

Case Report

Immediate autotransplantation of a mandibular premolar with complete roots to a fractured tooth site, using platelet-rich fibrin in an orthodontic patient, report of a case

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ABSTRACT

Transplantation of one tooth to another site in the same individual can be considered an attractive alternative to dental implants or fixed prostheses. This study reports the treatment results of a 16-year-old female with severe crowding in upper and lower arches and a fractured mandibular premolar with a poor prognosis. The crowding of the lower left quadrant was relieved by the extraction of the first premolar. This extracted tooth with a complete root was transplanted to the right quadrant with the fractured tooth. Platelet-rich fibrin can stimulate and accelerate periodontal healing. The platelet concentrate of this patient was prepared and applied to the socket wall at the time of surgery. The acceptable occlusion and the excellent 4-year prognosis of the transplanted tooth are presented.

Key Words: Autologous, platelet-rich fibrin, tooth fracture, transplantation

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INTRODUCTION

Autotransplantation, defined as the surgical removal of a tooth from one site and implanting it at another site in the same individual has gained much more attention in recent years. This procedure serves to substitute for congenitally or pathologic missing teeth due to trauma, ectopic eruption, severe caries, or periodontal disease and provides to replace the missing teeth with a natural one rather than a prosthesis or dental implant.^[1] Biological advantages of autotransplantation, such as physiologic stimulation of the periodontal ligament (PDL) and alveolar bone besides to enhanced esthetics, less complicated procedures of implant surgery, and less cost, makes this treatment option more attractive.^[2]

Orthodontic treatment plans involving extraction may be chosen for a patient to relieve crowding or compensate for a skeletal or dental discrepancy. The impact of extraction orthodontic treatment becomes more problematic in the adult population with an already missing tooth. They are more reluctant to having another tooth extracted.^[3] If the extracted tooth in one region could be transplanted to the site with a missing tooth, the patient would benefit from saving more teeth.

Backing to well-documented reports and reviews, after comprehensive case evaluation and selection,

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autotransplantation can be offered to patients with preextractions and congenitally missing teeth. Despite the high success rate of 80% survival rate of autotransplanted teeth,^[4,5] it may be a less heard treatment option. The speculations of failure of autotransplanted teeth with complete roots, less knowledge, and skill may be the possible reasons. Although the root development stage has been suggested as a prognostic factor for survival, recent systematic reviews have suggested favorable survival and success rates for autotransplantation of teeth with completed roots.^[4,6] Inflammatory root resorption and replacement resorption are among the most common complications.^[7]

Platelet-rich fibrin (PRF) or Choukroun's PRF is a second-generation platelet concentrate and is constituted from three major components: activated platelets and their growth factors, leukocytes and cytokines, and a fibrin matrix which is responsible for the slow release of growth factors during the critical period of healing proliferation stage. PRF is a great reservoir for the sustained release of transforming growth factor β , platelet-derived growth factors, and vascular endothelial growth factors which promote angiogenesis, cell proliferation, and migration.^[8] The application of PRF membranes has shown to greatly enhance periodontal and soft-tissue repair.^[8,9]

Here, we report an orthodontic patient with skeletal class I, severe crowding, a fractured premolar tooth, and multiple poor prognosis teeth. We decided to autotransplant a premolar from the left mandibular quadrant to the fractured site using PRF. We represent the results of 4 years of follow-up.

DIAGNOSIS AND ETIOLOGY

The patient was a 16-year-old female who attended the orthodontic department of X University of Medical Sciences with the primary chief concern of crowding. Initial clinical examination revealed a straight profile and normal competent lips. The tooth and gingival display were normal at rest and on a smile.

Intra-arch assessment showed severe crowding in the maxillary arch, in which both canines were blocked out and lateral incisors had linguversion. There was severe crowding in the lower arch as well, which the left second premolar was lingually blocked out. The patient had previously extracted the lower right first premolar, and the lower right second premolar was already fractured at the level of the cemento-enamel

junction (CEJ). The mandibular right first molar had a large amalgam restoration. The left and right canine were in a class II relationship, the left molar had a class I, and the right molar had a class III relationship. Maxillary and mandibular dental midlines were deviated 2 and 3 mm to right, respectively. The overjet and overbite were normal. Cephalometric analysis confirmed the normal sagittal and vertical skeletal relationships examined clinically. Maxillary and mandibular incisors had normal inclinations.

After comprehensive periodontal examination, the lower second premolar was confirmed unrestorable due to the fractured crown below CEJ, recurrent caries under the amalgam restoration of the lower right first molar and severe caries of both maxillary second premolars were apparent on the panoramic radiograph. The third molars were normally developing [Figure 1].

