PAPER – OPEN ACCESS

Comparison of Efficacy of Bovine Xenograft with or Without Platelet-Rich Fibrin in Intrabony Defects: A Systematic Review

Author : Karisha Hanna Sulviati Ashari, and Irma Ervina
DOI : 10.32734/tm.v2i1.2687
Electronic ISSN : 1234-1234
Print ISSN : 1234-5678

Volume 2 Issue 3 – 2025 TALENTA Conference Series: Tropical Medicine (TM)

TM Conference Series 02 (2025)
TALENTA Conference Series
Available online at https://talentaconfseries.usu.ac.id

Comparison of Efficacy of Bovine Xenograft with or Without Platelet- Rich Fibrin in Intrabony Defects: A Systematic Review

Karisha Hanna Sulviati Ashari[1], Irma Ervina[2]*

[1] *Periodontic Residency Program, Faculty of Dentistry, Universitas Sumatera Utara, Medan, Indonesia*
[2]*Department of Periodontics, Faculty of Dentistry, Universitas Sumatera Utara, Medan, Indonesia*

Irma.ervina@usu.ac.id

Abstract

PRF has been associated with biomaterials like bovine xenograft, and it has demonstrated superior efficacy in repairing intrabony defects when compared to bovine xenograft alone, but it remains unclear. The study aims to compare the results of platelet- rich fibrin (PRF) with those of bovine xenograft and bovine xenograft alone in treating intrabony defects. All studies presented PRF with bovine xenograft group exhibited a better result in clinical and radiographic parameters compared to the bovine xenograft alone group, which were the PRF-bovine xenograft group had lower pocket depth, higher clinical attachment level, lower vertical bone loss and depth of defects. Most of the studies showed there were no significant differences in results between the PRF with bovine xenograft group and bovine xenograft alone group in the treatment of intrabony defects. Still, both groups showed a better result on all parameters when compared to baseline. Only one study presented a significant result in all clinical parameters in intrabony defects between the inter-groups, and both groups also showed a better result on all parameters when compared to baseline. Xenograft does not have bone regeneration properties, so PRF combination can promote bone formation since it has numerous growth factors. Nevertheless, the extensive mesh interconnecting pore structure of bovine xenograft facilitates osteoblast migration and angiogenesis. Centrifugation preparation of PRF and bone defect types also determines healing results. Both groups effectively treat intrabony defects, but the PRF-bovine xenograft complex achieves better outcomes than bovine xenograft alone in intrabony defects.

Keywords: Platelet-rich fibrin; xenograft; bovine bone; intrabony defects

1. Introduction

Periodontal therapy attempts to restore the function and appearance of periodontal tissues by lowering inflammation and effectively managing risk factors. Treatment for intrabody defects involves a variety of treatments designed to rebuild the attachment apparatus, such as biomolecular techniques, directed tissue regeneration, bone substitutes, or combinations of some of these methods [1].

Several fundamental requirements must be met by bone substitute materials, including biocompatibility (supporting the growth of new bone tissue without causing adverse reactions or rejection), osteoconductivity (acting as a scaffold for the growth of new bone tissue), osteoinductivity (inducing osteoblasts to regenerate new bone tissue), and resorbability (transforming gradually as new bone tissue takes its place) [2-4]. Consequently, bone substitutes such as xenogeneic —of which one is derived from bovine bone (bovine porous bone mineral/BPBM)— are commonly utilized together with guided tissue regeneration [2]. Deproteinized bovine bone mineral (DBBM) or inorganic bovine bone matrix (ABBM) is the most often used source of xenografts. Still, it only has the osteoconductivity property, so it is unable to promote bone regeneration [4,5].

Selection and peer-review under responsibility of Seminar Periodental Update 5 2024
p-ISSN: 1234-5678, e-ISSN: 1234-1234, DOI: 10.32734/tm.v2i1.2687

The potential of biological mediators to accelerate wound healing and increase the therapeutic advantages of bone replacement grafts has drawn the attention of researchers in recent years. Platelet-rich fibrin (PRF) contains a number of self-derived biological agents that can enhance the healing of both soft and hard tissues. Since it gathers leukocytes and platelets so effectively, PRF, also termed autologous leukocyte and platelet-rich fibrin, is a refined form of platelet concentrate [6-8]. The form of PRF is determined by its centrifugation force and preparation time, as shown in Figure 1 [6].

