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REVIEW ARTICLE

The clinical implications of platelet-rich fibrin on periodontal regeneration: A systematic review

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KEYWORDS

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Abstract *Objectives:* Platelet concentrates have been shown to enhance periodontal regeneration when used as a treatment on their own or in conjunction with bone grafting materials. This systematic review aims to assess the effects of using platelet-rich fibrin (PRF), both alone and in combination with other conventionally used materials, on periodontal regeneration in clinical trials.

Materials and methods: A systematic electronic search was performed in the electronic databases MEDLINE (PubMed), Scopus, and Web of Science. Specifically, we searched for English language articles published between 2009 and 2019 that conducted in-human studies and included a summary of the results. Our primary search yielded 220 articles, and of these, 110 were clinical studies. Forty-four articles were then selected for a full reading.

Results: Twenty-six randomized control trials (RCTs) met the inclusion criteria and were included in this review. Despite the differences between the reviewed studies, most revealed the ability of PRF to promote periodontal wound healing. The positive effects of PRF were observed in clinical criteria, such as reductions in pocket probing depth (PD) and increases in clinical attachment level (CAL), as well as in the degree of defect bone fill, which was determined either radiographically or by surgical re-entry.

Conclusions: Additional studies are needed to compare the clinical outcomes of various PRF application procedures and establish standardized protocols for treating periodontal disease with PRF.

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Contents

1. Introduction

The field of maxillofacial surgery has been greatly advanced by the introduction of autologous platelets and their production via different techniques. Platelet concentrates are made by centrifuging the patient's blood. When used either alone or in combination with bone grafts, they have a significant impact on periodontal regeneration (Ehrenfest et al., 2014). Platelet concentrates have been classified into four main categories, based upon their leucocyte and fibrin content: pure platelet-rich plasma (P-PRP), leucocyte-platelet-rich plasma (L-PRP), pure platelet-rich fibrin (P-PRF), and leucocyte-platelet-rich fibrin (L-PRF). These classes can be further divided into two generations: the first generation includes platelet-rich plasma (PRP), while the second generation consists of platelet-rich fibrin, such as Choukroun's PRF (Ehrenfest et al., 2009).

PRP was first introduced by Marx et al. (1998), who combined PRP with cancellous bone to augment mandibular defects. Their study revealed that adding PRP to bone grafts accelerated bone regeneration and improved bone quality. PRP releases various growth factors, thereby providing the healing site with an effective growth factor delivery system. These growth factors crucially assist the cells that contribute to the healing process, including osteoblasts, fibroblasts, and cementoblasts, which each promote rapid tissue regeneration (Anitua et al., 2007).

The second generation platelet derivation, PRF, first appeared in France in 2001 (Choukroun et al., 2006). PRF consists of a patient-derived fibrin matrix, which is rich in thrombocytes and white blood cells. The primary difference between PRP and PRF is that PRF does not require any additives, such as anticoagulants, thrombin, or any other gelling agents (Dohan et al., 2006). Additionally, naturally polymerized PRF clots more effectively than PRP due to its slow, sustained release of growth factors over an average of 7-days following the onset of the wound. PRP, meanwhile, quickly releases a large quantity of growth factors during the first 48 h, resulting in a lighter fibrin clot (Dohan Ehrenfest et al., 2009; Passaretti et al., 2014).

This systematic review aims to investigate the value of using PRF either on its own or combined with conventionally used materials for periodontal regeneration in clinical trials.

2. Methodology

2.1. Search strategy

A systematic electronic search was performed in the electronic databases MEDLINE (PubMed), Scopus, and Web of Science. The reviewers searched for papers written in English and published from January 2009 to 2019 using the following terms: "'Platelet rich fibrin' AND 'Periodontal regeneration' OR 'PRF' AND 'Periodontal surgery.'" This review was registered with the International Prospective Register of Systematic Reviews (PROSPERO) and the issued identification number CRD42020215523. Our primary focus was to assess the efficacy of using PRF either alone or in combination with conventionally used materials for periodontal regeneration in periodontitis patients based on observed clinical outcomes, such as PD, CAL, and the level of bone fill.

The search strategy was divided into two phases. In the first phase, two reviewers (M.M. and A.E.) independently screened the titles and abstracts generated by the search. When publications did not fulfill the inclusion criteria, they were excluded upon the reviewers' agreement. Any disagreement between the two reviewers was resolved by discussion. During the second phase, the eligible articles' full texts were obtained and examined by both reviewers. The articles that fulfilled all selection criteria were processed for data extraction. This review was performed in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

2.2. Eligibility criteria

To be eligible for inclusion, publications had to meet the following criteria: they must (1) contain original research published in English; (2) conduct an RCT; (3) include test and control groups with periodontal defects; (4) report data outcomes, CAL, PD, and/or defect fill; and (5) conduct a randomized clinical trial, clinical study, or comparative study. Prospective and retrospective cohort studies, letters to editors, reviews, case series, case reports, and in vivo and in vitro studies were not included.

