ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at:www.ijdsir.com

Volume – 7, Issue – 5, October – 2024, Page No. : 83 - 91

Plasma-Rich Fibrin Unveiled: A Narrative Review of Its Impact on Implant Success

[1]Dr.Harini Gnana Prakash, MDS, Department of Prosthodontics and Implantology, SRM Dental College, India

[2]Dr. Rhythm Pandhi, BDS, Brijesh Dental Clinic, India

[3]Dr.Naval Ghule, BDS, Goregaon Dental Centre, India

[4]Dr. Anoli Agrawal, MDS, Assistant Professor, Department of Public Health Dentistry, ACPM Dental College, Dhule, Goregaon Dental Centre, India

Corresponding Author: Dr. Harini Gnana Prakash, MDS, Department of Prosthodontics and Implantology, SRM Dental College, India

Citation of this Article: Dr. Harini Gnana Prakash, Dr. Rhythm Pandhi, Dr. Naval Ghule, Dr. Anoli Agrawal, "Plasma-Rich Fibrin Unveiled: A Narrative Review of Its Impact on Implant Success", IJDSIR- October – 2024, Volume –7, Issue - 5, P. No. 83 – 91.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Dental implants are crucial for replacing missing teeth, but their success heavily relies on effective osseointegration and a robust foundation. Platelet-rich fibrin (PRF), derived from the patient's own blood, plays a vital role in accelerating healing and enhancing bone growth around implants. PRF, a second-generation platelet concentrate, contains a rich matrix of platelets, leukocytes, and growth factors that promote tissue regeneration. This natural biomaterial, developed by Choukroun, is known for its economical production, ease of use, and absence of anticoagulants.

In implant dentistry, PRF improves implant stability and osseointegration by fostering osteoblast adhesion and accelerating bone formation. It is used in various applications such as sinus lifts, socket healing, and mucogingival surgeries. PRF's ability to stimulate neoangiogenesis and reduce inflammation supports its use in immediate implant placements and treatment of peri-implantitis. Clinical studies demonstrate that PRF can enhance the quality of bone regeneration, reduce postoperative pain, and improve healing outcomes. By integrating PRF into treatment protocols, dental professionals can achieve better implant success rates and patient satisfaction.

This review synthesizes recent research on PRF's impact on implant dentistry, highlighting its mechanisms, benefits, and clinical applications. The evidence underscores PRF's role in improving implant outcomes and advancing dental regenerative techniques.

Keywords: Crucial, Platelet-rich fibrin, Sinus lifts, mucogingival surgeries

Introduction

Dental implants are like the superheroes of dentistry—these tiny but mighty titanium posts that replace missing teeth and restore our smile. But here's the fact: they need a strong foundation to stick around for the long haul - plasma-rich fibrin (PRF). It is made from your blood speeds up healing and boosts bone growth around the implant. It's nature's way of helping out—not synthetic. Together, implants and PRF tag team give us a smile that's beautiful, healthy, and strong. Rehabilitation of partially or completely edentulous spaces in the oral cavities can be done by placing oral implants. The foremost conditions essential for the success of an implant treatment are sufficient bone both qualitatively and quantitatively, the macro/micro design of the implant, the surgical method, and the insertion torque in the treatment area for proper osseointegration.[1] Implant stability is characterized by two types: mechanical (primary) and biological (secondary). During insertion, the implant functions like a screw, achieving primary stability through compressed bone that holds it securely in place. Secondary stability, on the other hand, reflects the osseointegration process and becomes the main contributor to overall stability after the initial weeks, when primary stability is predominant.[2]The process of osseointegration can be hastened by enhancing the healing following placement/positioning of an implant by implementing the use of recently developed platelet concentrates (PC). when these [PC] come in close connection with the sensitive/susceptible endothelium (exposed damaged tissue), they get triggered/set off and release numerous bioactive mediators, enhancing bone healing. [3] PCs were first introduced in the year 1954 followed by Titanium platelet-rich fibrin (PRF), advanced PRF (A-PRF) and injectable PRF which have come to use recently in the field of dentistry. [3]

