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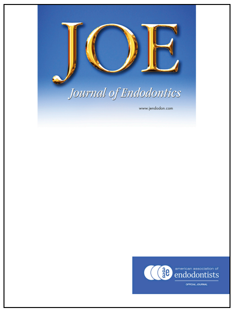

Guided double auto-transplantation of immature molars replacing multiple posterior teeth with extensive invasive external cervical resorption – a case report

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Guided double auto-transplantation of immature molars replacing multiple posterior teeth with extensive invasive external cervical resorption – a case report.

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Guided double auto-transplantation of immature molars replacing multiple posterior teeth with extensive invasive external cervical resorption – a case report.

Abstract

This case report describes the extraction of three mandibular posterior teeth (teeth #19, 20 and 21) with extensive invasive external cervical resorption (ECR) followed by guided double auto-transplantation of immature mandibular third molars (teeth #17 and 32). A 17-year-old male with a history of orthodontic treatment reported with intermittent pain in the mandibular left posterior region. Clinical and radiographic examination revealed extensive tooth tissue loss in teeth #19, 20 and 21 that was diagnosed as class 3 ECR (Patel 3Dp for teeth #20 and 21, 3Bp for tooth #19). Guided double auto-transplantation of the immature molar tooth #17 was performed to replace premolar teeth 20 and 21, and tooth #32 to replace tooth #19. At the 6-month follow-up the donor tooth #32 had symptoms of pulpitis and was managed with a full pulpotomy using tricalcium silicate cement. Both teeth were followed-up for 36 months when they were asymptomatic, had no associated periodontal defects, had positive pulp sensibility tests as well as radiographic evidence of substantial periapical bony healing. The roots of tooth #17 had only a limited increase in length, with apical hard tissue barrier deposition, whereas tooth #32 (after pulpotomy) had continued root development. The 36 months follow-up of this case highlights the success of an interdisciplinary approach when integrating three-dimensional guides for double auto-transplantation of immature molars to successfully replace multiple teeth with extensive invasive ECR.

Keywords

Case report, external cervical resorption, auto-transplantation, guided endodontics, pulpotomy, tricalcium silicate cements.

Introduction

External cervical resorption (ECR) is a complex and often aggressive pathological process that originates just apical to the epithelial attachment at the cervical region of teeth. The condition is initiated by clastic cell activity and is characterized by a progressive, pathological loss of tooth structure[1]. The etiology of ECR is multifactorial with potential risk factors including orthodontic treatment, dental trauma, intracoronal bleaching, and periodontal procedures[1,2]. ECR is predominantly an incidental clinical and/or radiographic finding and may remain asymptomatic until it involves the pulp or periodontal structures and as a consequence often leads to extensive tooth destruction before detection[3]. The clinical management of ECR ranges from monitoring to routine tooth restoration, complex surgical procedures, or extraction depending on the extent of progression, clinical symptoms, presence of bone-like tissue in the defect and the preferences of the patient[3]. Extensive ECR defects compromise the structural integrity of teeth with an inevitable impact on their long-term survival[3]. The progression of ECR is rapid in younger patients due to wide and patent dentinal tubules[4]. Extraction and tooth replacement in such scenarios is influenced by the patient's age, esthetic and functional demands, and the need to preserve alveolar bone[3,5].

Auto-transplantation of teeth is a biologically favorable treatment option for tooth loss with the advantages of preserving vital periodontal tissues, allowing subsequent tooth eruption as well as maintaining alveolar bone[6]. The prognosis of auto-transplantation depends on a multitude of factors including patient age, tooth type, degree of apical root closure, the presence of inflammation at the recipient site, the volume and density of bone at the site, procedure type (use of guides), and the viability of the periodontal ligament on the donor tooth[7-12]. The survival rate of auto-transplantation of immature teeth has been reported to be 96.3% over 10 years[13]. Successful guided auto-transplantation of immature premolar teeth has been demonstrated in maxillary anterior teeth with replacement resorption[14].

The integration of guides augments the benefits of autotransplantation, thereby enabling its application in challenging cases such as multiple ECR in young patients. Interestingly, there are no documented cases of replacing multiple teeth with extensive invasive ECR using guided double auto-transplantation of immature molars. This case report explores the clinical applicability, technique sensitivity, and outcomes associated with guided dual auto-transplantation of two immature molars as a treatment modality for three unrestorable mandibular posterior teeth compromised by extensive invasive ECR.