2.3. Risk of bias assessment

The reviewers independently assessed the risk of bias for each study, and conflicts were discussed based on the protocols outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins, 2011). Five bias domains were established: bias arising from the randomization process (D1), bias due to deviations from intended interventions (D2), bias due to missing outcome data (D3), bias in outcome measurements (D4), and bias in the selection of the reported result (D5). Studies were considered to have a "low risk of bias" if none of the above domains were present. If at least one domain raised questions or concerns, studies were given the label "raised some concerns/moderate risk," while studies were designated as "high risk" if at least one domain exhibited a high degree of bias or if several concerns were present in multiple domains. The Cochrane Collaboration tool was then used to generate the quality risk-of-bias assessment results' chart.

Fig. 1 PRISMA Flow chart of articles screening and exclusion.

3. Results

3.1. Search and selection

The electronic search and the initial screening yielded 220 articles for consideration. After excluding duplicated titles, 196 articles remained. These articles were then searched using the terms "'Clinical study' OR 'Clinical trial' OR 'Comparative study' AND 'Human study.'" Following this search, 110 articles remained. We then screened titles and abstracts to remove articles that were either unrelated to our objective or did not report clinical periodontal findings. A total of 44 articles remained. These articles were selected for a complete reading, and any doubt regarding a study's inclusion in this review was resolved by the reviewers' agreement to include or exclude that particular study.

Of the 44 articles, 18 were excluded. Two of these articles investigated gingival recession, one focused on dental implants, two discussed palatal wound healing, two considered maxillary sinus augmentation, four examined third molar extraction and osteonecrosis, and seven explored ridge augmentation and socket preservation. Ultimately, twenty-six randomized RCTs fulfilled the inclusion criteria and were selected for full text reviews (Fig. 1). The risk of bias assessment determined that twenty studies had a low risk of bias, three had a moderate risk, and three had a high risk (Fig. 2). These studies were designated as high risk due to concerns or missing information regarding D2, D3, D4, and D5.

Of the 26 fully reviewed studies, six used PRF compared to open flap debridement (OFD) alone (Arabacı et al., 2017; Bajaj et al., 2017; Kizildağ et al., 2018; Pradeep et al., 2012; Sharma and Pradeep, 2011a; Thorat et al., 2011). Two studies examined the application of PRF alone for treating class II furcation involvement (Bajaj et al., 2013; Sharma and Pradeep, 2011a). Of the studies that used PRF in combination with other materials, one added PRF to a collagen membrane (Panda et al., 2016). Seven used PRF together with bone graft materials to treat intrabony defects (IBDs; Agarwal et al., 2016; Chatterjee et al., 2017; Galav et al., 2016; Gamal et al., 2016; Lekovic et al., 2012; Pradeep et al., 2017; Sezgin et al., 2017). An additional four studies combined PRF with other regenerative agents for treating class II furcation involvement (Biswas et al., 2016; Kanoriya et al., 2017; Pradeep et al., 2016; Sharma and Pradeep, 2011a). Finally, in five studies, PRF was combined with either topical therapeutic agents (Kanoriya et al., 2016; Martande et al., 2016; Pradeep et al., 2015) or with

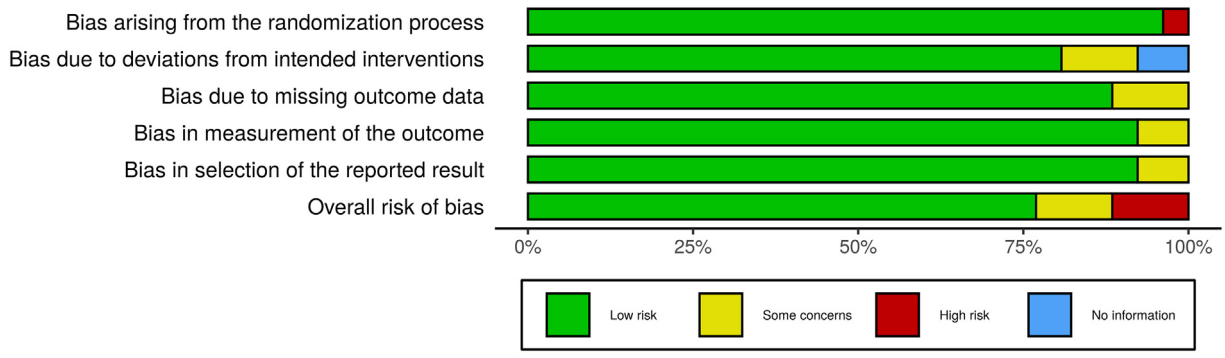

Fig. 2 Risk of bias assessment summary plot.