There are several protocols which are being followed to fabricate platelet concentrates which bring about different products with distinct characteristics. There are about four principal category/sets of platelet derivatives which are based upon the architecture of fibrin and the content of leukocytes. These are pure platelet-rich plasma, leukocyte and pure PRF (P-PRF) platelet-rich plasma (L-PRP), pure PRF (P-PRF), and leukocyte and PRF (L-PRF). PRF belongs to the second-generation platelet concentrate which was developed by Choukroun and is described as an autologous L-PRP material.[4]

PRF is drawn up from plasma following centrifugation of blood (Choukroun, Adda, Schoeffler & Varvelle, 2001). Platelets and leukocytes present in the plasma go through spontaneous coagulation. Similar to the blood clot which gets formed naturally at the defective site following injury, these activated platelets and leukocytes gets entrapped within the fibrin-rich matrix (Singer & Clark, 1999). PRF can be processed further by squeezing out more/extra serum giving rise to PRF membrane (Dohan et al., 2006) or can be mixed with grafts and biomaterials. [5]

PRF is relatively economical, quick to produce/draw up and does not require the use of any anticoagulant during preparation. This material provides and stimulates neo angiogenesis. This well fortified fibrin mesh of the PRF prevents it from dissolving at a faster rate following administration and warrants for a restrained release of the growth factors such as platelet-derived growth factor, insulin like growth factor, transforming growth factor, and vascular endothelial growth factor which enhances the vascular endothelial growth factor as well as osteoblastic proliferation and differentiation. [4]

Platelet rich fibrin has a robust/booming effect in stimulating healing of soft and osseous tissue including angiogenesis, immune control, and harnessing the circulating stem cells. [4]. PRF is used as an autologous barrier membrane in many clinical procedures, such as sinus lifting, healing of extraction socket, in implant dentistry, treatment of intraosseous periodontal defects and gingival recessions; it is also a new treatment choice for various mucogingival surgeries. [6]. This review aims to explore various effects of plasma rich fibrin in the field of implant dentistry.

Material and Methodology

To review the literature, Studies were selected from PubMed, Scopus, Web of Science, and Google Scholar within the publication year of 2016 to 2024, to provide a comprehensive overview of current knowledge on the effects of Platelet-Rich Fibrin in implant dentistry. The review focused on evaluating the association between PRF and composite resins. The search terms included: “plasma rich fibrin” “implant’’, “Platelet,” and “growth factor.” The research encompassed, Case reports, laboratory studies, clinical studies, and systematic reviews.

What is PRF?

Platelet-rich fibrin (PRF) is a concentrated blood product commonly used in dentistry to enhance healing across various procedures. PRF is created from plasma following the centrifugation of whole blood. [1,5] This suggests that with a 30-minute waiting time, the polymerization process begins to accelerate in membranes subjected to higher centrifugation forces. Over time, the impact of this force on resistance becomes more pronounced. Consequently, membranes produced with greater centrifugation force exhibit higher density and reduced porosity.[7] The plasma, which contains platelets and leukocytes, undergoes natural coagulation. Similar to the blood clot that forms at a wound site, the activated platelets and leukocytes become embedded in a fibrin-rich matrix. PRF can be further modified, such as by squeezing out additional serum to produce a PRF membrane), or by combining it with grafts and other biomaterial[5]. Its matrix aids in the migration, attachment, and proliferation of osteoblasts, which are crucial for bone formation. PRF contains a dense fibrin network enriched with leukocytes, cytokines, and glycoproteins, such as thrombospondin. [8]

2. What are the different types of PRF?

Changes to the centrifugation protocol enhance the quantity of platelet cells and positively affect the behaviour of monocytes/macrophages, leading to a mutually beneficial relationship that promotes tissue regeneration[3]. The main types of platelet derivatives are categorized based on their leukocyte content and fibrin structure. These include pure platelet-rich plasma (PRP), leukocyte and platelet-rich plasma (L-PRP), pure platelet-rich fibrin (P-PRF), and leukocyte and platelet-rich fibrin (L-PRF). PRF, developed by Choukroun, is a second-generation platelet concentrate classified as an autologous L-PRP material.[4]

