

Alveolar Socket Sealing Using Mucosal Grafts for Alveolar Ridge Preservation (Case Reports)

Penutupan Soket Alveolar Menggunakan Cangkok Mukosa untuk Preservasi Ridge Alveolar (Laporan Kasus)

Nurul Ain Mohamed Yusof, Rusmizan Yahaya, and Yuhaniz Ahmad Yaziz

Periodontic Specialist Unit, Kota Setar Dental Specialist Clinic, Alor Setar, Kedah,
Ministry of Health, Malaysia

Correspondence email to: dryuhaniz@yahoo.com

Received: 11 Dec 2024; Revised: 10 Jan 2025; Accepted: 20 Feb 2025; Published: 25 Feb 2025

ABSTRACT

The fresh extraction socket in the alveolar ridge poses a significant challenge in clinical practice, requiring the preservation of both the hard and soft tissue envelope to maintain stable ridge volume. Alveolar Ridge Preservation (ARP) is a surgical procedure aimed at minimizing bone loss following tooth extraction. It helps reduce the need for more complex treatments and optimizes outcomes for future prosthetic replacements of missing teeth. Various ARP techniques have been developed, including Guided Bone Regeneration (GBR), socket fillers, and socket sealing. Alveolar Socket Sealing (ASS) is a procedure that utilizes mucosal grafts or biomaterials to seal the socket, either to complement GBR or function independently to preserve soft tissue and prevent tissue collapse. This report presents two cases using the ASS procedure with mucosal grafts, a free autogenous tissue graft (FGG) and a Platelet-Rich Fibrin (PRF) membrane to seal the alveolar extraction sockets. These techniques were combined with the placement of xenograft bone grafting material. Both clinical approaches successfully limit bone dimensional changes while providing a cost-effective treatment strategy for dental implant placement.

Keywords: Alveolar ridge preservation, Dental implant, Free autogenous graft, Platelet-rich fibrin, Socket seal

ABSTRAK

Soket pada ekstraksi baru di alveolar ridge menimbulkan tantangan signifikan dalam praktik klinis, yang memerlukan presevasi baik pada jaringan keras maupun jaringan lunak untuk mempertahankan volume ridge yang stabil. *Alveolar Ridge Preservation* (ARP) adalah prosedur pembedahan yang bertujuan meminimalkan kehilangan tulang setelah pencabutan gigi. Hal ini membantu mengurangi kebutuhan akan perawatan yang lebih kompleks dan mengoptimalkan hasil penggantian gigi palsu di masa depan. Berbagai teknik ARP telah dikembangkan, termasuk *Guided Bone Regeneration* (GBR), pengisian dan penutupan soket. *Alveolar Socket Sealing* (ASS) adalah prosedur yang menggunakan cangkok mukosa atau biomaterial untuk menutup soket, baik untuk melengkapi GBR atau berfungsi secara independen untuk menjaga jaringan lunak dan mencegah kolapsnya jaringan lunak. Laporan ini menyajikan dua kasus yang menggunakan prosedur ASS dengan cangkok mukosa, cangkok jaringan autogenous bebas (FGG) dan membran *Platelet-Rich Fibrin* (PRF) untuk menutup soket ekstraksi gigi pada alveolar. Teknik-teknik ini dipadukan dengan penempatan material cangkok tulang xenograft. Kedua pendekatan klinis tersebut berhasil membatasi perubahan dimensi tulang sekaligus memberikan strategi perawatan yang hemat biaya untuk penempatan implan gigi.

