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CASE STUDY

Tooth autotransplantation outcomes using platelet-rich fibrin: A promising approach; case study

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Abstract

Background: Autogenous tooth transplantation refers to a surgical procedure involving the relocation of a tooth within the same individual. Incorporating platelet-rich fibrin (PRF) in this procedure holds the potential to improve healing, accelerate recovery, and optimize treatment outcomes.

Methods: In this article, the authors illustrate a PRF-based approach for autogenous tooth transplantation through two case scenarios. These cases outline the surgical steps of tooth transplantation and demonstrate the potential role of PRF in enhancing soft tissue healing. Furthermore, the article provides insights from a long-term follow-up spanning over 7 years.

Results: Tooth transplantation in young adults is promising but depends on factors such as root development stage and donor tooth size matching. Including PRF may improve healing, at least in the short term, due to its rich concentration of growth factors and cytokines, promoting effective tissue regeneration.

Conclusions: Autogenous tooth transplantation has shown to be a viable treatment option for replacing the missing dentition. Adding PRF to the autogenous tooth transplantation procedure may speed up and enhance the treatment outcome. While the favorable results of these cases might be partially attributed to the use of PRF, the contribution of PRF to the healing process of tooth transplant remains conjectural and requires validation through additional research.

KEYWORDS
transplantation, autologous, platelet-rich fibrin, biological factors, wound healing, case study

Key Points/Highlights

Tooth autotransplantation can be performed in younger patients without requiring root canal treatment, while also potentially benefiting from the incorporation of platelet-rich fibrin (PRF).

INTRODUCTION

Successful tooth autotransplantation depends on numerous biological and surgical factors.[1,2] A major element in ensuring the survival and success of a transplanted tooth is the presence of a sufficient number of periodontal ligament (PDL) cells occupying the tooth surface compared to osteoblasts or epithelial cells.[3] Evidence supports the hypothesis that endogenous stem cells can detect biological signals from platelet-rich fibrin (PRF) membranes.[4] One