The summary diagnosis was a skeletal class I patient with severe crowding in the maxilla and mandible, a preextraction of the lower right first premolar, and a fractured second premolar in the same quadrant [Figures 2-4].

Orthodontic treatment alternatives

Under normal conditions, extraction of both the upper and lower left first premolar and restoring the lower right second premolar with an implant restoration would be considered the ideal standard treatment. Extracting the upper first premolars and the lower left second premolar and space closure at that site may also be considered an option. A third alternative would be the extraction of the upper first premolars and one lower incisor to correct the canine relationship. Another possible option was destabilizing upper buccal segments to retract canines to a class I relationship. However, the specific condition of this patient, crowding in the mandibular left quadrant and the fractured tooth at the right quadrant lead to



Figure 1: Initial panoramic radiograph of patient.



Figure 2: Composite photographs of patient at the start of treatment.



Figure 3: Photography of initial dental models.

another treatment option which was suggested to the patient: Extracting the lower right second premolar and transplanting the left first premolar to this site. The mandibular left first premolar was selected for transplantation, as this tooth was blocked out of the arch, it already had a thin cortical plate covering and did not have adequate keratinized tissue. The upper second premolars were also to be extracted. Despite the anchorage requirements of the upper arch, this extraction plan was chosen to save the first premolars which had much better prognosis than the second premolars. After thorough explanation The patient

signed an informed consent to the treatment option of extracting the already poor prognosis teeth and to save the healthy teeth.

Treatment objectives

The objectives for this patient were to: (1) align the teeth and eliminate crowding, (2) Achieve a functional orthopedically stable occlusion, and (3) Manage the fractured tooth with autotransplanting the left premolar, while maintaining the already proportionate facial relationships.

Treatment progress

The patient was referred to the endodontic and restorative departments to eliminate active caries and restore teeth. She was also referred to the periodontics department for phase I periodontal therapy. After 2 months, fixed orthodontic therapy was initiated in the lower arch by leveling and aligning teeth with an MBT slot 0.022-inch system (Pinnacle, ortho technology, USA). The tooth to be transplanted was not bonded. Since space had been lost in the recipient site, space was regained by implementing a NiTi open coil. The upper arch was also leveled and aligned by extraction of the second premolars simultaneously.

A transpalatal bar connected the two maxillary molars. This in addition to banding the upper second molars was planned to reinforce posterior anchorage. A cone-beam computed tomography evaluation was done, and the recipient socket length and the root length of the donor's tooth were measured. Endodontic treatment of that tooth was performed before surgery. (Figure 5a and b)

To prepare a PRF membrane, briefly, 9cc of the patient's venous blood was withdrawn and collected in a plastic tube with a glass coating. The sample was immediately centrifuged at 2000 RPM, 400 g for 10 min. Residual cells were scraped and removed, and the fibrin clot (figure 6a) was transferred to a PRF box and compressed (PRF-BOX MCT, Seoul, Korea). As such the PRF membrane was prepared^[10] [Figure 6b].

The surgical procedure was performed as follows: first, the fractured premolar root at the recipient site was atraumatically extracted (Figure 5a, 5b) using piezosurgery, then, the socket was prepared by drilling for the premolar with longer root [Figure 5c]. The prepared socket was vigorously irrigated with PRF exudate and 0.9% saline. At this stage, the PRF membrane was applied to socket walls (Figure 6c) and the atraumatically extracted donor premolar tooth with intact PDL was immediately implanted in the site and secured with a simple suture. (Figure 7a, 7b) The tooth was splinted to adjacent teeth with ligature wire for 2 weeks. Heavy occlusal contacts were eliminated at the transplanted site, and a soft diet regime was prescribed. The patient was instructed to use amoxicillin 500 mg of every 8 h for a week and 400 mg of ibuprofen every 6 h for the 1st days.

Two weeks after the surgery, the patient returned to the orthodontic department and orthodontic treatment was resumed. After leveling and aligning, the canines and anterior teeth in the lower arch were retracted, and final adjustments for better occlusion were done.

Treatment results

After 25 months of treatment, a class II canine relationship was apparent on both sides. As the patient did not cooperate with using class II elastics and due to the missed appointments (during the very 1st months of the COVID-19 pandemic) and the resultant anchorage loss, this occlusion was considered acceptable. However, we might be able to prevent this anchorage loss by application of skeletal anchorage as bilateral miniscrews are inserted in the

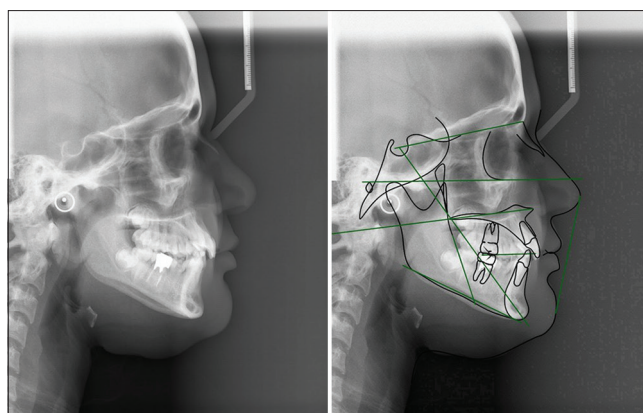


Figure 4: Initial lateral cephalogram radiograph and tracing.