Choukroun et al. developed a straightforward method for producing L-PRF in France. In this technique, venous blood is collected in glass tubes and then centrifuged at low speed. The absence of anticoagulants leads to immediate platelet activation and fibrin polymerization. The resulting PRF clot has a range of clinical applications. One of its benefits is that it gradually dissolves after application, with the three-dimensional fibrin network remodeling over time, mimicking the natural blood clot. [8]The membrane leukocytes platelet-rich fibrin (L-PRF), in its polymerized and gelled form, functions as a three-dimensional

framework. This concentrate consists of platelets, leukocytes, platelet microparticles, glycoproteins, and various plasma proteins.[7] Previous studies have shown that L-PRF can be considered an alternative material for repairing sinus perforations and managing extraction sockets.[9]

Additionally, the technique is simple and effective, allowing for larger quantities to be produced using only natural components as reactants. Consequently, L-PRF is well-suited for routine use and has been adopted in various countries, including France, Israel, and Italy.[8]

3.What is mechanism of action of PRF

L-PRF is a recent addition to the range of platelet-derived compounds . This concentrate is rich in growth factors, including PDGF1, TGFβ1, TGFβ2, VEGF, PD-ECGF, interleukin-1 (IL-1), IL-2, basic fibroblast growth factor (FGF-β), and platelet-activating factor 4 (PAF-4).[1]

Given that growth factors like BMPs and TGF-β are known to have osteoinductive properties that aid bone healing around implants, and considering that PRF is a rich source of these factors, we anticipate that using this material around the implant will enhance implant stability immediately after surgery, accelerate tissue healing, and promote new bone formation at the implant site.[5] Numerous growth and differentiation factors, including bone morphogenic proteins and lactoferrin, significantly enhance bone regeneration. Additionally, vitamin D is crucial for osseointegration, as it maintains calcium and phosphorus balance during bone metabolism.[6]

In a condensed PRF scaffold, leukocytes play a crucial role in both growth factor release and immune response. This concentrated platelet-rich suspension fosters tissue regeneration and wound healing. Transforming growth factor beta (TGF-β) accelerates reactionary dentinogenesis by stimulating odontoblastic activity . Additionally, leukocytes, cytokines, and lymphocytes help prevent infection and control inflammatory responses. Vascular endothelial growth factor (VEGF) supports angiogenesis, which is essential for revascularization.[8]

4. Why are we implementing the use of PRF in implant.

Rapid adhesion of osteoblasts to structured implant surfaces is essential for successful osseointegration and healing. While osteoblasts can initially settle on solid surfaces within minutes, strong adhesion is typically observed within 24 hours. The presence of PRP or PRF can accelerate this process.. Related studies have explored variations in osteoblast shape and contact patterns on implant surfaces, which indicate the extent of adhesion. These studies identified four stages of cell adhesion: Stage 1 involves initial contact via filopodia; Stage 2 includes the extension of lamellar lamellipodia; Stage 3 features the spreading of cytoplasm between lamellar lamellipodia; and Stage 4 is characterized by complete spreading into a round or polygonal shape (Figure 1).[10]

Figure 1:

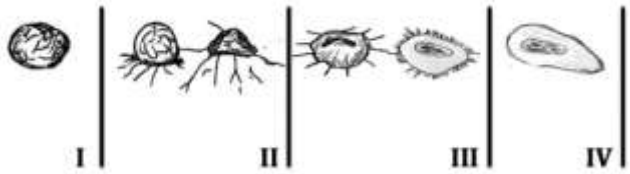


Fig [1]Schematic illustration of the various stages of cell adhesion as observed in SEM (modified from Rajaraman 21): I. Trypsin-harvested cells; II. Cell adhesion during filopodial growth; III. Stage of cytoplasmic webbing; IV. Flattened cell. [10]