Kata Kunci: Preservasi alveolar ridge, Implan gigi, Cangkok autogenous bebas, Platelet-rich fibrin, Penutupan soket



INTRODUCTION

Tooth extraction triggers a sequence of biological events that lead to alterations in the dimensions of the alveolar ridge, such as vertical and horizontal reduction of the alveolar crest.¹ The risk associated with this dimensional change is particularly evident in the maxillary anterior zone, while aesthetics may be compromised, due to the presence of the thin bundle bone.² To compensate for such alterations, a clinical strategy such as alveolar ridge preservation (ARP) should be employed to reduce the post-extraction resorption of the alveolar ridge, thereby preserving both hard and soft tissues. This preservation is crucial for the facilitation of prosthetically-driven implant placement, particularly when immediate implant or early implant placement is not possible due to patient- or site-specific reasons.³

The ARP technique typically involves placing bone graft material within the socket, often combined with a barrier membrane or a soft tissue graft to seal the socket entrance, following either a primary or secondary intention healing concept. Alveolar Socket Sealing (ASS) is an alternative surgical technique for managing post-extraction sockets, designed to promote ridge preservation and optimal regeneration. This approach helps maintain the height and width of the ridge by creating a stable environment for implant placement. It involves using soft tissue grafts or biomaterials to achieve primary wound closure and effectively seal the socket.

Several ASS techniques have been utilized in ARP procedures, such as free gingival graft (FGG), collagen matrix (CM), collagen sponge (CS), acellular dermal matrix (ADM), Platelet-Rich Fibrin (PRF) membrane and polytetrafluoroethylene membrane (PTFEm). There is no clear superiority regarding socket sealing material concerning soft and hard-tissue changes.⁴ No consensus has been made on the standard protocol among ARP techniques.⁵

The case reports aimed to discuss the use of different types of mucosal grafts, comparing the free autogenous graft (FGG) and PRF membrane for sealing alveolar sockets with a combination of xenograft bone material before dental implant placement.

CASE REPORT 1

A 64-year-old male patient presented with fractured, endodontically treated teeth 21 and 13. Given the hopeless prognosis of these teeth, extraction was deemed necessary. Consequently, the treatment plan involved extraction followed by an alveolar ridge preservation (ARP) procedure with alveolar socket sealing (ASS) using autogenous free gingival grafts and xenograft bone. This treatment approach aligned with the guidelines outlined in the current literature on managing such clinical cases.⁶

A pre-operative assessment, including clinical and radiographic examinations, was conducted before proceeding with the ARP procedure (Figure 1, 2). The ARP procedures for teeth 21 (Figure 3) and 13 (Figure 4) were performed separately due to differences in the timing of treatment.

A flapless minimally invasive teeth extraction was performed as gently as possible to minimize surgical trauma and promote the inflammatory remodelling process. Teeth luxation was carried out by separating the periodontal attachment apparatus from the root of the tooth, especially in the interdental areas, using a periotome. Following measurement of the oval outline of the sockets, a 1-2 mm deep incision was made on the palatal surface with a scalpel blade to obtain a free autogenous graft. The epithelialized soft tissue grafts were carefully harvested and placed over the graft material to seal the sockets and securely stabilized using single interrupted sutures.

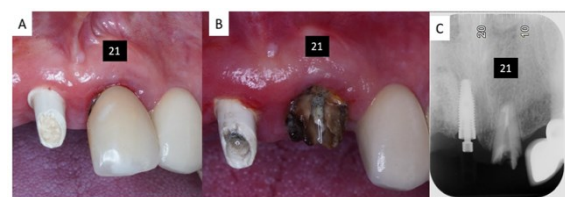


Figure 1. Photographs illustrating clinical and radiographic photo before ARP procedure of 21: (A) Upper left central incisor (tooth 21) with dental crown, (B) Upper left central incisor (tooth 21) following removal of dental crown with hopeless prognosis, (C) Periapical radiograph showing tooth 21 (without dental crown)

Additionally, routine post-operative instructions were provided, including the guidelines for analgesia and oral hygiene. The

patient was instructed not to wear the immediate denture provided for 24 hours and to avoid strenuous physical activity for 72 hours to prevent disruption or displacement of the primary clot. 0.12% Chlorhexidine Gluconate mouthwash was recommended starting 24 hours post-operatively, to be used twice daily, along with modified brushing and oral care techniques. Suture removal was scheduled for 7-10 days post-operatively.