Case report

A 17-year-old male presented in 2022 with the chief complaint of intermittent pain in the mandibular left posterior region over the past months, which had intensified in the five days prior to consultation. The patient reported a history of orthodontic treatment initiated in 2020 and completed in 2021. Clinical examination revealed severe tooth tissue loss in teeth #20 and 21 (Fig. 1A, B) with radiographic examination revealing extensive ECR on teeth #19, 20 and 21 (Fig. 1C-E). The teeth were tender to percussion and thermal and electric pulpal sensitivity tests were negative for all three teeth. A cone beam computed tomography (CBCT) scan was obtained (Orthophos S; Dentsply Sirona, Bensheim, Germany) (Fig. 1F) with a voxel size of 0.16 mm, field of view of 8 × 8 cm, and exposure parameters of 85 kV and 7 mA. The scan provided detailed assessment of the resorptive defects and their relationship to surrounding anatomical structures (Fig. 2A-C). The ECR defects were categorized as class III according to Heithersay[15] for ECR and based on Patel's CBCT-classification[16], they were categorized as follows:

- Teeth #20 and #21: Grade 3Dp (extending into the middle third of the root and involving the entire circumference with pulp involvement)
- Tooth #19: Grade 3Bp (extending into the middle third of the root and affecting two surfaces with pulp involvement)

The teeth were planned for extraction due to the invasive nature and extent of the lesions. Guided double tooth auto-transplantation of the immature teeth #17 and #32 into the sockets of teeth #19, 20 and 21were planned and discussed with the patient and their parents. After the consent of all involved, both transplant procedures were carried out in a single surgical session under local anesthesia.

Guided tooth auto-transplantation of two immature mandibular third molars in the #19-21 region after extraction:

The procedure was performed in the following stages:

a) Auto-transplant positioning planning,
b) Designing 3D printed replicas of the donor teeth,
c) Atraumatic extraction of the resorbed teeth and transplant site preparation with the aid of guides,
d) Atraumatic extraction of the donor teeth, and their placement and fixation in the recipient sites.

a) Auto-transplant position planning

Tooth #17 was transplanted to replace #20 and 21 and tooth #32 to replace tooth #19. Both #17 and 32 had immature apices (root development stage level 2) and were considered suitable for revascularization of the pulp tissue and natural root lengthening after the auto-transplantation. Planning of the donor teeth was based on the medium volume CBCT images (Ortophos SL 3D, Dentsply). The images were acquired with an 8 *8 cm field of view (70 kVp and 6.3 mA and 0.18mm voxel size). The recipient site bone dimensions as well as the crown size of the donor teeth (#17 and 32) were assessed. The crowns of teeth #19, 20 and 21 were approximately 8.5 mm, 8.0 mm, and 7.5 mm occluso-gingivally, and 7.0 mm, 7.0 mm, and 10.5 mm mesiodistally, respectively. The mesiodistal crown dimensions of donor teeth #17 and 32 were approximately 9.5 mm and 9.8 mm, respectively. Based on the similarity in mesiodistal width between donor and recipient sites, molar tooth #17 was selected to replace premolar teeth #20 and 21, while tooth #32 was selected to replace tooth #19.

b) Designing 3D printed replicas of the donor teeth

Donor tooth replicas were prepared as mentioned in a previous case report[14]. In brief, from the Digital Imaging and Communications in Medicine files of the CBCT images, the donor teeth replicas were generated after segmentation and stored as a stereolithographic file using software (NemoScan; Nemotec, Madrid, Spain). To aid in precise positioning of the donor teeth in the recipient sockets, a 3D-guide of both #17 and #32 were designed and printed using transparent biocompatible resin (Dental LT Clear Resin; Formlabs Inc., Somerville, MA, USA) (Fig. 2D, E).

c. *Atraumatic extraction of the resorbed teeth and transplant site preparation with the aid of guides*

The surgical procedure was performed under an inferior alveolar nerve block using 2% Lidocaine and 1:100,000 epinephrine (Norman, Madrid, Spain) via a 27-gauge needle. Teeth #19, 20 and 21 were extracted atraumatically. The bony socket between the premolars was modified using a round surgical bur under copious irrigation to accept the single donor tooth #17 (Fig. 3A). The sockets in the recipient sites were modified using low-speed surgical burs under constant irrigation guided by the donor tooth replicas to ensure precise fit and minimize the extra-alveolar time (Fig. 3B).

d. *Atraumatic extraction of the donor teeth, and their placement and fixation in the recipient sites.*

The donor teeth #17 and 32 were extracted atraumatically (henceforth referred as transplant) and transplanted in the #20, 21, and #19 regions respectively (Fig. 3C, D). The teeth were stabilized using a flexible orthodontic wire and composite for 4 weeks (Fig. 4A, B). The patient was advised to adhere to a soft diet for 14 days. Amoxicillin 500 mg as well as Ibuprofen 300 mg were prescribed for seven days.