Altering the surface chemistry of implants can increase the degree of bone-to-implant contact (BIC), thereby enhancing the healing process. Another effective strategy is to incorporate biomolecules and growth

factors onto the implant surface. Platelet-rich products have been shown to improve bone regeneration and accelerate osseointegration, which enhances the durability and stability of dental implants by boosting BIC.[11]

PRF is employed in the treatment of various conditions, such as gingival recession, extraction socket healing, cyst enucleation, periodontal issues, ridge preservation grafting, and endodontic procedures.[12]

Bone height and width are preserved, and wound healing is facilitated. For cases involving immediate implant placement, PRF has been reported to significantly enhance the rapid healing of extraction

5. How does PRF help in improving quality of immediate implant placement.

Immediate implant placement at the time of extraction, or early implant placement a few weeks after extraction with optimal soft-tissue healing, can reduce treatment duration and the number of surgical procedures. However, it presents challenges such as difficulties with soft tissue closure and a higher risk of failure due to pre-existing infection, which can impact the successful integration of dental implants.[13]

Nowadays, placing implants in fresh extraction sockets, particularly in the anterior maxilla, is becoming increasingly common and yields promising results with an implant survival rate of over 95% [1–3]. This approach offers several advantages, including the avoidance of a second surgery, a shorter treatment time by eliminating the waiting period for healing, and the early restoration of both function and aesthetics for the patient. [14] After tooth extraction, the alveolar socket often has a larger dimension than the implant's diameter, resulting in a space between the implant surface and the surrounding alveolar bone walls. This space is referred to as the jumping distance or peri-implant gap.[15]

In bone augmentation procedures, PRF has been introduced either as an adjunct or a replacement material to facilitate new bone formation.[15]

6. What are some of the post operative results following implant placement along with PRF

Choukron and his team introduced this technique to implant dentistry to enhance bone healing . Their studies indicate that the natural fibrin framework in PRF protects growth factors from proteolysis, allowing them to remain active for extended periods (up to 28 days). This results in effective neovascularization and accelerated wound closure with reduced postoperative infections.

An important consideration is whether the additional volume of PRF membranes creates excessive tension on the flaps and if this was adequately managed. This concern can be confidently addressed.[16]

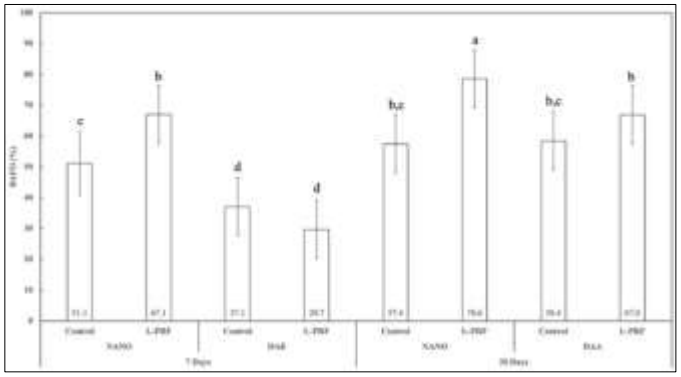
Maiorana et al. proposed that using PRF can lead to higher quality and quantity of bone regeneration, reduced osseointegration time, and improved soft tissue healing, with no risk of disease transmission unlike allografts. The anti-inflammatory and wound-healing properties of PRF could be beneficial in addressing any periapical infections in the extraction socket that might delay osseointegration. Additionally, the PRF membrane may protect marginal bone and support initial healing when the extraction socket cannot be sutured by primary intention. While PRF treatment can impact bone loss during the surgico-prosthetic phase, further studies with more sites are needed to determine its significant effects.[17]

The study included twenty patients (nine male and eleven female) with bilateral edentulous areas in the first molar region of the maxilla. The mean age of the patients was 39.60 ± 6.74 years. Each patient received two implants, one on each side. Group 1, which received

PRF, included 20 implants, while Group 2, which did not receive PRF, also included 20 implants. Two weeks after insertion, the mean Implant Stability Quotient (ISQ) was 60.60 ± 3.42 in Group 1 and 58.25 ± 3.64 in Group 2, showing a statistically significant difference between the groups (P = 0.04). At four weeks after insertion, the mean ISQ was 70.30 ± 3.36 in Group 1 and 67.15 ± 4.33 in Group 2.[18]

