Optimizing Third Molar Autotransplantation: Applications of Reverse-Engineered Surgical Templates and Rapid Prototyping of Three-Dimensional Teeth

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The success of autogenous tooth transplantation depends on the vitality of the periodontal ligament attached to the donor tooth, and its viability decreases when it is exposed extraorally. This report describes the case of a 16-year-old patient in whom a rapid prototyped tooth model was performed using cone-beam technology and a surgical template guide for autotransplantation as an effective technique for a critical time-based procedure.

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As early as the 18th century, autotransplantation has been used as a treatment for missing teeth. Its survival rate has been reported to have progressed resulting from technique modifications in more controlled settings.[1-4] One of the earlier techniques used in transplantation procedures was the use of an extracted donor tooth as a template for the preparation of the recipient site. Developments in cone-beam computed tomography (CBCT) and rapid prototyping (RP) have permitted innovations such as the fabrication of accurate surgical templates to aid in recipient-site preparation. The efficient usage of digital technology has helped shorten surgical time and avoid intraoperative errors.[5] The decrease in extraoral time has led to more predictable outcomes and improvements in the success rate for autotransplanted teeth. A good prognosis can be expected as long as careful handling of the donor tooth is observed, with no longer than 18 minutes of extraoral exposure.[2,6] It has been established that the most important factor in the success of autogenous tooth transplantation is the vitality of the periodontal ligament (PDL) attached to the donor tooth, and its viability decreases with extraoral exposure. Thus, the purpose of this case report was to present the clinical applications of RP tooth models for alveolar-site preparation and surgical template guides for locating central points during autotransplantation to normal or bone-grafted recipient sites as efficient techniques for a critical time-sensitive procedure.

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Report of Case

A healthy 16-year-old boy presented to the authors' department with concerns regarding pain on the right side of his mandible. An initial clinical examination and radiographs led to the suspicion of a developmental cyst to rule out ameloblastoma (Fig 1). The patient was referred to the endodontics department for an evaluation of the offending teeth. Decompression of the cyst was performed followed by root canal treatments of the lower right first and second molars. No change was visible within 1 year of the initial procedure. Then, the area was re-evaluated in consideration of an alternative treatment. A favorable environment, wide alveolar ridge, and the availability of donor teeth became the deciding factors in the patient's choice to undergo autotransplantation as a final treatment.

The objective of this case report was to document a successful autotransplantation procedure using a surgical stent and reverse-engineered RP tooth to an iliac-grafted bone site.

Materials and Methods

The cyst enucleation and autogenous bone graft were performed under general anesthesia. The anterior crest of the iliac bone was used as the donor site. The harvested autogenous bone was transformed into chips, combined with xenograft (Bio-Oss; Geistlich, Wolhusen, Switzerland), and implanted into the area of the mandibular defect. The biopsy results reported a radicular cyst on the lower right first and second molars. Good healing was observed 4 months before the patient's referral to the prosthodontics department for the fabrication of a surgical template guide and RP tooth models.

For the digital preparation of immediate transplantation after third molar extraction, CBCT and alginate impressions of the patient's oral cavity were obtained. The fiducial markers served as a reference for registering the 2 kinds of CT images in virtual space. Three radiopaque cylindrical markers were attached to the buccal surfaces of the lower left second premolar, right canine, and right second molar by composite resin after applying a bonding agent without etching. If these markers were connected, they would form an imaginary triangle, with the widest distance among the remaining teeth. CBCT scans (Dinnova; HDX, Seoul, Korea) were acquired with the fiducial markers in position (voxel size, 0.2 mm; field of view, 8 × 5 cm; voltage, 75 kVp; tube current, 6.0 mA), and a Digital Imaging and Communications in Medicine (DICOM) dataset was obtained. After impressions of the fiducial markers were verified to be intact, the patient was excused and a CBCT image of the plaster model was acquired.

In this case, instead of using the extraction socket as the recipient site, direct drilling and resection of the alveolar ridge were performed to prepare a tooth bed. To maintain highly viable transplanted teeth, templates of the same shape and size were fabricated and

FIGURE 1. Initial panoramic view. A large cyst below the lower right molars caused pain in the right mandible.

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