The patient was followed-up at 4 weeks for removal of the splint and then at 1 (Fig. 4C), 4, 8, 12, 24 and 36 months. At the 6-month follow-up, the patient complained of pain in the transplant #32. The tooth had an exaggerated response to cold and was tender to percussion. Radiographic examination revealed widening of the periodontal ligament and incomplete root closure. A complete pulpotomy was performed on #32 under local anesthesia using a sterile round carbide bur in a slow-speed handpiece to minimize heat generation and preserve healthy pulp tissue (Fig. 4D). Pulp hemostasis was achieved using cotton pellets moistened with 1% sodium hypochlorite solution, and pulp capping was performed using NeoPutty™ (Zarc, Oviedo, Spain), a calcium silicate hydraulic cement, and the tooth restored with dental resin composite.

The patient was followed up for 36 months with clinical and radiographic assessments. The patient was asymptomatic with vital pulp responses in both teeth #17 and 32 with no associated bone loss or periodontal pockets / mobility. Post-operative radiographs revealed partial root development of transplant #17 with an apical barrier and hard tissue-like deposition in the apical region. Transplant #32 had continued root development with apical closure, however, the roots were shorter compared to the adjacent molar. Both transplants had no signs of root resorption. At 24months, there was clear radiographic evidence of periradicular bone regeneration, normal periodontal ligament space, and lamina dura surrounding the transplanted teeth (Fig. 4E). At 36 months (Fig. 4F), radiographs revealed no further root development in transplants #17 and #32. However advanced apical bony healing as well as an increase in the thickness of root dentin was observed in #32. No root resorption or canal obliteration was observed in either transplant. The occlusal alignment was not achieved perfectly, and options such as orthodontic correction or indirect restorations were discussed with the patient. However, the patient confirmed that the occlusal alignment was not a problem and declined further treatment.

Discussion

The survival rate reported by Heithersay[15] for extensive ECR was 12.5% for class 4 lesions over 4 years and by Mavridou et al.[3] as approximately 35% over 10 years. The two main reasons for loss of such teeth were either progression of the resorption or vertical root fracture. Currently, intentional replantation is considered a viable option for managing teeth with extensive ECR[17,18], however, lack of PDL adjacent to the resorptive defect can compromise periodontal healing after replantation[3]. In this case, the patient presented with extensive invasive 3Dp and 3Bp type resorption[16] in teeth #19, 20 and 21. Auto-transplantation of immature teeth is a viable alternative for such unrestorable teeth in younger patients as there is the potential for pulp revascularization. The failure rate is high during the first year of follow-up, thus, the long-term success of treatment is predicted to be high if an auto-transplanted tooth survives the first year without complications[13].

In this case, transplant #17 had positive pulp responses over the entire 36-month follow-up period with limited root length growth and apical closure with hard tissue deposition. The stage of root development determines the processes of pulpal healing and continued root development. Auto-transplantation of teeth with immature roots was reported to result in 96% pulpal healing in comparison to that of mature roots (15%)[8].

However, transplanted teeth with early stages of root development were associated with a shorter final root length in comparison to the non-transplanted control teeth[9]. Only 21% of auto-transplanted teeth were reported to have normal root development whereas 65% had partial arrest of root growth, which is likely explained by partial or complete damage to Hertwigs root sheath[9]. In the current case, the root growth was partially arrested with apical barrier formation in transplant #17. Interestingly, transplant #32 had continued root development. The difference in root development in the transplants could be attributed to multiple factors such as a) severance of Hertwig's root sheath during extraction of #17 or disturbance of this structure post transplantation[9], b) re-establishment of optimum pH after pulpotomy with tricalcium silicates could have aided the root growth of tooth #32[19], and c) the initial root length of the #17 was shorter than #32.