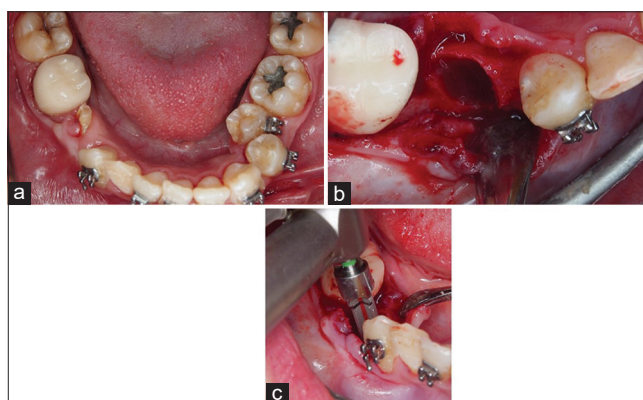


Figure 5: (a) PRF clot, (b) PRF membrane, (c) PRF applied in tooth socket. PRF: Platelet-rich fibrin.



Figure 6: (a) Entire arch before surgery, (b) extraction of fractured teeth, (c) preparation of recipient site.

palatal or alveolar region. This result was compatible with a functionally stable occlusion planned initially and there were not any occlusal interferences on the nonworking side, nor there were posterior contacts on the protrusive position.^[11] All extraction spaces were closed. Dental midlines were coincident with facial midlines. Crowding was totally eliminated, and smile esthetics had improved [Figures 8 and

9]. Oral hygiene status of the patient had improved significantly, though there were white spot lesions. Superimposition of the pretreatment and posttreatment lateral cephalogram tracings revealed that no noticeable skeletal change was obvious, there was slight maxillary molar tipping, proclination of maxillary incisors had occurred and there was no change in lower incisor inclination [Figure 10]. Posttreatment radiographic records are presented in Figure 11,12.

The results were stable 4 years after the surgery (2.5 years after debond). The transplanted tooth had no symptoms during and after orthodontic treatment. The serial periapical radiographs confirmed

the absence of any pathological status: ankylosis, replacement resorption, and inflammation were ruled out and the lamina dura was intact around the root [Figure 13].

Despite orthodontic mechanics implemented to correct the rotation of the transplanted teeth, it was not totally eliminated as were concerned to put heavier forces for longer durations.

DISCUSSION

The challenging topic of whether or not to extract teeth for orthodontic reasons has been a debating one for long years. Various factors including facial esthetics, age, periodontal condition of the patient, restorations, missing, and extracted teeth, all influence the orthodontic treatment plan to be conducted by an extraction or nonextraction plan.^[12] The real or perceived benefits of nonextraction treatment have made a great proportion of patients to request for a nonextraction treatment. This is particularly true for patients who already have a compromised dentition with some extracted teeth. This patient had several teeth with severe caries and a fractured tooth with a poor prognosis. As she learned about the treatment alternatives, she showed great desire to the autotransplantation plan. Less teeth were

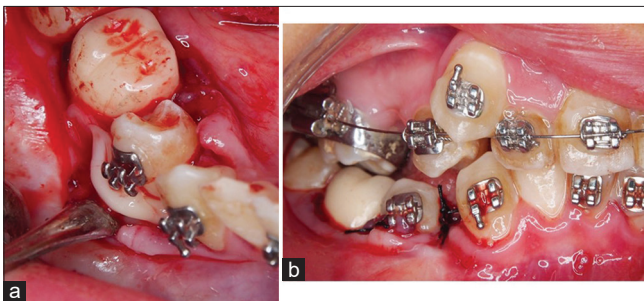


Figure 7: (a) Autotransplantation of teeth, (b) Sutured tooth, out of occlusion.



Figure 8: Composite photographs of patient at debonding of orthodontic appliances.



Figure 9: Photography of final dental models.