It has been shown that combining bovine xenograft with PRF enhances the regenerative benefits of xenograft material, suggesting that the combination is better than either bovine xenograft or PRF alone in terms of results [4,9,10]. While PRF has been associated with biomaterials like bovine xenograft, it has demonstrated superior efficacy in repairing intrabony defects compared to bovine xenograft alone [11-13]. However, it remains unclear how PRF, in combination with bovine xenograft, affects bone regeneration. This systematic review aimed to evaluate the efficacy of bovine xenograft alone compared to the combination of PRF and bovine xenograft in treating intrabony defects.

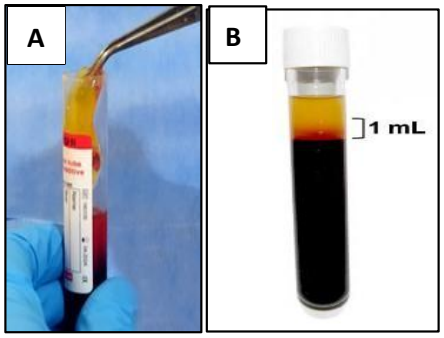

Figure 1. Platelet-rich fibrin. A. The gelatinous PRF, B. The liquid PRF [6].

2. Methods

Following PRISMA guidance, the authors used a systematic review approach to search for clinical trials published between 2014 and 2024. They independently searched several databases using manual and electronic methods, including PubMed, Google Scholar, and the Cochrane Library. The following keywords were used in various combinations to search the data: Platelet-Rich Fibrin, Xenograft, Bovine Bone, and Intrabony Defects. After analyzing the titles and abstracts, the complete publications were chosen for comprehensive examination and analysis based on the qualifying requirements.

A specific question was developed using the PICO concept (participant, intervention, comparison, and outcome) by the PRISMA criteria:

- P stands for the patient with intrabony defects;
- I stands for treatment using a combination of PRF with bovine xenograft;
- C stands for efficacy comparison between PRF with bovine xenograft and bovine xenograft alone with several months of follow-up after treatment;
- O stands for outcome; these represent clinical parameters, including pocket depth (PD) and clinical attachment level (CAL), as well as radiographic parameters, including vertical bone loss (VBL) and depth of defect (DD) following treatment.

The chosen studies were all randomized clinical trials (RCTs) with an English publication date of no more than ten years. They described in vivo investigations comparing the effects of a combination of PRF and bovine xenograft with bovine xenograft alone, with follow-up periods ranging from three to twenty-four months. Excluded from consideration were all case reports, in vitro experiments, reviews, and studies written in languages other than

English. If there were many follow-ups in the trial, every outcome was documented. Studies using qualitative analysis extracted publications that satisfied the inclusion criteria. Publications that satisfied the requirements for the qualitative assessment were then chosen for this systematic review.

Evaluating the quality of the methodology used in each study is crucial to comprehend the findings. The JBI Checklist for Randomized Controlled Trials was utilized to assess the caliber of every research project. The randomization and subject allocation protocol, whether examiners and participants were blinded to the intervention, the treatment methods administered to the subjects, the follow-up protocols, the techniques for measuring the outcomes, and the statistical analysis employed were all assessed. JBI's Checklist for Randomized Controlled Trials, shown in Table 1, was used to assess the quality of the literature for this systematic review.

Table 1. Quality assessment of analyzed literature.