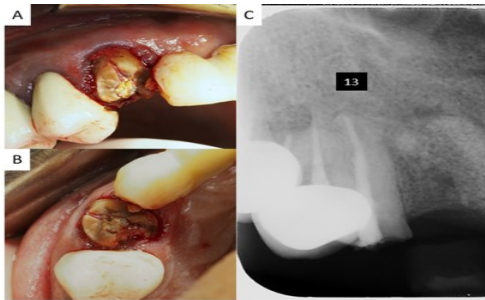


Figure 2. Photographs illustrating clinical and radiographic photo before ARP procedure of 13: (A,B) Upper Right canine before extraction, (C) Periapical radiograph showing tooth 13 with endodontic failure and fractured crown

On day 3 post-surgery, the patient reported a bad smell originating from the area of tooth 13. The surgical site was irrigated, and necrotic tissue was debrided. Despite this complication, the procedure's outcome was not compromised, as granulation tissue had formed beneath the graft, effectively securing the biomaterial within the socket.

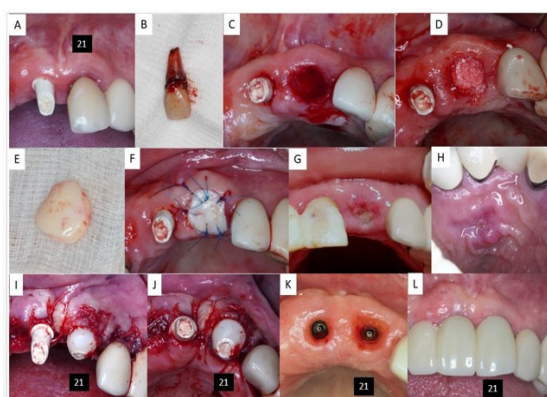


Figure 3. Clinical and radiographic photographs illustrating the surgical protocol for ARP with the ASS technique at 21 area: (A) Upper left central incisor (tooth 21), (B) Atraumatic tooth extraction of 21, (C) Fresh alveolar socket with preserved bone walls and soft tissues, (D) Filling of the gingival socket with xenograft, (E) Epithelialized soft tissue graft, (F) Soft tissue graft was harvested from the palate and sutured on the recipient bed to

seal the socket aperture, (G,H) Uneventful healing of the donor and recipient sites, (I,J,K) Dental implant placement of 21 with healing abutment, (L) Final implant-supported restoration at 21, 11 and 12

At 4 weeks post-surgery, complete epithelialization was observed, with a soft tissue socket seal evident at the 13 and 21 grafted sites. At the six-month post-operative visit, the edentulous ridge demonstrated favourable healing with adequate keratinized tissue. A periapical radiograph taken at six months revealed radiographic evidence of bone fill at the extraction sites (Fig. 4 and 5).

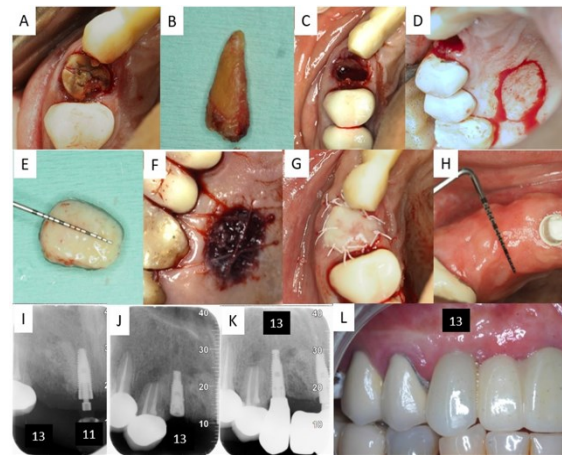


Figure 4. Clinical and radiographic photographs illustrating the surgical protocol for ARP with the ASS technique at 13 area (A,B) Fresh alveolar socket following atraumatic tooth extraction of 13, (C) Filling of the extraction socket with xenograft, (D,E,F,G) Free epithelialized tissue graft was harvested from the palate and sutured on the recipient bed to seal the socket aperture, (H) Surgical site at 6 months post-operatively showing complete healing and maintenance of buccolingual alveolar bone width, (I) Radiographic evidence of bone fill at the extraction sites of 13), (J,K,L) Dental implant placement at 13