Transplant #32 had signs of pulpal inflammation at 6 months, which necessitated complete pulpotomy to allow further root development and maintain the vitality of the remaining pulp. An increase in root length and a decrease in the width of the root canal as well as a positive vital response was observed at 36 months. The development of pulp necrosis for a molar donor tooth was reported to be 2.5% and the success rate to a molar recipient site was 95% in comparison to that of the premolar recipient site[13].

Use of 3-dimensional replicas has advantages including short extra-oral time and minimal handling of the donor tooth, fewer attempts when fitting the donor tooth in the recipient site, precise socket modification thus allowing minimal PDL damage, and enhanced healing of the auto-transplanted teeth[20]. The mean extraoral time ranges between 0-7 minutes when using guided templates for auto-transplantation. The success and survival rates when using guided 3D printed replicas for auto-transplantation range from 80.0% to 91.1% and 95.5% to 100%, respectively[20]. Previously, successful management of a young patient with maxillary anterior tooth replacement resorption with 3D guided auto-transplantation of an immature premolar has been reported[14]. However, the donor premolar had root canal obliteration with root-end closure at the 12 months follow-up.

In this case, the transplants were stabilized using wire and composite, however, suture splints for seven days after auto-transplantation has been suggested[21]. Fixation with wire and composite can have a negative influence on the clinical outcome over 3-year follow-ups with a reduction of survival rate to 73.5% in comparison to suture fixation (92.9%)[22]. In the present case, a flexible orthodontic wire and composite splint was selected based on the specific clinical circumstances. Two immature molar transplants were used to replace three posterior teeth in a single surgical session, and the recipient sites required extensive socket modification. Under these conditions, controlled stabilization was considered necessary to limit excessive micromovement during the initial periodontal healing phase. Importantly, the splint was flexible and not rigid, and fixation was limited to four weeks to minimize the risk of ankylosis.

In this case, auto-transplantation was favored over implants or prosthetic replacement in order to preserve alveolar bone and maintain tooth function, which is particularly relevant in developing individuals[6] . Auto-transplanted teeth are capable of growing with the mandible, thereby promoting alveolar ridge development, whereas implants or other prosthetic replacement options lack this ability[23]. This approach maintains the proprioception of the periodontal ligament, which implants are unable to achieve [24]. Hence, auto-transplantation is biologically advantageous and adapted to the patient's age and developmental stage.

The strength of the case is the use of 3D printed auto-replicas for auto-transplantation and the relatively long 36-month follow-up. An obvious limitation is the small number of teeth that were treated with the result that the quality of evidence is not high. Thus, well designed clinical trials are recommended in future with long term follow-up.

Conclusion

This case report highlights two key points. Firstly, the use of CBCT and 3D replicas as aids during the auto-transplantation of teeth with extensive external cervical root resorption. Secondly, two teeth were used to replace three teeth lost due to ECR without affecting the occlusion whilst also allowing natural progressive jaw growth and maintained bone volume. Guided double auto-transplantation is therefore a viable alternative option to prosthetic or implant-based approaches in young patients when multiple teeth have ECR.