No.	Question	Sezgin Y et al.	Liu K et al.	Singhal D et al.
1	Was true randomization used for the assignment of participants to treatment groups?	Yes	Yes	Yes
2	Was allocation to treatment groups concealed?	Yes	Yes	Yes
3	Were treatment groups similar at the baseline?	Yes	Yes	Yes
4	Were participants blind to treatment assignment?	Yes	Yes	Yes
5	Were those delivering treatment blind to treatment assignment?	Yes	No	Unclea r
6	Were outcomes assessors blind to treatment assignment?	Yes	No	Unclea r
7	Were treatment groups treated identically other than the intervention of interest?	Yes	Yes	Yes
8	Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analyzed?	Yes	Yes	Yes
9	Were participants analyzed in the groups to which they were randomized?	Yes	Yes	Yes
10	Were outcomes measured in the same way for treatment groups?	Yes	Yes	Yes
11	Were outcomes measured reliably?	Yes	Yes	Yes

No.	Question	Sezgin Y et al.	Liu K et al.	Singhal D et al.
12	Was appropriate statistical analysis used?	Yes	Yes	Yes
13	Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	Yes	Yes	Yes

Following a keyword search that yielded a total of 4.110 articles, 732 articles were obtained based on the study design and the intended analysis timeframe. In addition, 712 articles with unrelated names and abstracts were eliminated, 16 were excluded because full text was not found, and 1 was excluded after full-text assessment, leaving 3 articles in this systematic review. The research selection PRISMA flow diagram is demonstrated in Figure 2.

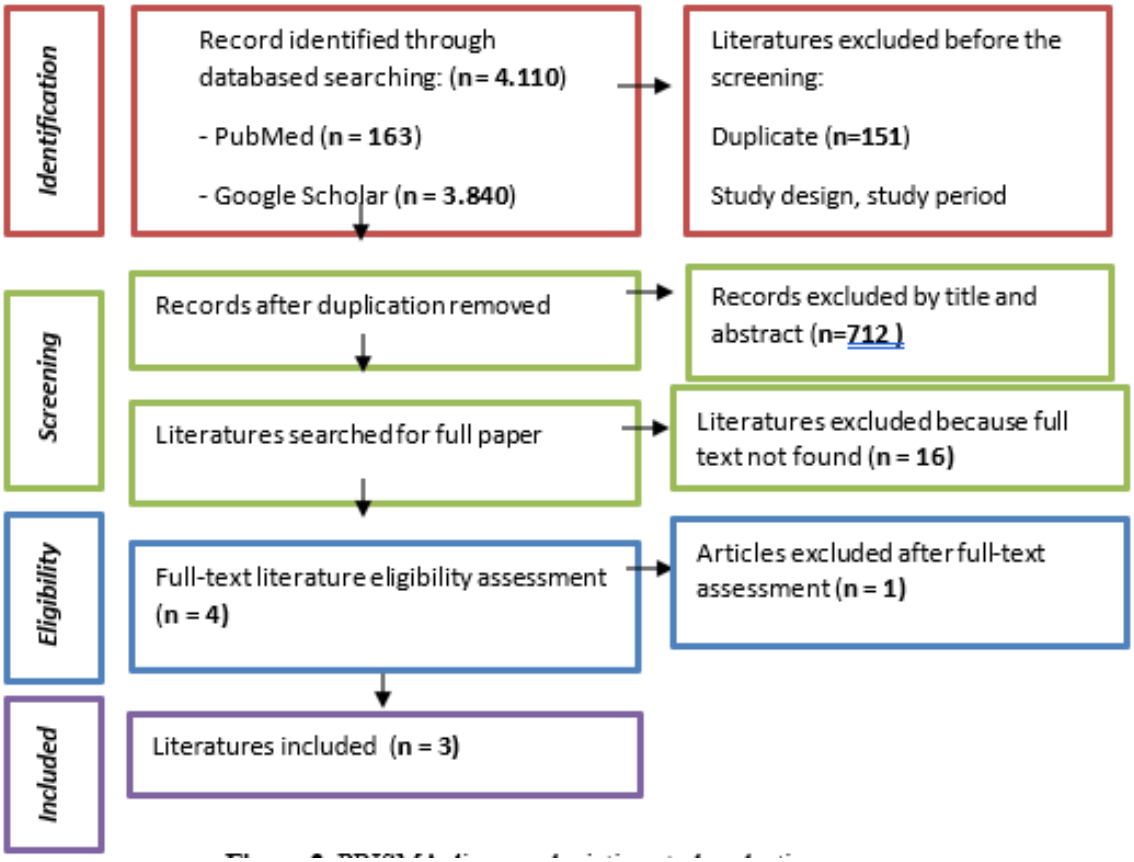

Figure 2. PRISMA diagram depicting study selection.