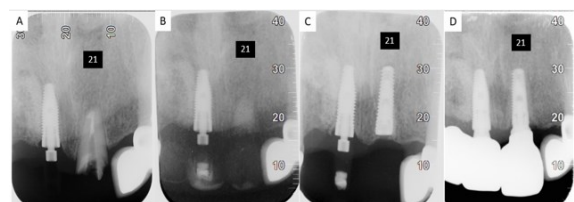


Figure 5. Radiographic photographs (A,B,C,D) of dental implant-supported crowns at 21 site

Re-entry surgery after 6 months revealed adequate ridge dimensions for implant placement, eliminating the need for further augmentation. Dental implants were placed, and crown prostheses with acceptable

aesthetic outcomes were successfully achieved. Figure 6 shows the final implant-supported restoration of 21 and 13 at 2-year follow-up.



Figure 6. Post-operative clinical photograph showing the final implant-supported restoration at 2-year follow-up visit (B) compared to baseline (A)

CASE REPORT 2

A 56-year-old male, fit and healthy patient presented with generalized periodontitis, Stage III Grade C. The patient underwent periodontal stabilization through a series of non-surgical and surgical periodontal therapies. Tooth 36 was deemed to have a poor prognosis and was indicated for extraction. The treatment plan included atraumatic extraction followed by an Alveolar Ridge Preservation (ARP) procedure with Alveolar Socket Sealing (ASS), utilizing a Platelet-Rich Fibrin (PRF) membrane and xenograft bone placement within the extraction socket.

The phlebotomy procedure was performed to collect blood samples in two 10 ml glass-coated plastic tubes, which were immediately centrifuged (Choukroun Duo Quattro) at 1,300 rpm for 8 minutes to produce PRF membranes (Fig. 7).

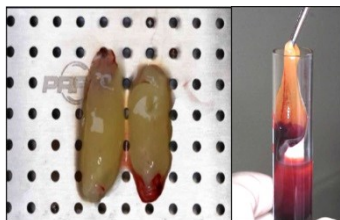


Figure 7. PRF membranes produced from the patient's blood

An atraumatic luxation of tooth 36 was carried out by carefully separating the periodontal attachment apparatus from the root

of the tooth, particularly in the interdental areas, using a periosteal elevator. The extraction socket was thoroughly curetted to remove all granulation tissue, followed by copious irrigation with saline. Xenograft bone material mixed with PRF membrane that has been cut into small pieces was placed into the extraction socket up to the alveolar crest. Two layers of PRF membrane were placed over the graft material to maximize its regenerative potential and effectively cover the extraction site. It was securely stabilized using horizontal mattress sutures. No flap retraction, and consequently, no primary closure was performed, allowing the sockets to heal via secondary intention.

Post-operative instructions were provided, including guidelines for analgesia and oral hygiene. Review visits for wound care were scheduled every 2-3 days to monitor surgical wounds and post-operative pain. The wound-healing process was uneventful. Sutures were removed on day 10 post-operatively. On day 15, there was good progress in wound healing and socket closure. Resorption of the PRF membrane can also be seen. At 3 months follow-up, soft tissue has healed over the extraction socket with maintenance of the keratinized tissue (Fig. 8).

DISCUSSION

The 2018 EFP's XV European Workshop in Periodontology concluded that ARP may prevent bone reduction of 1.5-2.4 mm horizontal, 1-2.5 mm vertical mid-buccal, and 0.8-1.5mm vertical midlingual.⁷ Based on a review article, no definitive protocol in ARP as there is no evidence to support the superiority of one technique over another.⁶

Sealing the socket with a barrier is a critical component of ARP procedures to stabilize the blood clot. Furthermore, MacBeth et al. reported that guided bone regeneration and ASS are effective in minimizing vertical alveolar (buccal and palatal) bone loss.⁸ Their study also indicated that ARP procedures may reduce the need for additional ridge augmentation during implant placement.

Soft tissue grafting involving free gingival graft (FGG) has traditionally been utilized as the "gold standard technique" for soft tissue augmentation. The use of FGG as an ASS technique has the advantage of preserving the height of the buccal bone, as

demonstrated in clinical case 1. This outcome is consistent with the findings of Karaca et al.,⁹ who reported that the heights of the buccal and lingual crestal bones were preserved in maxillary extraction sockets treated with ASS using FGG.