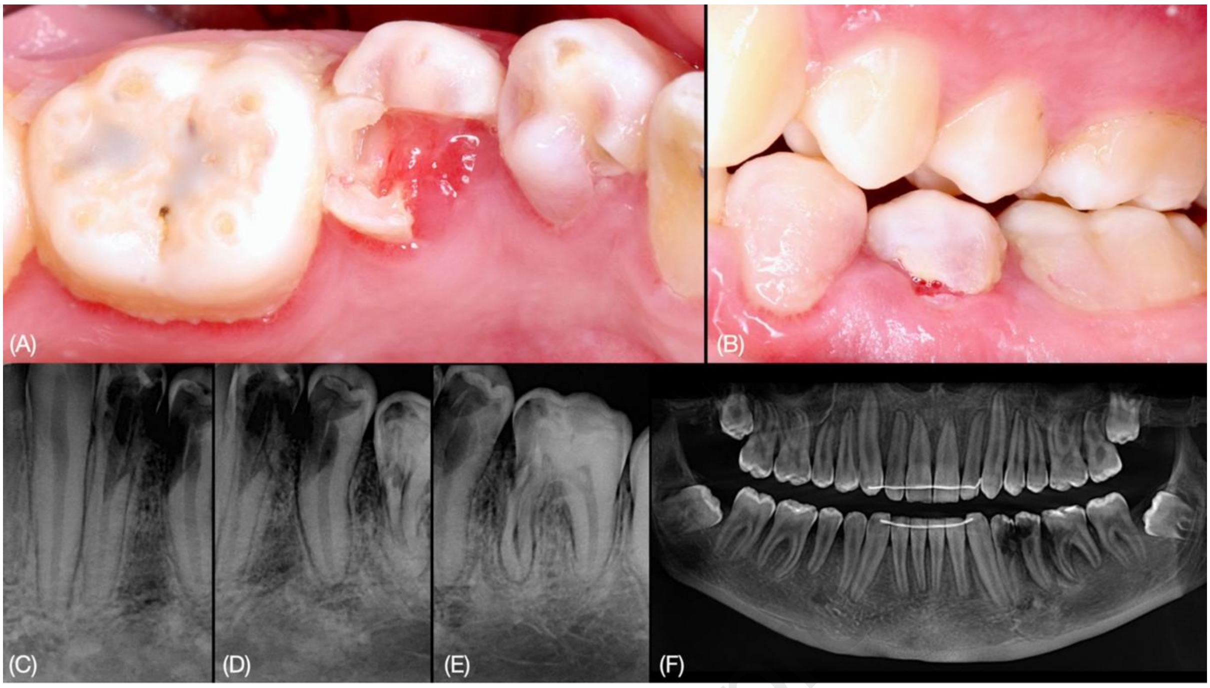

Figure 1. Initial clinical and radiographic presentation. (A, B) Occlusal and buccal views of teeth #20 and #21 showing severe tooth tissue loss. (C, D, E) Periapical radiographs revealing extensive external cervical resorption (ECR) on teeth #19, #20, and #21. (F) Panoramic view from the cone beam computed tomography (CBCT) scan.

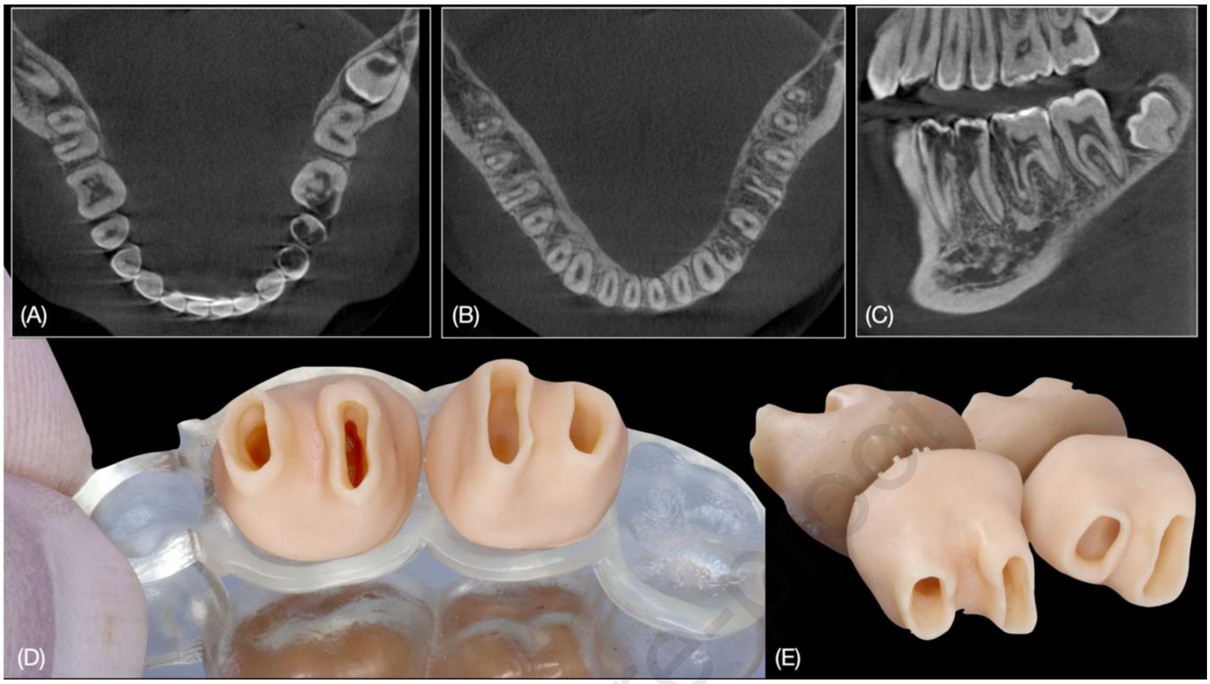

Figure 2. Pre-surgical CBCT assessment and 3D printed replicas. (A-C) CBCT images providing a detailed assessment of the resorptive defects in teeth #19, #20, and #21 and their relationship to surrounding anatomical structures. (D, E) 3D printed replicas of donor teeth #17 and #32.