3. Result

Table 2 shows the characteristics of the selected studies. Three RCTs were included, two with split-mouth designs and one with a parallel design. The investigations included 12 to 15 volunteers with intrabony defects, ranging in age from 24 to 61. None of the study participants had any systemic disorders, were pregnant or nursing, smoked or had poor dental hygiene.

Table 2. Characteristics of selected literature

Author Year	Number of Samples	Age	Intervention	Control Group	Follow-Up
Sezgin Y et al, 2017[11]	15 patients; 7 women and 8 men	38-61	Combination of ABBM and PRF	ABBM	Before surgery, 3 months and 6 months after treatment
Liu K et al, 2021[12]	15 patients; 11 women and 4 men	24-60	Combination of BPMB and PRF	BPBM	Before surgery, 6 months, 12 months, and 24 months after treatment
Singhal D et al, 2022[13]	12 patients	30-55	Combination of ABBM and PRF	ABBM	Before surgery, 3 months and 6 months after treatment

PRF, platelet-rich fibrin; BPBM, bovine porous bone mineral; ABBM, anorganic bovine bone mineral

Table 3 demonstrated that there was a significant drop in clinical and radiographic parameters in both groups when compared to baseline, which is the PRF-bovine xenograft group had lower PD values, higher CAL values, and lower VBL and DD values than the bovine xenografts only group. However, two studies showed no significant differences in results between the PRF-bovine xenograft group and the bovine xenograft group alone in treating intrabony defects. Still, both groups showed better results on all parameters when compared to baseline. Only one study presented a significant result in all clinical parameters in intrabony defects between the inter-groups. Also, it showed a better result on all parameters when compared to baseline.

Both groups from all studies showed notable gains over baseline in terms of CAL gain. Only CAL demonstrated a significant increase in gain between the intervention and control groups in the intergroup comparison. Hard tissue findings indicated that both treatment groups significantly improved, relative to baseline, regarding vertical bone increase and defect depth; however, only one study showed a significant drop in vertical bone increase between the groups.

4. Discussion

The components of a bovine xenograft include deproteinized, sterilized bovine bone with a porosity of 75–80% and crystals the size of 10 mm that mimic human cortical granules. Furthermore, xenografts have no capacity for osteogenesis or osteoinduction because of their entire deproteinization. The large-mesh interconnecting pore system facilitates osteoblast migration and angiogenesis. Numerous histological investigations have demonstrated that mature, compact bone surrounds most bovine xenograft particles. Along with growing bone, mesenchymal cells, osteoblasts, and tiny capillaries were visible in certain Haversian canals. The contact between the bovine xenograft particles and the newly generated bone was free of gaps, with essential newly formed bone serving as bridges connecting the xenograft granules. Because of their non-resorbable qualities, xenografts are a very significant class of bone grafts [2,3].

A tetramolecular fibrin matrix that contains platelets, leukocytes, cytokines, and circulating stem cells are the components that makeup PRF. PRF was studied as a possible regenerative substance for intrabony defects because of its physical and biochemical characteristics, which make it beneficial for use in periodontal wound repair [14].

