

Guided autotransplantation of tooth: An innovative approach

ABSTRACT

This case report describes a novel approach of guided autotransplantation of tooth so that we can assess its feasibility, accuracy, and stability. In the present case, autotransplantation of a third molar at the recipient site of mandibular first molar was done. Three-dimensional (3D) replica of donor tooth along with surgical guiding template was virtually designed and fabricated using 3D printing. The 3D replica and surgical template helped in the surgical modification of recipient site and placement of donor tooth in the exact position. Root canal treatment of the donor tooth was carried out after 2 weeks. At 6 months' follow-up, the transplanted tooth was functional with no evidence of mobility or periodontal inflammation. Radiographic evaluation showed the absence of widening of periodontal space and external root resorption. Hence, the transplantation of the third molar is an outstanding procedure for replacing a lost permanent molar tooth which in turn restores esthetics and function.

Keywords: Three-dimensional surgical guiding template, three-dimensional tooth replica model, guided autotransplantation, guided surgery

INTRODUCTION

The principle of conservative dentistry is to save natural tooth, but in some circumstances, tooth has to be extracted. The replacement of missing teeth is required to restore masticatory function and esthetics. Missing teeth could be replaced with removable or fixed prosthesis, which is sometimes unacceptable to the patient. The other alternatives are autotransplantation and osseointegrated implants-supported prosthesis.

The osseointegrated implants generally are not opted in adolescent patients,^[1] since they cannot pursue the craniofacial growth and would remain in infraocclusion during continuing development. In those patients, autotransplantation of tooth can be a viable option as it can be done during continued facial growth and eruption of the teeth to maintain the alveolar bone height as they come out in harmony with the neighboring teeth.^[2] Autotransplantation is the technique of surgical placement of a tooth from its original location in the mouth to another site in the same individual. This procedure also preserves

attached gingiva with a natural shape leading to good esthetic results along with the sense of proprioception. Moreover, it has low bone resorption rate and relatively low-cost.^[3] The survival of autotransplanted teeth is high, with proper donor tooth selection, precise knowledge about dimensions of recipient site, and accurate surgical procedures. Researchers evaluated the survival rates of conventional autotransplanted teeth with complete or incomplete root formation were 84%–94%, respectively,^[4] because the tooth to be transplanted was the only guide

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and used for repeated try-in to place the donor tooth into new socket. This prolonged extra-alveolar time damaged the periodontal ligament (PDL) cells which caused a negative impact on successful autotransplantation of teeth.

Recently, more digitalized approach, i.e., guided autotransplantation of tooth has been introduced which would surely increase the survival rate of autotransplanted tooth. This technique utilizes cone-beam computed tomography (CBCT) imaging, three-dimensional (3D) replica of donor tooth along with 3D surgical guiding template which helps in the prior preparation of recipient socket reducing the extraoral time, decreased chances of injury to PDL cells, and precisely transfer of donor tooth into recipient site.

CASE REPORT

A 17 year old male reported to the department having a chief complaint of pain and swelling in the right lower back teeth region. The pain was dull in nature that aggravated on chewing and subsided after medication. No significant medical history was found. Clinical examination showed grossly decayed right mandibular first molar [Figure 1a] which was tender on percussion with sinus opening on the buccal surface of the tooth. Radiographic examination revealed radiolucency of furcation area and in relation to the mesial root [Figure 1b]. Hence, extraction was recommended due to the unfavorable prognosis of the tooth.

The patient enquired about the replacement of tooth after the extraction of 46, he was explained all the treatment options. After analysis and discussion, the patient opted for autotransplantation of 48. Therefore, the extraction of 48 and then transplantation into 46 recipient sites were planned for a one visit procedure, and an informed consent was acquired.

To attain more predictable outcome of autotransplantation, we preferred the use of 3D-guided template with 3D tooth replica so that it could reduce extraoral time and increase the adaptability of the donor tooth at the recipient site.