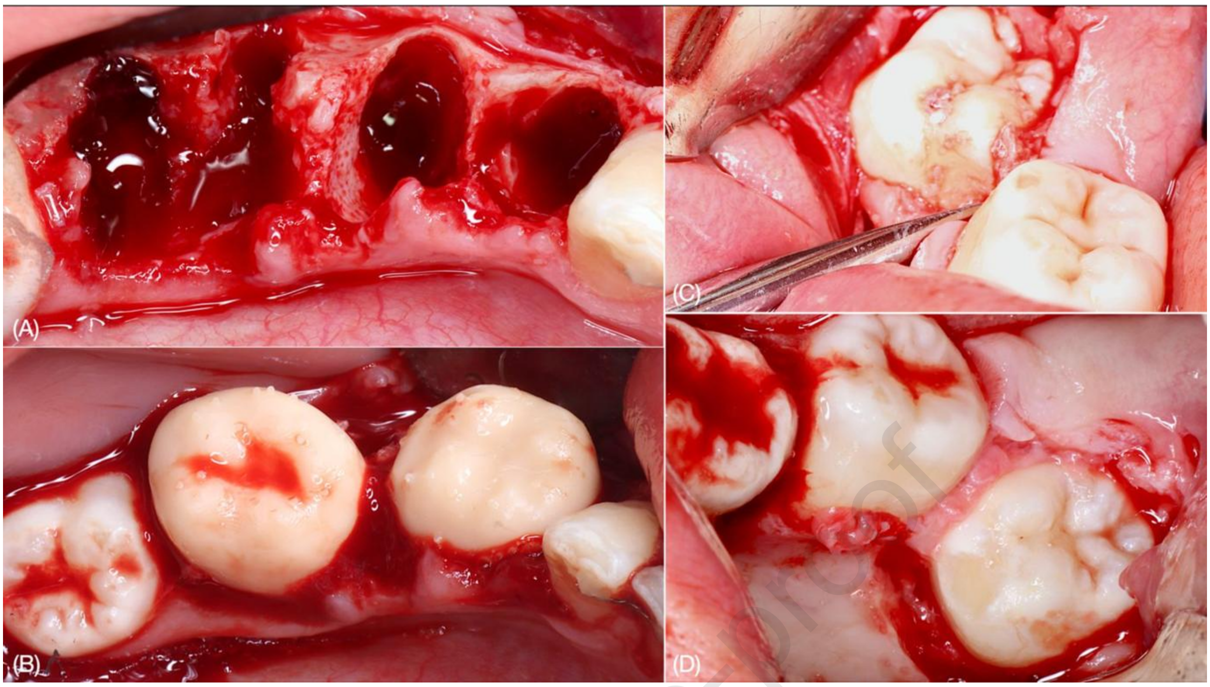

Figure 3. Surgical procedure and tooth transplantation. (A) Surgical site preparation showing the modification to the bony socket between the premolar teeth #19, #20. (B) Donor tooth replicas in the recipient sites to allow adjustments to the sockets to ensure a precise fit and minimize extra-alveolar time. (C, D) Placement and fixation of the atraumatically extracted donor teeth (#17 and #32) into the #20, #21, and #19 regions, respectively.

Figure 4. Post-operative periapical radiographs over the 36-month follow-up. (A, B) Immediate post-operative radiographs showing the stabilized transplanted teeth. (C) Radiographic follow-up at 1 month. (D) Radiograph of tooth #32 at the 6-month follow-up showing the calcium silicate hydraulic pulp capping cement used during the complete pulpotomy. (E) Radiographic follow-up at 24 months demonstrating periradicular bone regeneration and ongoing root-end closure (F) Radiographic follow-up at 36 months demonstrating no further increase in root length on transplants #17 and #32; however, an increased thickness of root dentin in #32 has occurred. There are no signs of apical pathosis with either transplant.