Table 3. Results extracted from analysed literature

Author Year	Study Design	Number of Samples	Age	Intervention	Control Group	Bone defect type	Centifugation parameters speed (rpm) x time (min)	Result	Conclusion
Sezgin Y et al, 2017[11]	RCT 6 months	15 patients; 7 women and 8 men	38-61	Combination of ABBM and PRF	ABBM	2 or 3 wall defects	2.700 rpm x 12	There was similar PD reduction, a significant CAL gain, and similar value, of radiographic DD and VBL reduction between the two groups	Both PRF-ABBM and ABBM alone are beneficial in treating intrabony defects
Liu K et al, 2021[12]	RCT 24 months	15 patients; 11 women and 4 men	24-60	Combination of BPMB and PRF	BPBM	NR	700 rpm x 3	There was a significant PD reduction, a significant CAL gain in intervention group, and a similar value of percentage radiographic DD and VBL reduction between two groups.	This study showed that PRF-BPBM complex has better clinical outcomes than BPPM alone

Author Year	Study Design	Number of Samples	Age	Intervention	Control Group	Bone defect type	Centifugation parameters speed (rpm) x time (min)	Result	Conclusion
Singhal D et al, 2022[13]	RCT 12 months	12 patients	30-55	Combination of ABBM and PRF	ABBM	2 or 3 wall defects	3000 rpm x 12	There was similar PD reduction, a significant CAL gain on intervention group, similar value of radiographic DD reduction and significant VBL reduction between two groups.	Both PRF-BPBM and ABBM alone are beneficial in treating intrabony defects

RCT, randomized clinical trial; PRF, platelet-rich fibrin; BPBM, bovine porous bone mineral; ABBM, anorganic bovine bone mineral; NR, not reported; PD, probing depth; CAL, clinical attachment level; VBL, vertical bone loss; DD, defect of depth; rpm, rotations per minute.

One of PRF's characteristics during centrifugation is its spontaneous, gradual polymerization. This kind of polymerization makes it easier for PRF to gradually release growth factors, which are crucial for cell division, proliferation, and chemotaxis and inducing periodontal regeneration. Furthermore, the fibrin network's structure can shield growth factors from proteolysis, resulting in longer growth factor release, longer duration of action, and promotion of tissue repair. This leads to more effective cell migration and proliferation. During fibrin matrix remodeling, PRF would be able to release cytokines gradually; this mechanism could account for the therapeutically reported healing capabilities of PRF [6,7,15].

The PRF combination in bovine xenograft group's higher successful regeneration may have been induced primarily by the following factors: 1) Platelet-derived growth factor, transforming growth factor β1, and epidermal growth factor are just a few examples of the abundant autologous growth factors found in PRF that may stimulate the migration, proliferation, and differentiation of various periodontium-related cells, thereby increasing the possibility of periodontal regeneration; 2) PRF inhibits osteoclastogenesis and osteoclast development; and 3) PRF exhibits antibacterial activity against a range of periodontal disease agents [6-17].

Two studies applied the minced gelatinous form of PRF with the bovine xenograft. The gelatinous form of PRF was created by higher centrifugation for 12 minutes. Minced PRF is simple to manipulate and distribute to the surgical site, which is why it was chosen to be used in with the bovine xenograft. However, it is still nonrigid, making it less effective in preserving space in periodontal defects [4,16]. PRF is a more solid and rigid material compared to other biological preparations such as enamel matrix proteins and platelet-rich plasma (PRP). Combining a semi-liquid substance with a mineralized graft material like bovine xenograft has considerably improved the clinical outcomes of intrabony lesions [16,17]. The combination of minced gelatinous PRF and bovine xenograft is shown in Figure 3.

Figure 3. Bovine xenograft with minced PRF [3].

One study result shows a substantially greater PD and CAL reduction in the intervention group compared to the control group. However, neither the radiographic vertical bone loss nor the radiographic depth of the intrabony defect differed significantly between the two groups. This occurs because slower centrifugation was used to create the liquid PRF type, which contains more growth factors than the gelatinous PRF type [18- 24]. Conversely, the mixture of liquid PRF and bovine xenograft does not produce a granular mass, making it more applicable than granular materials like bovine xenograft alone or bovine xenograft with minced PRF [12]. Other studies also showed when compared to PRP and controls, liquid PRF produced considerably more mineralized nodules and increased ALP activity, as evidenced by osteogenic differentiation [23,24]. The combination of liquid PRF and bovine xenograft is shown in Figure 4.