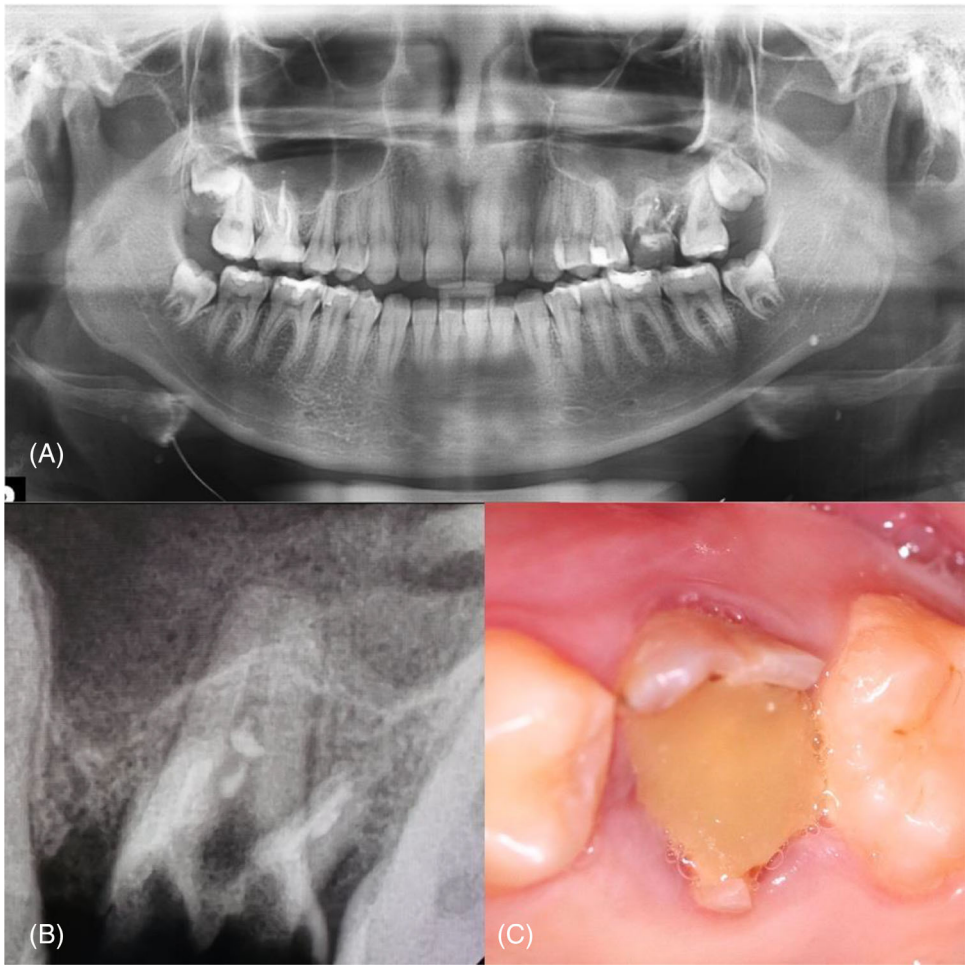

FIGURE 1 A 16-year-old female patient underwent a clinical and radiographic examination, which revealed an extensively decayed tooth, #14, that was beyond restoration. The examination included the following: (A) A panoramic radiograph demonstrated the condition of the teeth, the level of the bone, and the developing third molars. (B) A periapical radiograph showed an unrestorable badly decayed first permanent molar near the maxillary sinus. (C) A clinical photo depicted the condition of the crown and the supporting tissues.

of the common sequelae from autotransplantation procedures is ankylosis of the transplanted tooth, which may or may not require endodontic therapy.[5,6] However, a primary study of in vivo and clinical studies provides support to the notion that the use of biologics such as PRF is more effective in regenerating PDL-like tissues and preventing ankylosis.[3,7]

There are several advantages of applying autotransplantation as a possible treatment option to replace missing teeth. It offers proprioception during function and can have a favorable prognosis, particularly in the growing patient population, although satisfactory outcomes have also been reported in older adults.[8] This treatment option allows the preservation of the alveolar bone volume by preserving PDL.[9] From an economic perspective, tooth autotransplantation has shown potential as a reasonable option to replace a missing tooth in a less costly manner compared to implants.[10]

In oral regenerative applications, PRF is typically used either alone or in combination with bone grafts to stimulate bone growth and promote vascularization. This fibrin-based matrix facilitates the migration, attachment, and proliferation of osteoblasts, thereby facilitating the formation of new bone tissue.[11] PRF offers advantages such as cost-effectiveness, ease of preparation, and practicality for routine clinical use.[12] PRF acts as a slow-release local delivery vehicle for growth factors, whereas platelet-rich plasma (PRP) releases most of its growth factors in the first 48 h.[13] The effectiveness of utilizing PRF to enhance oral wound healing has been evaluated clinically and radiographically in numerous studies.[13] Although this review acknowledged the positive effects of PRF on overall clinical outcomes, the high variability in surgical protocols did not allow the formation of a concrete, generalizable conclusion or recommendation.

Therefore, this case study aimed to demonstrate successful long-term outcomes of two cases of successful tooth autotransplantation when PRF was also used to promote healing and minimize possible side effects.