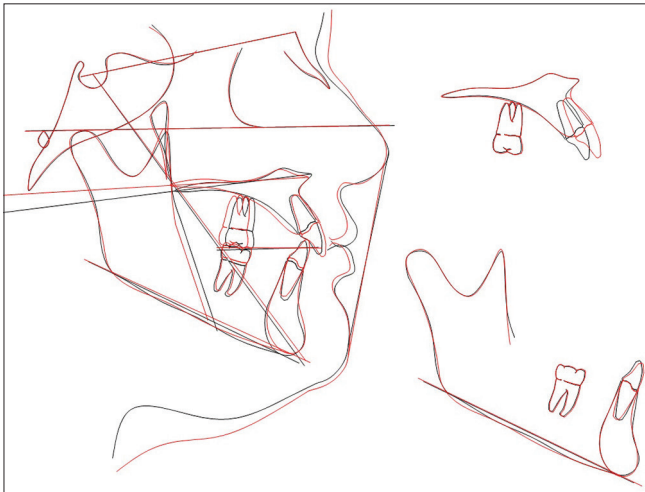


Figure 10: Superimposition of initial and final lateral cephalograms.

to be extracted and saving treatment time and cost and less tooth movement were among the advantages of this plan. A prosthetic implant may be considered a viable alternative, however, the remaining vertical growth would have led to postponing the surgery and consequent migration and drifting of adjacent teeth and supra-eruption of upper teeth necessitated full-time retention of the dentition.

The most common complications associated with tooth autotransplantation are root resorption and ankylosis.^[5] From a biological standpoint, successful autotransplantation relies on PDL cells' viability and proliferative capacity. PRF is an autologous platelet concentrate which serves as a great reservoir of growth factors. It has been shown that it quickly stimulates tissue healing through a significant increase in the recruitment and proliferation of a variety of cells including endothelial cells, fibroblasts, and osteoblasts which promote angiogenesis and repair. Local concentrates of various growth factors and cytokines trapped within the fibrous scaffolding regulate and enhance

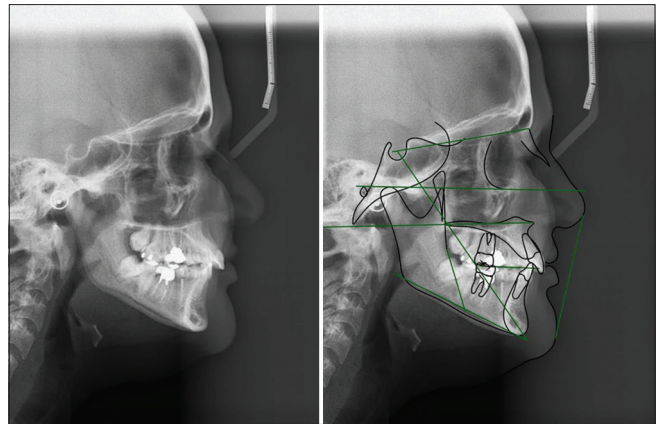


Figure 11: Final lateral cephalogram radiograph and tracing.



Figure 12: Posttreatment panoramic radiograph.

the biological process of regeneration as a result the clinical outcomes of soft and hard oral tissue surgery enhance.^[13] In this case, we used a PRF membrane applied to the socket walls which may have a major effect on the survival of PDL cells, affecting the healing process, and resulting in the prevention of ankylosis and root resorption.

From a clinical perspective, alongside a comprehensive and well-coordinated teamwork of a periodontist/oral surgeon, an endodontist, and an orthodontist, a successful autotransplantation is dependent on a series of factors: prescription of systemic antibiotics, endodontic treatment performed preoperatively, postoperatively or extraorally, splinting with proper technique, and the donor tooth morphology. The assumption that this procedure will fail in teeth with completely formed roots is no longer acceptable. Meta-analysis has confirmed that autotransplantation of the tooth with complete roots is stable and 5-year survival rates are excellent: 90.4% (95 confidence interval of: 84.9%–94.1%).^[14]

Other factors such as preapplication of orthodontic force, atraumatic extraction, and minimal extraoral



Figure 13: Four-year follow-up periapical radiograph of the transplanted tooth.

manipulation time (<15 min)^[15] have also been reported to increase success rates.^[3] Early orthodontic force applied to the transplanted tooth has been shown to stimulate periodontal healing and may prevent ankylosis.^[1] Technological advances have also been proposed recently to enhance success rates. Computer-aided rapid prototyping models have been shown to minimize the extraoral time during the surgical procedure of autotransplantation and reduce PDL injury.^[7]

In this case, we applied very light orthodontic force (0.012 NiTi) 2 weeks after the surgery was performed, which may also have contributed to periodontal healing.

In the 4-year follow-up periapical radiograph, the alveolar crest and lamina dura of the transplanted premolar were intact and healthy.

CONCLUSION

The autotransplanted tooth showed an acceptable result after 4 years of follow-up. Autotransplantation of teeth with complete roots should be considered a treatment alternative to prosthetic restorations. Surgical adjuncts may greatly enhance the success rates of autotransplantation. PRF can eliminate the risk of ankylosis or resorption.

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Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or nonfinancial in this article.

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