Table 1 Summary of clinical trials studies included in this review.

Author/ Year	Type of study	Sample size	Defect type	Study groups	Assessed clinical parameters	Results
Kizildağ et al. 2018	Split mouth RCT	16 patients with 32 sites	Intra-bony defects IBD	Gp I: leukocyte-platelet-rich fibrin (L-PRF) + (OFD) GpII: OFD alone	PD and CAL were measured at baseline and 6 months. GCF BMP-2 and IL-1 assessed at baseline, 1, 2, and 4 weeks.	Group I showed significant PD reduction and CAL gain, increased BMP-2 and IL-1, than group II.
Pradeep et al. 2017	RCT	62 patients with 90 sites	3-Wall IBD	Gp I: PRF + OFD Gp II: PRF + HA + OFD Gp III: OFD (controls)	PD, CAL, IBD depth, and defect fill percentage were measured at baseline and 9 months	Gp I showed better results than Gp II and Gp III
Patel et al. 2017	Split mouth RCT	13 patients with 13 sites bilaterally	IBD	Gp I: PRF + OFD Gp II: OFD alone	PD, CALrv and BF. Evaluation was done at 6, 9, and 12 months.	PRF group also showed significant soft tissue healing and reduction in PD. BF was 45.18% ± 7.57% for Gp I and 21.6% ± 9.3% for GpII
Bajaj et al. 2017	Split mouth RCT	17 patients with 27 sites bilaterally	3-Wall IBD in AP.	Gp I: PRF + OFD Gp II: OFD alone	PD, CAL and radiographic bone fill and defect depth decrease.	PRF group also showed significant reduction in PD, CAL and increased bone fill.
Arabacı et al. 2017	Split mouth RCT	26 patients with 52 sites	IBD	Gp I: PRF + OFD Gp II: OFD alone	PD, CAL, FGF-2, TGF-B, and PDGF-BB	Gp I showed significant reduction in PD, CAL and more expression of the evaluated growth factors
Sezgin et al. 2017	RCT split-mouth	21 patients with 15 sites bilaterally	IBD	Gp I: ABBM alone (control group) Gp II: ABBM-PRF	PI, GI, PD, GR, CAL, VBL, DD, and defect angle were recorded at baseline and 6 months	CAL gain was greater in Gp II than Gp I Both therapies are effective in the treatment of intra-bony defects.
Kanoriya et al. 2017	RCT	72 patients with 72 sites	Mandibular Degree II Furcation Defects	Gp I: access therapy only Gp II: access therapy + PRF Gp III: access therapy + PRF + 1% ALN	PI, MSI, PD, RVAL, RHAL and IBDD baseline and 9 months	Gp III showed more RDF (56.01% ± 2.64%) than Gp II (49.43% ± 3.70%) and Gp I (10.25% ± 3.66%) at 9 months.
Chatterjee et al., 2017	RCT	38 patients with 90 sites	IBD	Gp I: OFD Gp II: OFD + PRF Gp III: OFD + titanium TPRF	PPD, CAL, and DD were assessed at baseline and 9 months	No significant difference between groups II and III Gp II and III showed significant improvements compared with Gp I
Galav et al. 2016	RCT	20 patients with 20 sites	IBD	Gp I: PRF Gp II: ABG. autogenous bone grafting	PPD, RAL, bone fill, and RBF were recorded at baseline, 3, 6, and 9 months	Gp II showed significantly greater RBF (30.34%) and surgical reentry bone fill 65.31%, compared to PRF 20.22% and 43.64%.
Kanoriya et al. 2016	RCT	96 patients with 90 sites	IBD	Gp I:access therapy only Gp II: access therapy + PRF Gp III: access therapy + PRF + 1% ALN	Site-specific PI, MSI, BI, PD, CAL, GML, and IBDR were measured at baseline and 9 months	Gp III showed greater PD reduction and CAL gain. GP III showed IBD depth reduction (54.05%) compared to Gp II (46%) and Gp (7.33%)
Pradeep et al. 2016	RCT	110 patients with 105 sites	IBD	Gp I; OFD Gp II: OFD + PRF Gp III: OFD + PRF + 1.2% RSV gel	PI, mSBI, PD, CAL and IBD depth were assessed at baseline and 9 months	Gp III showed significant improvement in all parameters than other 2 groups.
Aydemir et al., 2016	Split mouth RCT	56 patients with 24 and 25 sites bilaterally	IBD	Gp I: EMD Gp II: EMD + PRF.	CAL, PD, GR, DD, DW and DA were measured at baseline and 6 months	Both groups showed similar results in all parameters
Martande et al., 2016	RCT	96 patients with 32	IBD	Gp I: OFD + PRF Gp II:	Site-specific PI, mSBI, PD,	Gp II showed better results than Gp I and III.