A significant difference in pain was observed between the groups from the 1st to the 7th day postoperatively in this study. The use of PRF appears to reduce pain, aligning with the findings of Ozgul et al. (2015), who reported reduced postoperative pain with PRF after third molar extraction, as well as with Marenzi et al.'s study in 2015.[19]

Histomorphometric measurements of the percentage of bone area fraction occupancy (BAFO) revealed statistically significant differences for all pairwise comparisons at 7 and 30 days ($p < 0.002$), except for the nanoHA surface without L-PRF use ($p = 0.363$). At 7 days, there was a statistically significant difference between the nanoHA and DAE surfaces, regardless of L-PRF use ($p < 0.048$). At 30 days, no statistically significant difference was observed between the nanoHA and DAE surfaces without L-PRF ($p = 0.881$). However, with L-PRF, the nanoHA surface showed better performance compared to the DAE surface ($p < 0.050$). While the presence of L-PRF significantly increased the bone-to-implant contact (BIC) percentage for nanoHA at both 7 and 30 days ($p < 0.025$), it did not have a significant effect on the BAFO percentage ($p > 0.200$).Graph 2 .[20]



Graph [2] Graphics illustrating the percentage of bone area fraction occupancy (BAFO) as a function of time, implant surface, and the presence or absence of L-PRF (average ± 95% CI) are provided. Different letters indicate statistically significant differences ($p < 0.05$). [20]

7. Treatment of Peri Implantitis with PRF

Peri-implant mucositis is an inflammatory lesion that resides in the soft tissue surrounding a dental implant without signs of bone loss following the initial bone remodeling. In contrast, peri-implantitis also affects the supporting bone, causing progressive bone loss beyond the normal biologic remodeling.[21]. The locus resistentiae minoris created by the foreign body reaction has resulted in a series of events potentially leading to implant failure. An increased number of procedures with no clear etiology of complications has led to an increase in cases of peri-implant disease. [21] Peri-implantitis bone defects are a common issue during dental implant restoration. While peri-implantitis generally has minimal impact on the overall success rate of dental implants, it can affect the treatment process and postoperative quality of life. In this study, PRF combined with GBR technology was used to reconstruct peri-implantitis bone defects. The results indicate that PRF promotes the growth of soft tissues in the oral cavity at all stages of healing. PRF helps alleviate pain during surgery, improves medium-term recovery, reduces the risk of

reinfection and rejection, and accelerates bone regeneration while increasing bone density. This combination ultimately minimizes wear and tear on the patient's defect site.[22]

8. Some of the other clinical implementation of PRF in dentistry

PRF is employed in the treatment of various conditions, such as gingival recession, extraction socket healing, cyst enucleation, periodontal issues, ridge preservation grafting, and endodontic procedures.[12] incorporating L-PRF into the DBBM graft in the maxillary sinus sped up bone healing, which enabled the earlier placement of dental implants.[9]

Bone height and width are preserved, and wound healing is facilitated. For cases involving immediate implant placement, PRF has been reported to significantly enhance the rapid healing of extraction sockets. When used in conjunction with bone grafts, PRF provides a synergistic effect. Additionally, intrabony defects are treated with open flap debridement and PRF to address clinical attachment loss.[23]

In 2017, Castro et al. conducted a systematic review to evaluate the effectiveness of L-PRF in inducing neo-bone formation in periodontal defects.[19]

In a case report, an avulsed tooth with a periapical abscess was treated by shaping the canal and placing a triple antibiotic paste until the follow-up. The antibiotic paste was then removed, and the canal was irrigated. Revascularization was carried out, with PRF prepared and inserted into the canal, followed by the placement of biodentine and glass ionomer cement. After 6 months, PRF contributed to the closure of the apex, repair, and thickening of the radicular dentin.[8]