The use of bovine xenograft alone in the control group may have obscured any beneficial effects of PRF in the treatment, as the results of two studies indicate that treatment with PRF combination in bovine xenograft may not have produced significantly better results than those obtained with bovine xenograft alone. It may be suggested that bovine xenograft alone can be applied as therapy for intrabony defects. Afterward, compared to the bovine xenograft alone, the PRF combination in the xenograft exhibits a markedly better result in all parameters. One

possible explanation for this could be that PRF contains numerous growth factors, while these factors can stimulate the migration, proliferation, and differentiation of various periodontal cells within the scaffold. Osteoblast migration and angiogenesis are facilitated by the complex [4-7,25,26].

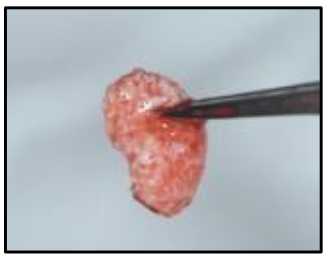

Figure 4. Bovine xenograft with liquid PRF [12].

The radiographic parameters from the studies do not present significant differences in the intergroup. This may relate to the number of remaining walls that were examined since almost all of the studies examine intrabony defects with two or three walls. Comparing the xenograft's property for regeneration to PRF would have been most effective in a three-wall research [26].

5. Conclusion

Intrabony defects can be effectively treated with both bovine xenograft and PRF combination in bovine xenograft. However, the addition of PRF to bovine xenograft may enhance clinical and radiographic parameters, especially in CAL gain. Applying PRF greatly improves the ability of bovine xenograft to promote tissue regeneration in managing intrabony defects in humans.

Conflict of Interest

The systematic review does not contain any conflict of interest.

References

[1] Figueira EA, de Assis AO, Montenegro SCL, et al. Long-term periodontal tissue outcome in regenerated infrabony and furcation defects: a systematic review. Clin Oral Investig. 2014;18: 1881-1892.

[2] Dumitrescu AL. Chemicals in surgery periodontal therapy. Berlin: Springer; 2011:73-144.

[3] Miron RJ. Optimized bone graft. Periodontology 2000. 2024;94:143–160.

[4] Lekovic V, Milinkovic I, Aleksic Z, et al. Platelet-rich fibrin and bovine porous bone mineral vs. platelet-rich fibrin in the treatment of intrabony periodontal defects. J Periodontal Res. 2012;47:409-417.

[5] Slotte C, Asklöw B, Sultan J, Norderyd O. A randomized study of open-flap surgery of 32 intrabony defects with and without adjunct bovine bone mineral treatment. J Periodontol. 2012;83(8):999-1007.

[6] Calciolari E, Dourou M, Akcali A, Donos N. Differences between first- and second-generation autologous platelet concentrates.Periodontology 2000. 2024;00:1–22.

[7] Miron RJ et al. Use of platelet-rich fibrin for the treatment of periodontal intrabony defects: a systematic review and meta-analysis. Clin Oral Invest. 2021; 25:2461– 2478.

[8] Idiri K, Bandiaky O, Soueidan A, Verner C, Renard E, Struillou X. The effectiveness of the addition of platelet-rich fibrin to bovine xenografts in sinus and bone ridge augmentation: a systematic review. J. Funct. Biomater. 2023: 1-14.

[9] Pradeep AR, Bajaj P, Rao NS, Agarwal E, Naik SB. Platelet-rich fibrin combined with a porous hydroxyapatite graft for the treatment of 3-wall intrabony defects in chronic periodontitis: a randomized controlled clinical trial. J Periodontol. 2017;88:1288-1296.

[10] Chandradas ND, Ravindra S, Rangaraju VM, Jain S, Dasappa S. Efficacy of platelet rich fibrin in the treatment of human intrabony defects with or without one graft: A randomized controlled trial. Journal of International Society of Preventive and Community Dentistry. 2016; 6(2): 153-159.

[11] Sezgin Y, Uraz A, Taner IL, Çulhaoğlu R. Effects of platelet-rich fibrin on healing of intra-bony defects treated with anorganic bovine bone mineral. Braz Oral Res. 2017;31:1-15.