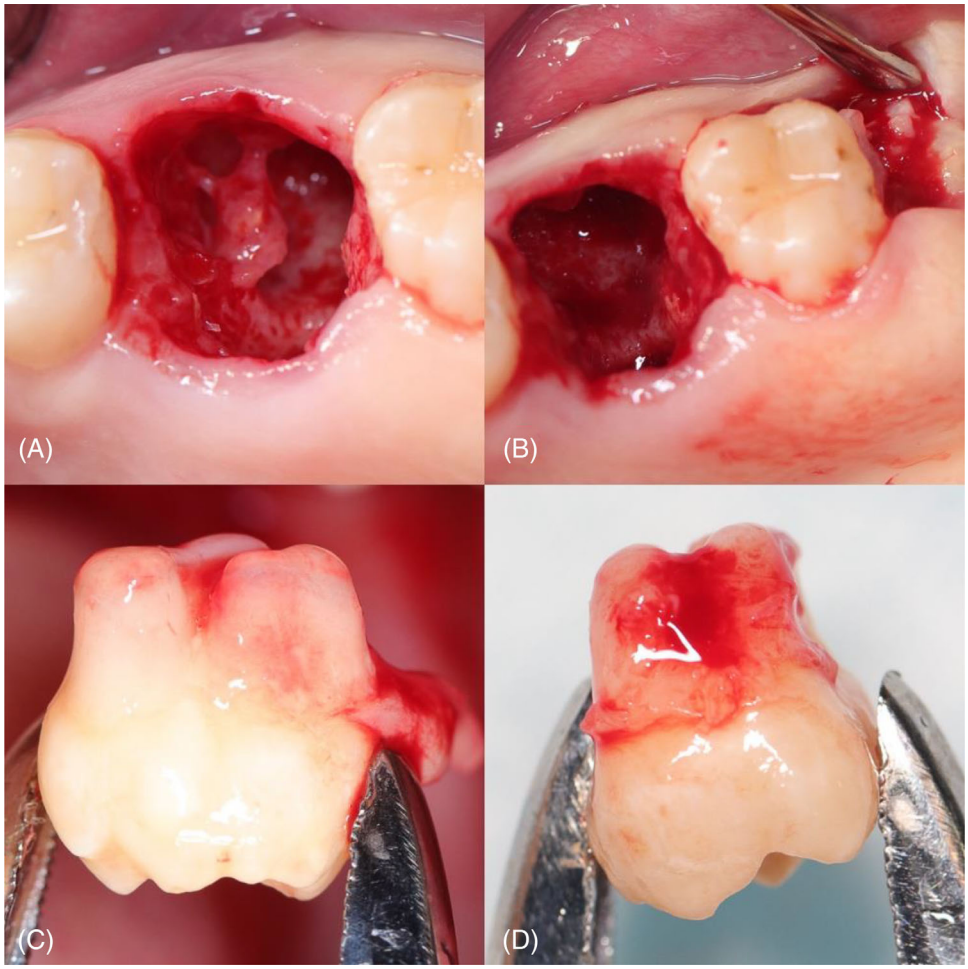

FIGURE 2 (A) Occlusal view of the socket after minimally traumatic extraction. (B) Occlusal view showing the extraction of the soft tissue-impacted third molar. (C) Close-up clinical photo immediately after surgical removal, showing the immature third molar. (D) The transplanted tooth should be held from the crown to avoid any disruption to the periodontal ligament (PDL) cells.

MATERIALS AND METHODS

Clinical presentation

Two periodontally healthy females, aged 16 and 17, respectively, presented at Alhussein Private Dental Clinic, Tripoli, Libya 2017 with severe dental pain localized in the posterior region and a present third molar in the same quadrant (Figures 1–7). Clinical and radiographic examinations revealed an extensively decayed first molar tooth beyond restoration. The first case involved a maxillary first molar, and the second involved a mandibular first molar, both with a history of endodontic therapy. No other regions of the dentition were noted by the patients as a part of their chief complaint. The medical history for all patients was unremarkable, with no record of radiation treatment or bisphosphonate therapy. Radiographs were obtained before the surgery to assess the general condition of the alveolar bone and dentition, which did not reveal any relevant pathosis in the region of interest apart from the tooth to be extracted. We conducted a comprehensive assessment of clinical parameters, including mobility, for each patient. Our evaluation meticulously covered parameters such as probing depth, attachment levels, mobility, and other relevant clinical indicators both before and after the tooth transplantation procedure.

Case management

Prior to starting the surgery, blood samples were collected from each patient with a 21-gauge needle, and 6–810 mL blood collection tubes were filled without the addition of anticoagulants. After collection, the blood was immediately centrifuged[*] with a force of approximately 400 G (2700 rpm) for 12 min. L-PRF membranes were generated with specific settings, including a 33° rotor angulation, 50 mm radius at the clot, and 80 mm at the maximum. The process was carried out using 9-mL glass-coated plastic tubes[†]. After

[*] Intra-Spin EBA 200, Intra-Lock System, FL, USA.
[†] Intra-Spin EBA 200, Intra-Lock System, FL, USA.

