have a closed apex in adults, which means that patients require a root canal treatment before transplantation and are subject to such complications as root resorption and attachment loss. Other difficulties include high technique sensitivity compared with dental implant, unpredictable prognosis, and no option for retreatment because of loss of the donor tooth. However, these difficulties can be overcome by the computer-aided rapid prototyping (CARP) model. The CARP model is fabricated using cone-beam computed tomographic imaging and permits analysis of the actual dimensions of the donor tooth. This technique allows preparation of the recipient bone cavity before extraction of the donor tooth. Moreover, the CARP model can minimize the extra socket time and the possible injury of the donor tooth during autotransplantation (8).

Many recent studies have investigated periodontal ligament (PDL)–derived cells for periodontal regeneration (9). Recent advancements in stem cell biology and regenerative medicine have led to the development of several procedures, including bone grafting and the use of growth factors and host-modulating agents, particularly PDL, which is known to have regeneration potential. Stem cells that have been isolated from PDL exhibit characteristics similar to those of bone marrow stem cells (10). PDL stem cells have the ability to form PDL structures when transplanted into animal models of periodontal defects, showing their potential use for the regeneration of periodontal tissues (11).

According to these studies, bone regeneration can be induced at the recipient site after transplantation when the PDL cells of the donor tooth root are preserved. Theoretically, both horizontal bone growth and vertical bone growth are possible (12), but few cases have reported vertical bone growth in the case of mature third molar autotransplantation. The purpose of this case series was to report 2 successful autotransplantation cases of a mature third molar that showed significant vertical bone growth.

Case Reports

Case 1. In March 2003, a 32-year-old man was referred to the Department of Conservative Dentistry at Yonsei University Dental Hospital, Seoul, Korea, for transplantation

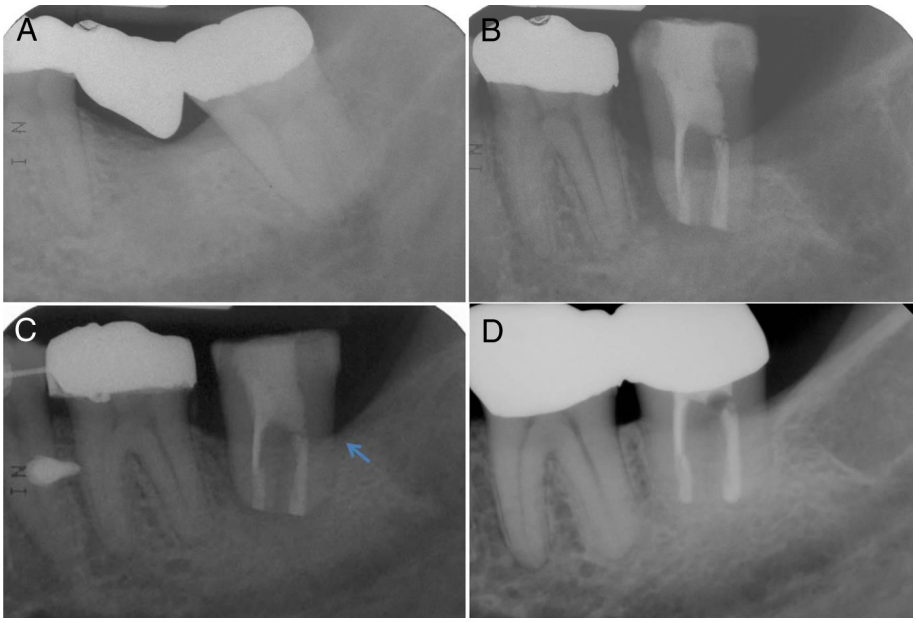

Figure 1. (*A*) The preoperative periapical radiograph. (*B*) The postoperative periapical radiograph. (*C*) Four months after autotransplantation. The bone grew to the cervical area (*arrow*). (*D*) Ten years after autotransplantation. The transplant was asymptomatic and maintained a normal bone level.