Preoperative preparation

A selective right mandibular arch cone-beam computed tomographic (i-CAT, Kavo dental, Germany) scan in the digital imaging and communications in medicine (DICOM) format was taken [Figure 1c and d]. Silicon rubber base impressions (Coltene, Switzerland) were taken. Dental cast created with die stone was scanned to obtain a virtual image.

Laboratory procedure

The DICOM file was imported to surgical planning software (Acteon ais software, Italy). Images of the selected donor tooth were segmented and converted to stereo lithography (STL) files [Figure 2a]. The STL image of donor tooth and surgical template [Figure 2b] was superimposed on the scanned virtual image to determine the defined position of donor tooth in the recipient site. Then, the STL images of

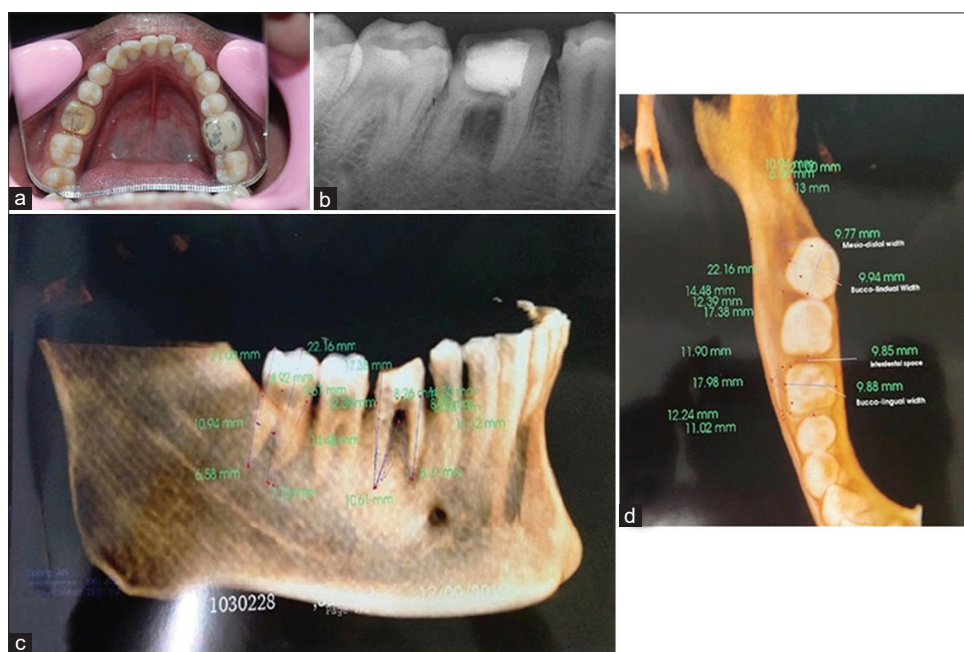


Figure 1: Grossly broken 46 (a) preoperative photograph (b) preoperative radiograph (c) cone-beam computed tomography showing mesiodistal, cervicoapical, and occlusocervical dimension of donor tooth and recipient site (d) cone-beam computed tomography showing buccolingual dimension of donor tooth and recipient site

donor tooth and surgical template were sent together to a 3D printer (Planmeca creo 3dprinter, Helsinki) for fabrication with biocompatible resin [Figure 2c-e].

Surgical procedure

After prophylactic antibiotic and local anesthesia administration, 46 was sectioned with a tungsten carbide bur and extraction of 46 was done using forceps [Figure 3a]. Extraction socket was inspected [Figure 3b], and radiograph was taken to ensure the absence of any remnant of bone or tooth [Figure 3]. The recipient socket was surgically modified using surgical round bur at slow speed with copious irrigation [Figure 3d] and 3D tooth model was accurately placed in recipient socket with the help of surgical template after repeated try-in [Figure 3e and f].