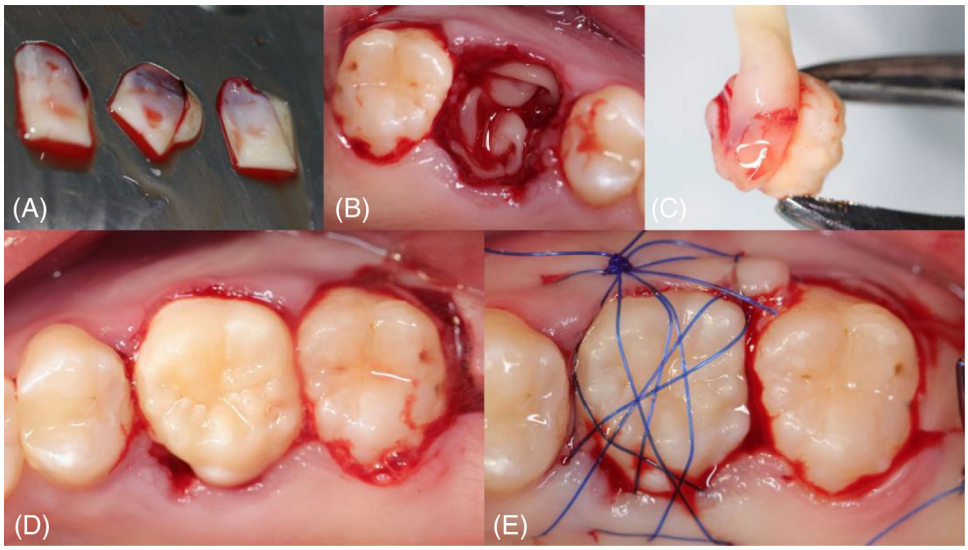

FIGURE 3 (A) Platelet-rich fibrin (PRF) membranes were prepared from the patient's blood. (B) Two to three PRF membranes were packed inside the socket before transplantation. (C) Another PRF membrane was wrapped around the transplanted tooth. (D) Occlusal view of the transplanted tooth. (E) Occlusal view showing stabilization with 5-0 sutures at both the transplant site and the donor site.

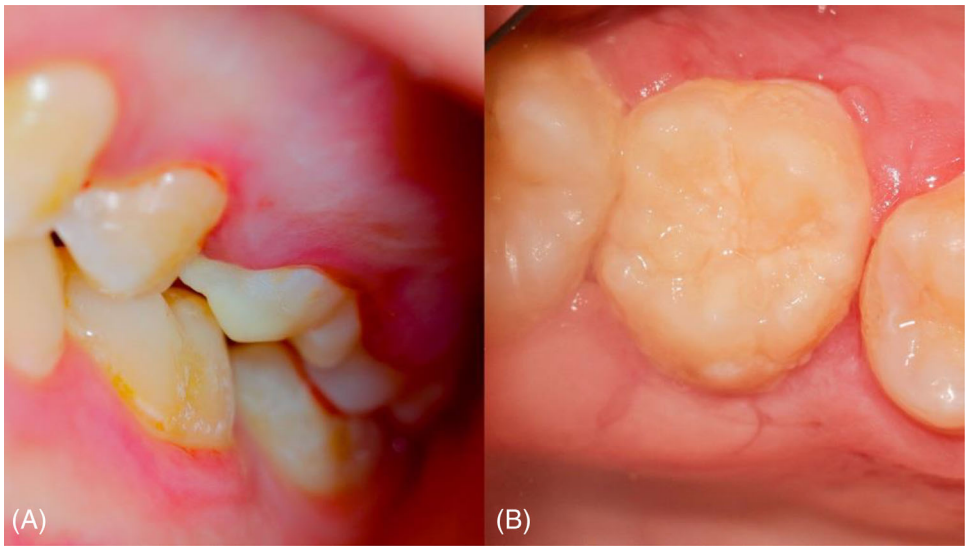

FIGURE 4 (A) Clinical side view during maximum intercuspation immediately after transplantation. (B) Occlusal view after 2 weeks follow-up.

centrifugation, the tubes were placed vertically in a rack allowing the blood to clot for about 15–20 min. The clot was removed from the collection tubes bluntly and placed into the PRF cassette[‡]. Light pressure was applied to the PRF clot to facilitate gentle compression and formation of the membrane.[14]

The clinical cases involved gently extracting hopeless teeth before autotransplantation. If the interdental septa were intact, minor surgery was performed to reshape the socket in order to accommodate the transplantation. Meticulous care was taken to achieve complete debridement. Granulation tissue was removed using a small surgical curette to ensure the elimination of any inflammatory tissue and to create a favorable environment for optimal healing. The third molars were carefully extracted with ligament preservation, avoiding root disturbance (Figure 2). PRF membranes were used to enhance cell viability in the transplanted tooth (Figure 3). The occlusal adjustment was performed to minimize donor tooth damage, and non-absorbable sutures were used to stabilize the transplanted tooth (cross-mattress sutures and single-interrupted sutures)[§] (Figure 3). Post-surgery radiographs

[‡] Intra-Spin EBA 200, Intra-Lock System, FL, USA.

[§] Ethicon, NJ, USA.