of a left mandible third molar. The patient's dental history revealed that a left mandible second molar was extracted 2 years ago because of caries, and a 3-unit gold bridge was performed (Fig. 1*A*). For orthodontic treatment, the existing 3-unit bridge was to be removed and tooth #17 transplanted to the #18 area. A computed tomographic (CT) image was taken to analyze the volumetric size of the donor tooth and to fabricate the CARP model. Three-dimensional data (Digital Imaging and Communication in Medicine format) of the donor tooth were obtained from the CT Highspeed Advantage Scanner and a DentaScan program produced by GE Medical Systems (Milwaukee, WI). The CT protocol used for this procedure involved a slit thickness of 1 mm. The 3-dimensional digital data obtained were fed into a visualization program (V-Works; Cybermed Co, Seoul, Korea) and then exported to the rapid prototyping machine for fabrication of the actual-sized tooth starch model (13).

The surgical technique was completed as previously reported (14). In brief, 2% lidocaine (with 1:100,000 epinephrine) was administered, the 3-unit gold bridge was removed, and root canal treatment was performed before the left mandible third molar was extracted to reduce the extraoral time. The mucoperiosteal flaps were raised in the area surrounding teeth #17 and #18. The recipient site was prepared by removing the crestal bone with a Lindemann drill (Komet Dental, Lemgo, Germany) or a round burr with abundant saline irrigation. To minimize injury to the PDL of the donor tooth, the CARP model was used to obtain a socket of the proper size and shape to receive the donor tooth. Donor tooth #17 was extracted gently in a buccal-lingual direction, and during the withdrawal movement, special attention was paid in order for the beak of the forceps not to touch the cementum. The tooth was wrapped with wet gauze to keep the root surface moist throughout the extraoral procedure, and an apicoectomy retrofilled with IRM (Dentsply Caulk, Milford, DE) was performed to prevent possible endodontic complications. The extraoral time was 6 minutes 45 seconds. The transplant was stabilized with crossover sutures with 4-0 Vicryl (Ethicon, Somerville, NJ) without a splint.

The patient visited the clinic 4 months later. Immediately after the operation, the bone level had only reached the middle of the root. However, at the 4-month follow-up, the bone grew to the cervical area (Fig. 1*B* and *C*). At the 1-year follow-up, the bone level at the 4-month follow-up was maintained. The patient returned yearly for clinical and radiographic follow-up. At the last 10-year follow-up visit, the transplant was asymptomatic and maintained a normal bone level (Fig. 1*D*).

Case 2. A 57-year-old man visited our clinic. A full eruption of the left mandible third molar was observed on a panoramic radiograph, and the patient was scheduled for transplantation of tooth #18 (Fig. 2*A*). A CT image was taken to analyze the volumetric size of the donor tooth and to fabricate the CARP model.

Endodontic treatment was completed in tooth #17 before extraction and elevation of mucoperiosteal flaps surrounding #18 after the patient was administered local anesthesia. The recipient site was prepared, tooth #17 was extracted, and an apicoectomy retrofilled with IRM was performed. The extraoral time was 6 minutes 22 seconds. The transplant was sutured and stabilized with a resin wire splint for 7 days.

At the 3-month follow-up, vertical bone growth was observed on the transplant distal area on radiographic examination. At the 1-year follow-up, the bone level was equivalent to that of the distal bone of tooth #19 (Fig. 2*B* and *C*). The patient returned yearly for clinical and radiographic follow-up. At the last 10-year follow-up visit, the transplant was asymptomatic and maintained a normal bone level (Fig. 2*D*).

Discussion

In many cases of tooth replacement, there is inadequate vertical volume in the recipient site bone when a significant period of time has passed since tooth extraction or a tooth has been extracted because of a periodontal problem. Because bone defects are not capable of regeneration, bone reconstruction is essential for proper function when correcting an edentulous site with a dental implant. Autograft procedures produce the best results but require a donor site (15). Active research efforts have pursued guided bone regeneration with artificial bone substitutes since the 1980s, and artificial bone substitutes are more frequently used than autografts (16, 17). However, artificial bone substitutes have no osteogenic potential and thus present some difficulties with complete bone regeneration (15). Attempts have