Conclusion

To conclude PRF can aid in the improvement of implant stability following placement by enhancing the quality and quantity of bone regeneration, improving healing of soft tissue surrounding the implant, reducing the osseointegration time. Since it is easy to manufacture PRF it can be used in day to day clinical practises. Based upon the architecture of fibrin and the contents of leucocyte about four principle sets of platelets are derived include pure platelet-rich plasma (PRP), leukocyte and platelet-rich plasma (L-PRP), pure platelet-rich fibrin (P-PRF), and leukocyte and platelet-rich fibrin (L-PRF). It aids in reducing pain during surgery, improves medium turn of recovery, reduces risk of rejection of implant. It minimizes trauma on the patient defective site by accelerating bone regeneration while increasing bone density. It is used in the treatment of various dental procedures such as cyst enucleation, gingival recession, extraction socket healing, ridge preservation grafting, periodontal issues, endodontic procedure. Healing of peri implant tissue is enhanced by gain in soft tissue width and thickness around the implant. When used along with GBR technology it repairs bony defect and reduces pain during the repair process. Nevertheless, further studies like prospective, longitudinal and clinical trials must be conducted to justify and validate the effects of PRF in implant dentistry further.

References

1. Naeimi Darestani M, Asl Roosta H, Mosaddad SA, Yaghoubee S. The effect of leukocyte-and platelet-rich fibrin on the bone loss and primary stability of implants placed in posterior maxilla: a randomized clinical trial. International Journal of Implant Dentistry. 2023 Aug 9;9(1):23.
2. Lyris V, Millen C, Besi E, Pace-Balzan A. Effect of leukocyte and platelet rich fibrin (L-PRF) on stability of dental implants. A systematic review and

meta-analysis. British Journal of Oral and Maxillofacial Surgery. 2021 Dec 1;59(10):1130-9.

3. Shetye AG, Rathee M, Jain P, Agarkar V, Kaushik S, Alam M. Effect of advanced platelet-rich fibrin and concentrated growth factor on tissues around implants in maxillary anterior region. The Journal of Indian Prosthodontic Society. 2022 Apr 1;22(2):169-78.
4. Tabassum S, Raj SC, Rath H, Mishra AK, Mohapatra A, Patnaik K. Effect of platelet rich fibrin on stability of dental implants: A systematic review and meta-analysis. International Journal of Health Sciences. 2022 Sep;16(5):58.
5. Strauss FJ, Stähli A, Gruber R. The use of platelet-rich fibrin to enhance the outcomes of implant therapy: a systematic review. Clinical oral implants research. 2018 Oct;29:6-19.
6. Cheruvu RN, Katuri KK, Dhulipalla R, Kolaparthy L, Adurty C, Thota KM. Evaluation of soft tissue and crestal bone changes around non-submerged implants with and without a platelet-rich fibrin membrane: A randomized controlled clinical trial. Dental and Medical Problems. 2023;60(3):437-43.
7. Petronilho VG, de Fátima Balderrama Í, de Oliveira LA, Queiroz PM, Zubek MG, Gottardo VD. Evaluation of mechanical properties of platelet-rich fibrin membrane for implant surgery: An analysis: in vitro. Journal of Indian Society of Periodontology. 2022 Jan 1;26(1):19-23.
8. Arshad S, Tehreem F, Rehab khan M, Ahmed F, Marya A, Karobari MI. Platelet-rich fibrin used in regenerative endodontics and dentistry: current uses, limitations, and future recommendations for application. International journal of dentistry. 2021;2021(1):4514598.
9. Pichotano EC, de Molon RS, Freitas de Paula LG, de Souza RV, Marcantonio Jr E, Zandim-Barcelos DL. Early placement of dental implants in maxillary sinus grafted with leukocyte and platelet-rich fibrin and deproteinized bovine bone mineral. Journal of Oral Implantology. 2018 Jun 1;44(3):199-206.
10. Steller D, Herbst N, Pries R, Juhl D, Klinger M, Hakim SG. Impacts of platelet-rich fibrin and platelet-rich plasma on primary osteoblast adhesion onto titanium implants in a bisphosphonate in vitro model. Journal of Oral Pathology & Medicine. 2019 Nov;48(10):943-50.
11. Anapu MP, Atluri KR, Tripuraneni SC, Issrani R, Bader AK, Alkhalaf ZA, Sghaireen MG, Prabhu N, Alshammari RR, Khalid G, Matab G. Evaluation of effect on stability of implants with and without platelet rich fibrin using a resonance frequency analyzer-An in-vivo study. Heliyon. 2024 Apr 15;10(7).
12. Sharma K, Roy S, Kumari A, Bhargavi M, Patel S, Ingale P, Laddha R. A Comparative Evaluation of Soft and Hard Tissue Changes Around Dental Implants Placed With and Without Platelet-Rich Fibrin. Cureus. 2023 Mar;15(3).
13. Chary NO, Raju MS, Sajjan MS, Gottumukkala SN, Manyam R. Comparison of quality of bone and insertion torque values of early implants placed at 6 and 8 weeks in sockets preserved with advanced platelet-rich fibrin: A randomized controlled trial. The Journal of Indian Prosthodontic Society. 2021 Oct 1;21(4):366-74.
14. Shahbaz Alam M, Dhiman A, Jain V, Bhutia O, Pruthi G. Vertical bone implant contact around anterior immediate implants and their stability after using either alloplast or L-PRF or both in peri-