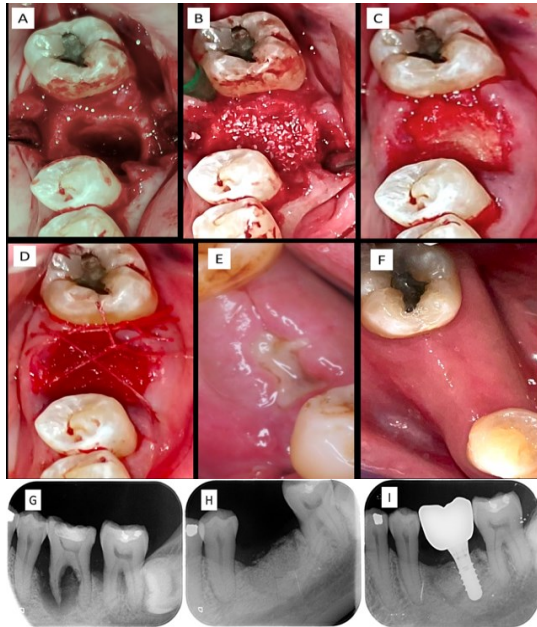


Figure 8. Clinical and radiographic photographs of ASS and PRF membrane procedure (A) Atraumatic extraction of tooth 36 and curettage of socket, (B) Placement of xenograft bone material up to the crestal bone, (C) Double layer of PRF membrane placed to cover the graft material, (D) PRF membrane secured with horizontal mattress sutures, (E) Surgical site at 15 days post-operatively showing progress of wound closure and disintegration of PRF membrane, (F) Surgical site at 3 months post-operatively showing total wound closure and maintenance of keratinized tissue, (G) Periapical radiograph of tooth 36 before extraction, (H) Periapical radiograph showing bone fill within the socket up to the crystal level at 6 months postoperatively, (I) Periapical radiograph of the dental implant placed at tooth 36 site.

Additionally, FGG provides an adequate supply of keratinized gingiva, which is crucial for maintaining stable and healthy soft tissues around dental implants.^{10,11} The thickness and size of the FGG, and close adaptation to the recipient site will determine sufficient blood supply for the survival of the graft. However, the limitations associated with FGG, including donor site morbidity, limited donor tissue availability, and postoperative pain, have prompted the search for alternative approaches.

Other techniques that have been employed to preserve the socket involve the use of guided bone regeneration (GBR) and growth factors (GFs) such as platelet-rich fibrin (PRF). The use of PRF has recently been advocated in conjunction with ARP to enhance soft and hard tissue healing and regeneration. The concentration of leukocytes within the PRF matrix plays a crucial role in tissue healing and regeneration, contributing to the osteoimmune response. The reported benefits of incorporating PRF membranes as ASS during ARP include reduced healing time, enhanced angiogenesis and bone regeneration, effective socket sealing via the fibrin matrix, antibacterial properties, and a decreased risk of post-extraction pain and infection.

Results from previous studies showed that the PRF acts as a physical support for cell migration and proliferation, creating a conducive environment for fibroblasts to facilitate wound closure and healing.^{12,13,14,15} From a clinical perspective, PRF promotes rapid closure of the alveolar socket, which is essential for bone healing and regeneration. In this case report, the healing of the soft tissue covering the extraction socket can be seen at 10-15 days postoperatively. On average, the resorption of the PRF membrane can be seen at 10-28 days.¹⁶

In clinical case 2, tooth 36 had a history of severe periodontal infection, resulting in significant clinical attachment loss and reduced bone height. Consequently, the outcome of ARP could only be achieved up to the level of the reduced crestal bone. Thorough curettage of the extraction socket was critical for removing infected granulation tissue before placing the bone grafts. Several studies have compared free gingival grafts (FGG) and PRF as ASS strategies in ARP. A recent study by Afifi et al. concluded that both FGG and PRF are effective techniques for ARP. However, PRF offers an additional advantage in maintaining the buccolingual dimensions of the extraction socket.¹⁷