[12] Liu K, Huang Z, Chen Z, Han B, Ouyang X. Treatment of periodontal intrabony defects using bovine porous bone mineral and guided tissue regeneration with/without platelet-rich fibrin: a randomized controlled clinical trial. J Periodontol. 2021;1–8.

[13] Singhal D, Bali S, Aggarwal P, Nautiyal A, Pal K. Comparative evaluation of anorganic bovine bone matrix (abbm) with or without platelet rich fibrin intreatment of intrabony defects:a randomized controlled trial. Journal of Pharmaceutical Negative Results. 2022;13(6):1703-1710.

[14] Djais A, Siswanto H. A comparative study of platelet rich fibrin and bone graft in intrabony defect treatment: A systematic review. J Dentomaxillofac Sci. 2020;5(3):137-140.

[15] Miron JR, Chai J, Zheng S, Feng M, Sculean A, Zhang Y. A novel method for evaluating and quantifying cell types in platelet rich fibrin and an introduction to horizontal centrifugation. J Biomed Mater Res. 2019; 107(10): 2257-2271.

[16] Camargo PM, Lekovic V, Weinlaender M, Resnik TD, Pavlovic M, Kenney EB. A surgical re-entry study on the influence of platelet-rich plasma in enhancing the regenerative effects of bovine porous bone mineral and guided tissue regeneration in the treatment of intrabony defects in humans. J Periodontol 2009;80:915–922.

[17] Dori F, Kovacs V, Arweiler NB et al. Effect of platelet-rich plasma on the healing of intrabony defects treated with an anorganic bovine bone mineral: a pilot study. J Periodontol 2009;80: 1599–1605.

[18] Rexhepi I et al. Efficacy of inorganic bovine bone combined with leukocyte and platelet-rich fibrin or collagen membranes for treating unfavorable periodontal infrabony defects: Randomized non-inferiority trial. J Periodontol. 2021;1–12.

[19] Miron JR, Zhang Y. Autologous liquid platelet rich fibrin: A novel drug delivery system. Acta Biomaterialia. 2018;75:35–51.

[20] Miron RJ, Gruber R, Farshidfar N, Sculean A, Zhang Y. Ten years of injectable platelet-rich fibrin. Periodontology 2000. 2024;94:92–113.

[21] Kobayashi E, Fluckiger L, Fujioka-Kobayashi M, et al. Comparative release of growth factors from PRP, PRF, and advanced-PRF. Clin Oral Investig. 2016;20:2353-2360

[22] Isık G, Yüce OM, Koçak-Topbas N, Günbay T. Guided bone regeneration simultaneous with implant placement using bovine-derived xenograft with and without liquid platelet-rich fibrin: A randomized controlled clinical trial. Clin. Oral Investig. 2021, 25, 5563–5575.

[23] Thanasrisuebwong P, Surarit R, Bencharit S, Ruangsawasdi N. Influence of fractionation methods on physical and biological properties of injectable platelet- rich fibrin: an exploratory study. Int J Mol Sci. 2019; 20:1657.

[24] Valladão CAA, Monteiro MF, Joly JC. Guided bone regeneration in staged vertical and horizontal bone augmentation using platelet-rich fibrin associated with bone grafts: a retrospective clinical study. Int J Implant Dent. 2020; 6:72.

[25] Karayurek F. Combining platelet rich fibrin with different bone graft materials: An experimental study on the histopathological and immunohistochemical aspects of bone healing. Journal of Cranio-Maxillo-Facial Surgery. 2019;47:815-825.

[26] Sculean A, Nikolidakis D, Nikou G, Ivanovic A, Chapple IL, Stavropoulos A. Biomaterials for promoting periodontal regeneration in human intrabony defects: a systematic review. Periodontology 2000. 2015;68:182–216.Prabhu M, Amitha R, Bijhu T. Treatment of orthodontically induced gingival hyperplasia by diode laser- A case report. NUJHS 2015; 5:66-8.