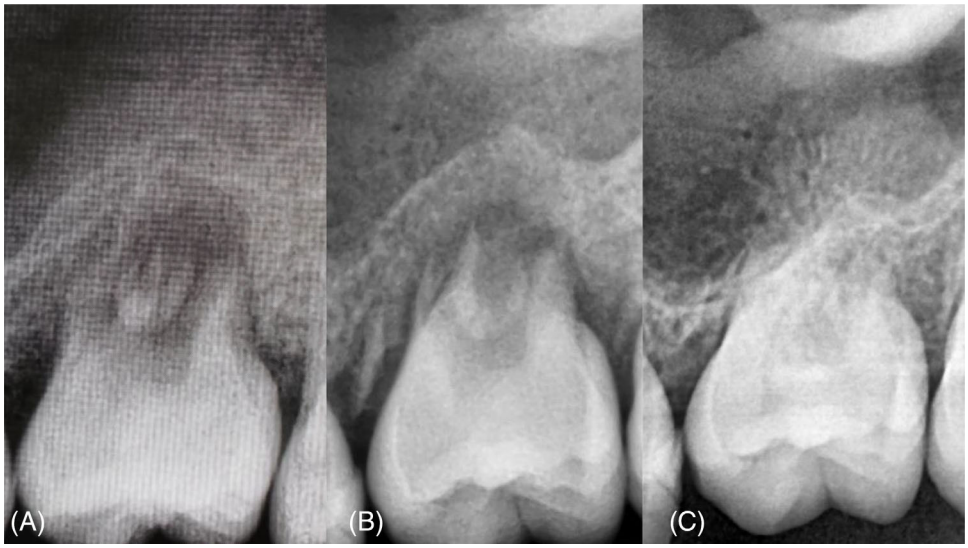

FIGURE 5 (A) Periapical radiograph immediately after transplantation. (B) 12-month follow-up. (C) 24-month follow-up.

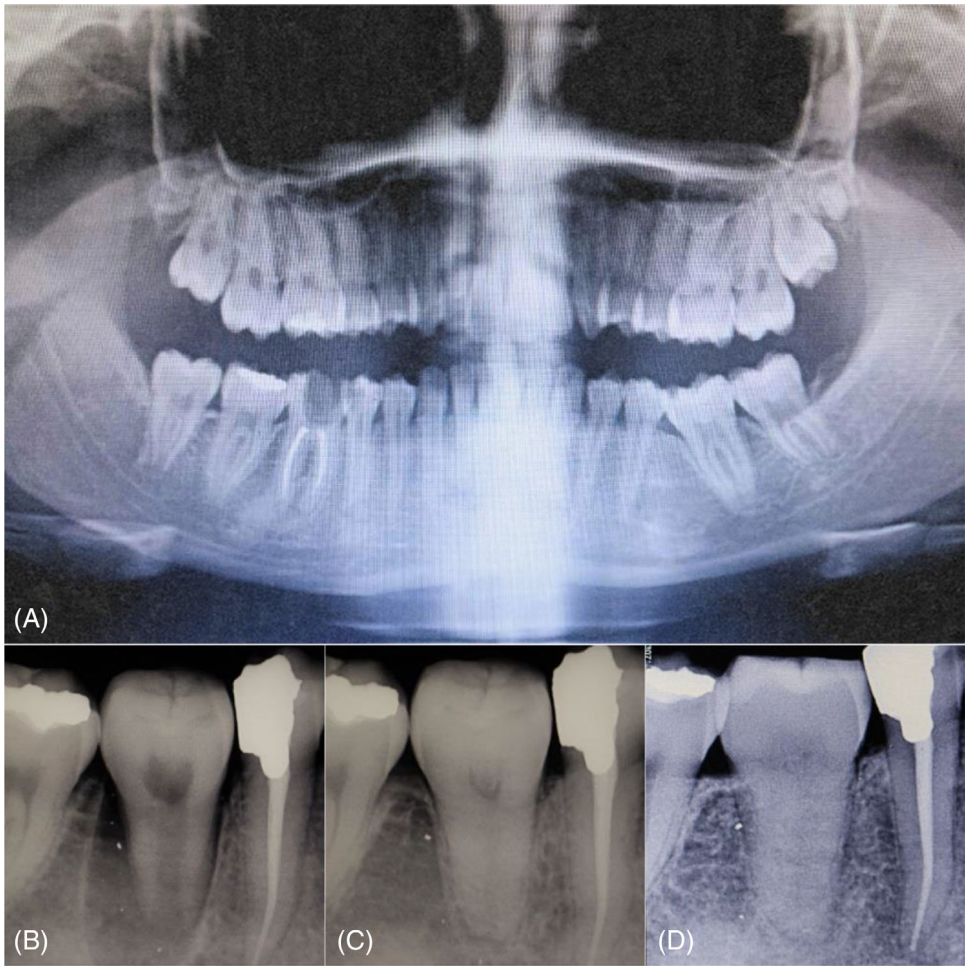

FIGURE 6 A 17-year-old female patient underwent clinical and radiographic examination, which revealed an extensively decayed tooth (#30) that was beyond restoration. The examination included: (A) A panoramic radiograph demonstrating the overall condition of the teeth, the level of the bone, and the developing third molars. (B) A periapical radiograph immediately after transplantation. (C) A 48-month follow-up radiograph. (D) An 84-month follow-up radiograph.