An interesting observation in our cases was that both ASS approach effectively stabilized the blood clot, which in turn facilitated the stabilization of the bone graft. It has been suggested that the role of a mucosal graft extends beyond merely protecting the graft material within the socket. Its presence allows sufficient time for granulation tissue to

form beneath it and for the maturation of keratinized mucosa to occur. Furthermore, mucosal grafts contribute to improved soft tissue conditions by maintaining or increasing keratinized tissue.^{18,19}

Compared to resorbable membranes, which are associated with higher costs, the use of FGG or PRF as part of the ASS strategy significantly reduces the cost of ARP while providing effective results. Furthermore, there is a high risk of membrane exposure, even when the membrane is fully covered by coronally advancing the buccal gingiva of the extraction socket. It is technically difficult to achieve primary closure in an extraction socket defect. Previous studies have reported membrane exposure rates of 42–57%.²⁰ Additionally, the placement of a resorbable membrane also increases the risk of membrane collapse and infection.

Nevertheless, one of the limitations of using FGG is the colour match of the graft to adjacent tissue when compared to resorbable membranes. The colour and texture of the grafted site may be inconsistent with the surrounding tissue, which is a significant aesthetic drawback. Besides that, the use of soft tissue grafts may cause adverse events such as pain, swelling, discomfort at the harvested site, and an increase in surgery time.

Another limitation of this case report is the unavailability of cone beam computed tomography (CBCT) to evaluate the radiographic bone changes. A radiographic measurement stent at the extraction site should be fabricated as a radiographic reference. Thus, the bone dimensional changes can be compared accurately by using CBCT to assess the effectiveness of using free autogenous graft and PRF for sealing alveolar sockets with the combination of bone graft material.

CONCLUSION

Utilizing a mucosal graft with the combination of xenograft bone material remains a viable clinical strategy for ASS procedures in ARP. Both clinical approaches successfully limit bone dimensional changes while providing a cost-effective treatment strategy for dental implant placement.

SUGGESTIONS

Future research in the area of ARP should evaluate the influence of patient factors

and different treatment modalities in well-conducted, adequately powered, and multiple-arm clinical trials to allow clinicians to make evidence-based decisions while minimizing errors and complications.

ACKNOWLEDGEMENTS

The authors would like to thank the Director General of the Ministry of Health Malaysia for his permission to publish this article. The authors would also like to extend their gratitude to the staffs in Kota Setar Periodontic Specialist Unit for their contribution in this case report.

REFERENCE

1. Araújo MG, Lindhe J. Dimensional ridge alterations following tooth extraction. An experimental study in the dog. *J Clin Periodontol.* 2005;32(2):212-18. doi:10.1111/j.1600-051X.2005.00642.x
2. Chappuis V, Bruegger OE, Reyes M, Shahim K, Nolte L-P, Buser D. Ridge alterations post-extraction in the esthetic zone: a 3D analysis with CBCT. *J Dent Res.* 2013;92(12):195S-201S. doi:https://doi.org/10.1177/0022034513506713
3. Avila-Ortiz G, Chambrone L, Vignoletti F. Effect of alveolar ridge preservation interventions following tooth extraction: A systematic review and meta-analysis. *J Clin Periodontol.* 2019;46(21):195-223. doi:10.1111/jcpe.13057
4. Lopez-Pacheco A, Soto-Penaloza D, Gomez M, Penarrocha-Oltra D, Alarcon MA. Socket seal surgery techniques in the esthetic zone: A systematic review with meta-analysis and trial sequential analysis of randomized clinical trials. *Int J Implant Dent.* 2021;7(1):13; doi:https://doi.org/10.1186/s40729-021-00294-2
5. Kim Y-K, Ku J-K. Extraction socket preservation. *J Korean Assoc Oral Maxillofac Surg.* 2020;46(6):435-439. doi:https://doi.org/10.5125/jkaoms.2020.46.6.435
6. Kalsi A, Kalsi JS, Bassi S. Alveolar Ridge Preservation: Why. When and How. *Br Dent J.* 2019;227(4):264-274. doi:10.1038/s41415-019-0647-2
7. Tonetti MS, Jung RE, Avila-Ortiz G, et al. Management of the extraction socket and