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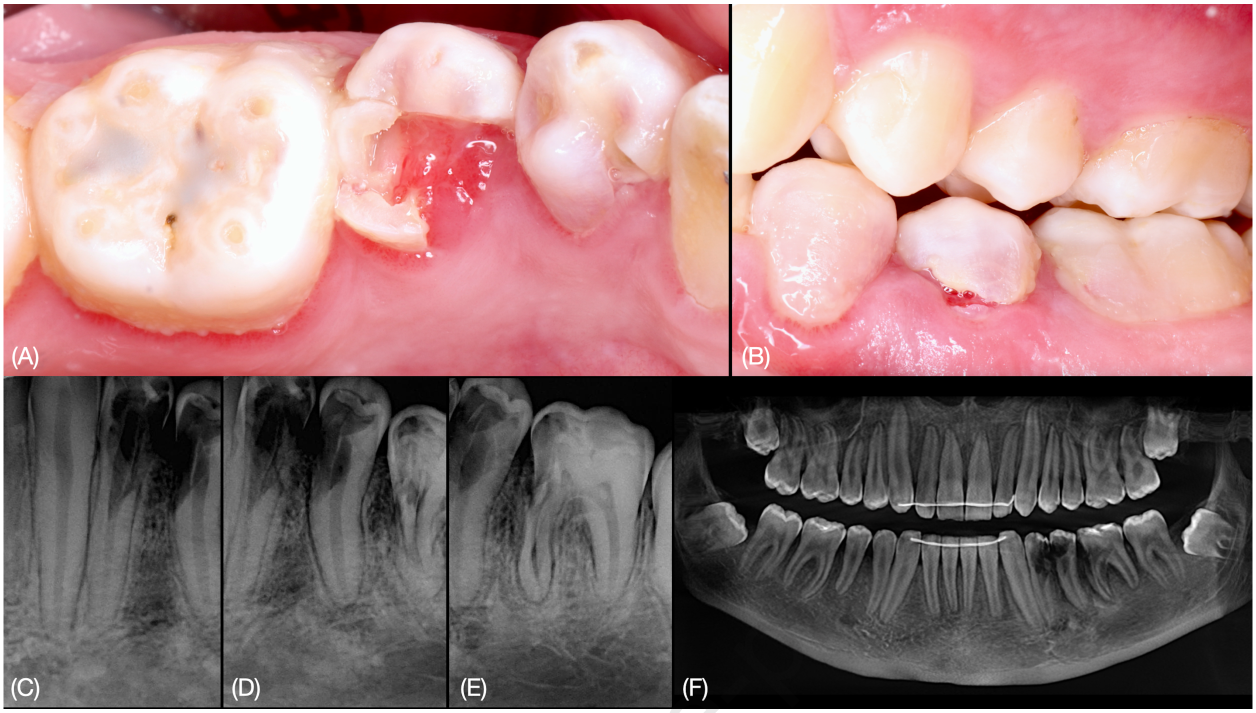
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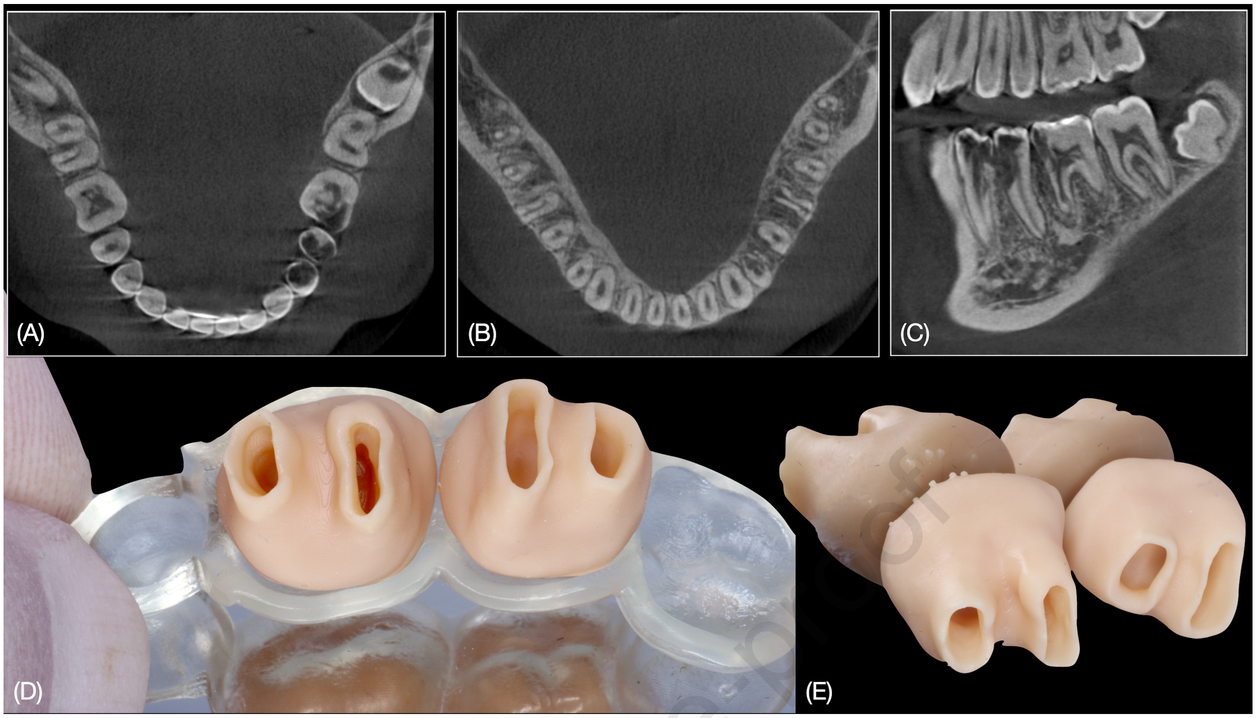