FIGURE 7 (A) Lateral view during maximum intercuspation, taken 7 years after transplantation. (B) Periapical radiograph captured 84 months post-transplantation. (C) Lateral view showing the condition of the supporting tissues at 84 months. (D) Occlusal view, obtained during the 84-month follow-up.

and clinical photographs were taken for baseline assessment (Figures 4 and 5). Post-operative medications including analgesics were prescribed and post-operative instructions were provided including avoiding hard food eating on the surgical side to ensure optimal recovery for the patients.

RESULTS

Clinical outcomes

The first case underwent a follow-up visit after two weeks of treatment, during which the sutures were removed as depicted in Figure 4. The healing process progressed smoothly, and there were no complications observed. Subsequent follow-up appointments were scheduled at 12 and 24 months, during which periodic radiographs were taken (Figure 5). Over time, the initially immature root of the transplanted tooth exhibited further development. Critically, the tooth remained stable throughout the follow-up period, obviating the need for any endodontic intervention.

Similarly, in the second case, the healing process was uneventful, with no complications reported. Follow-up assessments took place at 48 and 84 months, involving both radiographic and clinical documentation (Figures 6 and 7). Notably, the previously immature root of the transplanted tooth continued to undergo maturation. Impressively, the transplanted tooth remained stable throughout the entire 7-year follow-up period, without necessitating any endodontic procedures.

DISCUSSION

Current evidence concerning long-term outcomes of autotransplanted teeth in humans and factors related to their failure is limited. The results of these two clinical case studies support the idea that the stage of root development may significantly influence the success of autotransplantation,

aligning with the results of previous studies.[1] Tsukiboshi documented an 82% success rate based on the examination of 250 cases over a period of 6 years.[5] Like other surgical procedures, careful selection of cases and thorough treatment planning are crucial for achieving successful autotransplantation. It is essential to assess the suitability and compatibility of both the donor tooth and the recipient site accurately. Achieving successful transplantation requires a strong match in shape and size between the donor tooth and the recipient site.[15] Maxillary transplants are associated with a higher risk of failure due to significant variations in tooth size and shape, as well as other anatomic barriers such as the maxillary sinus floor proximity to the molar sockets.[15] In this instance, the minimal extra-oral time was achieved due to the close size match between the donor tooth and recipient site, ensuring excellent compatibility.[16–18] Furthermore, to minimize handling and trauma, the donor's tooth was carefully protected in wet gauze and inserted into the recipient site with minimal preparation.

Although autotransplantation is an alternative to a dental implant for tooth replacement, particularly in cases where future growth and development are expected, other factors still require consideration. This approach minimizes adjacent tooth movement without immediate prosthetics, but orthodontic treatment might still be necessary for proper alignment. The application of biological additives has been shown to stimulate the production of growth factors, which play a crucial role in promoting wound healing and regenerative processes.[19] Moreover, these biologics can enhance soft tissue healing and decrease the occurrence of postoperative complications. When used in suitable cases, patients may experience reduced postoperative pain and a decreased requirement for pain-relieving medications.[20] Although patient-reported outcomes were not reported in these cases, this is certainly an important and clinically relevant outcome measure to be explored in future longitudinal studies.

CONCLUSIONS

Autogenous tooth transplantation is a promising treatment option for young adult patients. Success is influenced by factors such as the stage of root development and the matching size between the donor tooth and the recipient site. Additionally, incorporating PRF can also enhance early healing and stabilization, leading to clinically successful long-term tooth survival.

AUTHOR CONTRIBUTIONS

Study conception and design: Fatemeh SamavatiJame and Abdusalam Alrmali; equal distribution and drafting of the manuscript: Fatemeh SamavatiJame, Abdusalam Alrmali, Pablo Galindo-Fernandez, and Sandra Stuhr; final editing and critical revision: Sandra Stuhr and Hom-Lay Wang. All authors gave their final approval and agreed to be accountable for all aspects of the work.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

PATIENT CONSENT STATEMENT

Treatment consent for each patient was obtained orally from the patient's parents. No patient identifiers can be noted in the figures.

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