- timing of implant placement: Consensus report and clinical recommendations of group 3 of the XV European Workshop in Periodontology. *J Clin Periodontol*. 2019;46(Suppl.21):183-194.
8. MacBeth ND, Donos N, Mardas N. Alveolar ridge preservation with guided bone regeneration or socket seal technique. A randomised, single-blind controlled clinical trial. *Clin Oral Implants Res*. 2022;33(7):681-99.
 9. Karaca C, Er N, Gulsahi A, Koseoglu OT. Alveolar ridge preservation with a free gingival graft in the anterior maxilla: Volumetric evaluation in a randomized clinical trial. *Int J Oral Maxillofac Surg*. 2015;44(6):774-80. doi:http://dx.doi.org/10.1016/j.ijom.2015.01.015
 10. El-Sioufi I, Oikonomou I, Koletsi D, Bobetsis YA, Madianos PN, Vassilopoulos S. Clinical evaluation of different alveolar ridge preservation techniques after tooth extraction: a randomized clinical trial. *Clin Oral Investig*. 2023;27(8):4471-80. doi:https://doi.org/10.1007/s00784-023-05068-1
 11. Segnini B, Borges-Filho FF, GNicoli L, et al. Impact of soft tissue graft on the preservation of compromised sockets: A randomized controlled clinical pilot study. *Acta Odontol Latinoam*. 2021;34(2):119-26.
 12. Pavlovic, V.; Ciric, M.; Jovanovic, V.; Trandafilovic, M.; Stojanovic, P. Platelet-rich fibrin: Basics of biological actions and protocol modifications. *Open Med*. 2021;16 446–54.
 13. Miron RJ, Fujioka-Kobayashi M, Moraschini V, Zhang Y, Gruber R, Wang HL. Efficacy of platelet-rich fibrin on bone formation, part 1: Alveolar ridge preservation. *Int J Oral Implantol (Berl)*. 2021;14(2):181-94. PMID: 34006080.
 14. Ucer C, Khan RS. Alveolar Ridge Preservation with Autologous Platelet-Rich Fibrin (PRF): Case Reports and the Rationale. *Dent J (Basel)*. 2023;11(10):244. doi: 10.3390/dj11100244. PMID: 37886929; PMCID: PMC10605266.
 15. Ucer C, Khan RS. Extraction Socket Augmentation with Autologous Platelet-Rich Fibrin (PRF): The Rationale for Socket Augmentation. *Dent J (Basel)*. 2023;11(8):196. doi: 10.3390/dj11080196.
 16. Yamashita Y, Chen K, Kuroda S, Kasugai S. Stability of platelet-rich fibrin in vivo: histological study in rats. *Jr Oral Tissue Eng*. 2016;14:83–90.
 17. Afifi HHA, Nasr SS, Bin Shabaib MS, Alharthi SS, Shoeib M. Socket Preservation Using Platelet-Rich Fibrin and Free Gingival Grafts. *Int Dent J*. 2025 Feb;75(1):345-51.
 18. Meloni SM, Tallarico M, Lolli FM, Deledda A, Pisano M, Jovanovic SA. Postextraction socket preservation using epithelial connective tissue graft vs porcine collagen matrix. 1-year results of a randomised controlled trial. *Eur J Oral Implant*. 2015;8(1):39-48.
 19. Schneider D, Schmidlin PR, Philipp A, et al. Labial soft tissue volume evaluation of different techniques for ridge preservation after tooth extraction: a randomized controlled clinical trial. *J Clin Periodontol*. 2024;41(6):612-7. doi:10.1111/jcpe.12246
 20. McGuire MK, Scheyer ET, Lipton DI, Gunsolley JC. Randomized, controlled, clinical trial to evaluate a xenogeneic collagen matrix as an alternative to free gingival grafting for oral soft tissue augmentation: A 6- to 8-year follow-up. *J Periodontol*. 2020;92(8):1088-95. doi:https://doi.org/10.1002/JPER.20-062