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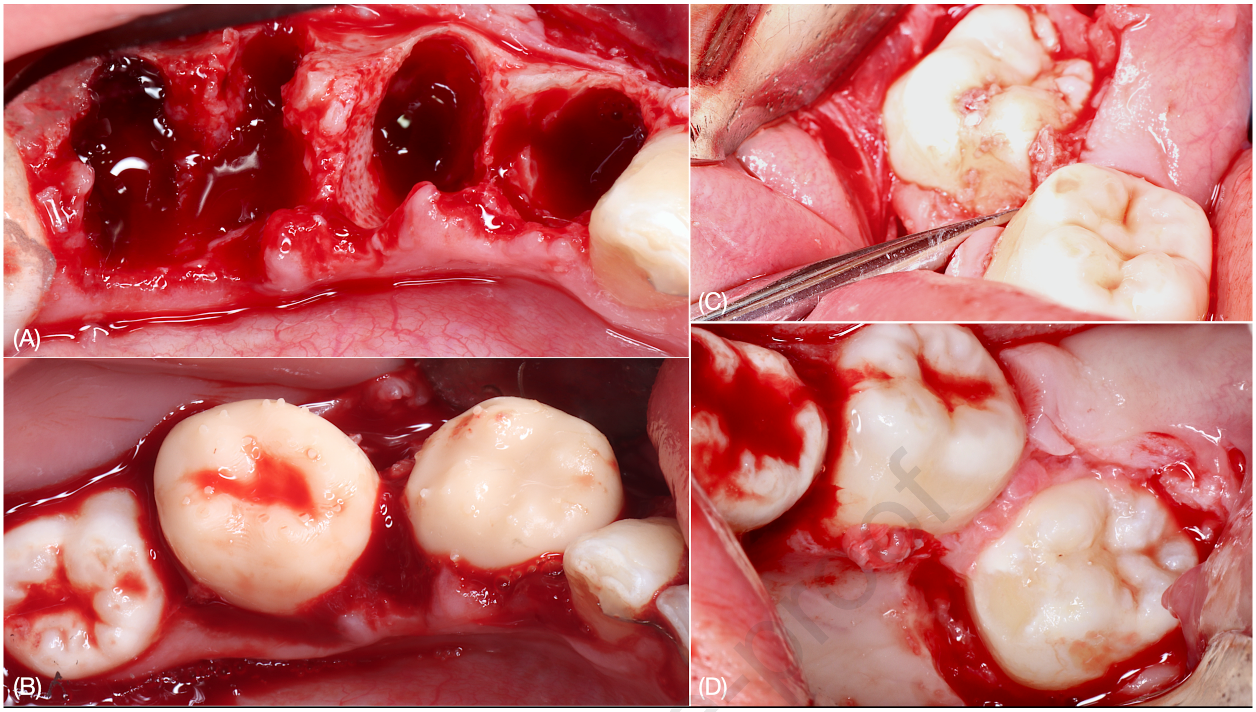

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