Then, surgical extraction of donor tooth 48 was performed atraumatically using forceps. The elevators use was eliminated to prevent the damage of the cementum and the PDL. Tooth 48 was fitted into 3D guiding template and placed in the recipient site to check the initial fit [Figure 4a]. After minor modifications of surgical site, transplanted tooth 48 was placed in its desired position [Figure 4b and c] and confirmed with the radiograph [Figure 4d]. After checking occlusion [Figure 4e] semi-rigid splinting with nonabsorbable sutures [Figure 4c] and composite resin (3M ESPE filtek supreme ultra flowable restorative, Michigan, United States) was done for 10 days and the transplanted tooth was left out of occlusion. Postoperative radiographs were taken; medications were prescribed and instructions were given to the patient. After 2 weeks, the patient was recalled and endodontic treatment was performed in autotransplanted tooth [Figure 5a].

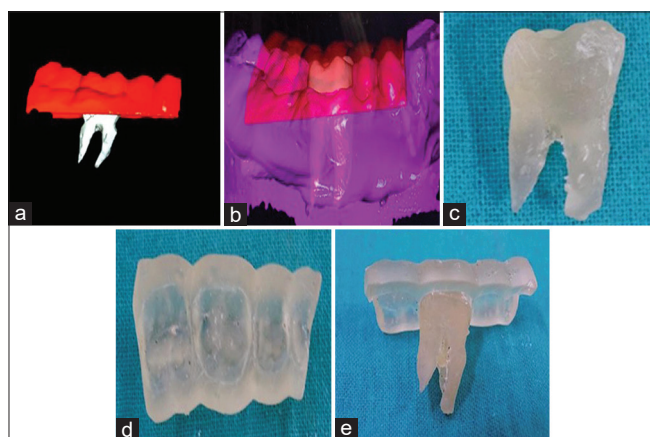


Figure 2: (a) Stereolithography image of both tooth replica 48 and surgical template (b) stereo lithography image of tooth replica and guiding template superimposed on virtual image (c) three-dimensional printed model of 48 (d) three-dimensional printed template inner surface (e) three-dimensional replica fitted into surgical template

DISCUSSION

In the present case, we prepared 3D replica of donor tooth (48) along with surgical template to modify the recipient socket (46) and minimizing the injury to PDL. Similarly, EzEldeen *et al.*^[5] also used 3D analysis using CBCT for guided tooth autotransplantation. When Verweij *et al.*^[6] utilized donor tooth replicas, they reported the high success rate of 80.0%–91.1% and survival rate of around 95.5%–100%. Most vital factors in eminent tooth transplantation are the good tissue adaptation and preservation of PDL. The PDL may be affected by the extraoral time of donor tooth, amount of try-in attempts, clinician ability, and the recipient socket trauma. In the present case, the use of 3D replica helped to keep extra oral time of around 12 min. Andreasen *et al.*^[7] report states that if the extraoral time of donor tooth is less than 18 min, periodontal healing would proceed normal. The present case utilized 3D replica of donor tooth along with 3D surgical guiding template which enhanced the ease of surgery and resulted in optimal 3D positioning of donor tooth. Mena-Alvarez *et al.*^[8] reported 3D printed surgical templates and 3D replica minimize the frequency of trial insertions with accurate donor tooth placement at recipient site.

In the present case, semirigid fixation of the donor tooth was done using sutures and composite resin for 7–10 days to maintain appropriate functional movement of the transplanted tooth and to promote bone healing.^[4] After 2 weeks of surgical procedure, endodontic treatment of donor tooth was performed. As Chung *et al.*^[9] has suggested endodontic therapy of donor tooth with completely formed root should be done after 2 weeks, as this may prevent trauma to PDL during initial healing. Delay in endodontic treatment may lead to the progression of pulpal inflammation