Implant gap: A prospective randomized trial. Journal of Maxillofacial and Oral Surgery. 2020:1-9.

15. Elsheikh HA, Abdelsameaa SE, Elbahnasi AA, Abdel-Rahman FH. Comparison between platelet rich fibrin as space filling material versus xenograft and alloplastic bone grafting materials in immediate implant placement: a randomized clinical trial. BMC Oral Health. 2023 Dec 8;23(1):977.
16. Hehn J, Schwenk T, Striegel M, Schlee M. The effect of PRF (platelet-rich fibrin) inserted with a split-flap technique on soft tissue thickening and initial marginal bone loss around implants: results of a randomized, controlled clinical trial. International Journal of Implant Dentistry. 2016 Dec;2:1-0.
17. Khan ZA, Jhingran R, Bains VK, Madan R, Srivastava R, Rizvi I. Evaluation of peri-implant tissues around nanopore surface implants with or without platelet rich fibrin: a clinico-radiographic study. Biomedical Materials. 2018 Jan 9;13(2):025002.
18. Tabrizi R, Arabion H, Karagah T. Does platelet-rich fibrin increase the stability of implants in the posterior of the maxilla? A split-mouth randomized clinical trial. International journal of oral and maxillofacial surgery. 2018 May 1;47(5):672-5.
19. Sleem SS, Zayet MK, El-Ghareeb TI, Saleh HA. Evaluation of the bio-stimulatory effect of platelet rich fibrin augmented by diode LASER compared to platelet rich fibrin alone on dental implant replacing posterior mandibular teeth. Randomised clinical trial: split mouth study. Open Access Macedonian Journal of Medical Sciences. 2019 Mar 3;7(5):869.
20. Júnior JA, Nóbrega F, Oliveira PG, Bergamo ET, Cadore U, Gomes MZ, Kjellin P, Chaushu L, Bezerra F, Ghiraldini B, Scombatti de Souza S. Evaluation of Implant Surface Modification with Nanohydroxyapatite Associated with the Use of L-PRF: In Vivo Study in Rats. Journal of Functional Biomaterials. 2023 Jul 14;14(7):370.
21. Shah R, Shah H, Shetty O, Mistry G. A novel approach to treat peri implantitis with the help of PRF. The Pan African Medical Journal. 2017;27.
22. Sun G, Cao L, Li H. Effects of platelet-rich fibrin combined with guided bone regeneration in the reconstruction of peri-implantitis bone defect. American journal of translational research. 2021;13(7):8397.
23. Miron RJ, Zucchelli G, Pikos MA, Salama M, Lee S, Guillemette V, Fujioka-Kobayashi M, Bishara M, Zhang Y, Wang HL, Chandad F. Use of platelet-rich fibrin in regenerative dentistry: a systematic review. Clinical oral investigations. 2017 Jul;21:1913-27.