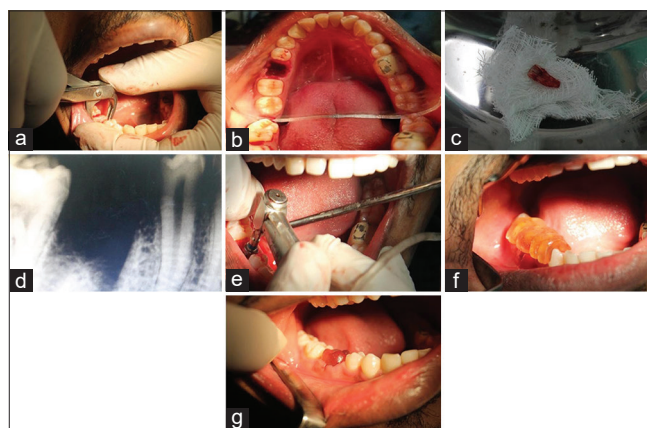


Figure 3: Extraction (a) 46 (b) socket (c) extracted 46 (d) recipient site IOPAR (e) surgical modification of the recipient socket (f) try-in using three-dimensional tooth model fitted in surgical template (g) three-dimensional tooth model placed in recipient socket

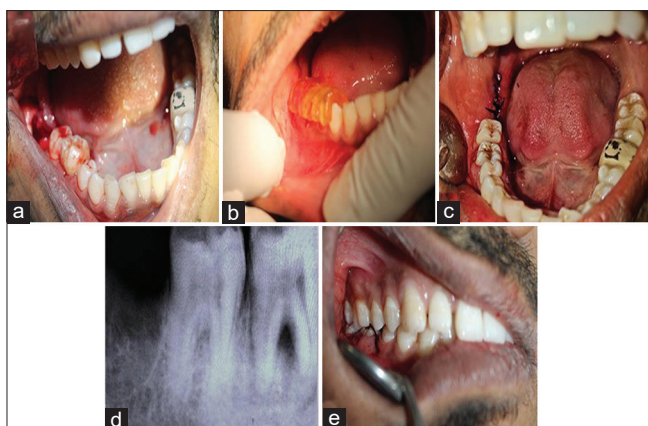


Figure 4: (a) Initial try-in of 48 at recipient site (b) try-in, 48 fitted in guiding template (c) Autotransplanted tooth 48 in recipient site (d) postoperative radiograph showing 48 at recipient site and extraction socket (e) donor tooth 48 in occlusion

to periodontal space that result in secondary inflammatory resorption.

At 6 months' follow up, tooth showed positive response as there were no signs of inflammation and mobility in its socket; normal mastication was evident, gingival color, gingival contour [Figure 5b and c] and the depth of pocket were all normal [Figure 5d]. On radiographic examination, no periapical radiolucency was observed and the lamina dura appeared normal [Figure 5e]. There was no sign of ankylosis in relation to the guided autotransplanted tooth. In the similar type of case, Alvarez *et al.*^[8] also reported no ankylosis after 2 years of follow-up.

CONCLUSION

3D-printed guiding templates and donor tooth replicas application in autotransplantation reduced the extraoral time which prevent the additional PDL damage and align the tooth buccolingually and cervically in its desired position. Therefore, the utilization of 3D tooth replica and guided template has increased the favorable outcome and contributes greatly to prolonging the function of natural teeth.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

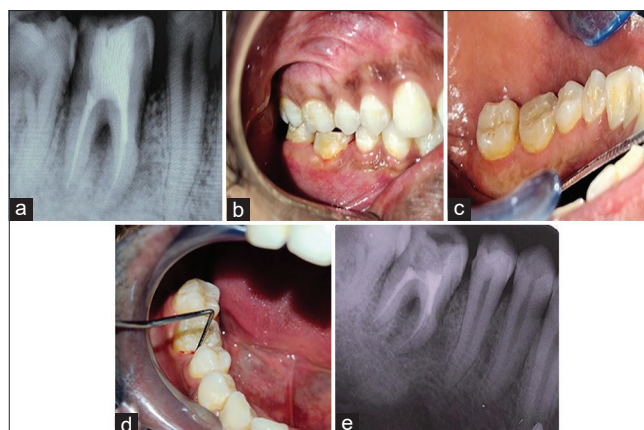


Figure 5: (a) Postobturation radiograph of autotransplanted tooth after 2 weeks (b-e) showing buccal view, lingual view with normal gingival color and contour, periodontal pocket depth and IOPAR radiograph of autotransplanted tooth at follow-up visit after 6 months

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Conflicts of interest

There are no conflicts of interest.

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