Table 1 (*continued*)

Author/ Year	Type of study	Sample size	Defect type	Study groups	Assessed clinical parameters	Results
		sites bilaterally		OFD + PRF + 1.2% ATV Gp III: OFD alone.	rCAL, GML and IBDD reduction were assessed at baseline and 9 months	IBD was 50.96% ± 4.88% for GP II compared with Gp I (47.91% ± 4.79%), and a greater reduction than Gp III (5.54% ± 1.71%)
Biswas et al. 2016	RCT	15 patients with 20 sites	Furcation grade II	Gp I: Bioactive Glass (Putty) Gp II: PRF	PD, GI, PI, CAL, and horizontal probing depth of furcation involvement	Both groups showed similar clinical improvements, however, PD were more reduced in BG group than PRF.
Panda et al. 2016	Split mouth RCT	16 patients with 16 sites bilaterally	IBD	Gp I: PRF + resorbable collagen membrane Gp II: collagen membranes alone	PI, mSBI, PD, CAL, GML and RDD were assessed at baseline and after 9 months.	Gp I showed more defects fill than Gp II.
Gamal et al. 2016	RCT	30 patients with 30 sites	IBD	Gp I: PRF Gp II: PRGF Gp III: Xenografts platelets rich in growth factors (PRGF)	PD, CAL, IBD, VEGF and PDGF-BB were assessed at days 1, 3,7, 14, 21, and 30 days.	No significant clinical differences were reported among the three groups during the two observation periods
Agarwal et al. 2016	Split mouth RCT	32 patients with 32 sites bilaterally	IBD	Gp I: PRF + DFDBA Gp II: DFDBA + saline	PD, CAL, REC, and RBF were measured at baseline and 12-months	Gp II showed better results than Gp I regarding PD, CAL, and REC. Gp I showed 3.50 ± 0.67 bone than Gp II 2.49 ± 0.64 mm.
Pradeep et al. 2016	RCT	120 patients with 105 sites	Grade II furcation defects	Gp I: OFD + placebo gel Gp II: PRF + HA + OFD Gp III: 1.2 mg RSV gel + PRF + HA + OFD	PD, rvCAL, rhCAL, IBDD, and percentage DF were recorded at baseline and after 9 months	Better results were observed for Gp III and II than I. Significant Percentage bone fill was found for Gp III and II (61.94% ± 3.54%, 54.69% ± 1.93%) than Gp I (10.09% ± 4.28%).
Pradeep et al. 2015	RCT	120 patients with 120 sites	IBD	Gp I: OFD Gp II: OFD + PRF Gp III: OFD + 1% MF Gp IV: OFD + PRF + 1% MF	PI, mSBI, PD, RAL, GML, and IBDD were evaluated at baseline and 9 months.	Gp IV better clinical improvement and more defect depth reduction compared to other groups.
Gupta et al. 2014	RCT	30 patients with 44 sites	IBD	Gp I: Emdogain EMD Gp II: PRF	PD, CAL, IBDD and IBDA were evaluated at baseline and after 6 months.	Both groups showed intrabony defects regeneration however, Gp I showed significant defect fill (43.07% ± 12.21) than Gp II (32.41% ± 14.61).
Bajaj et al. 2013	RCT	72 patients with 72 sites	Grade II furcation defects	Gp I: OFD + PRF Gp II: OFD + PRP Gp III: OFD	PD, rvCAL, hCAL and GML were measured at baseline and after 9 m.	The use of autologous PRF or PRP were both effective in the treatment of furcation defects with uneventful healing of sites.
Pradeep et al. 2012	RCT	54 patients with 90 sites	IBD	Gp I:PRF + OFD Gp II:PRP + OFD Gp III: OFD	PD, CAL, IBDD, and percentage DF were assessed at baseline and after 9 months	Both Gp I and II showed better PD reduction and CAL gain Significant bone fill was found for Gp I (55.41% ± 11.39%) and Gp II(56.85% ± 14.01%) compared with Gp III (1.56% ± 15.12%).
Lekovic et al. 2012	RCT Split mouth	17 patients with 17 sites bilaterally	IBD	Gp I: PRF alone Gp II: PRF + BPBM xenograft	PD, CAL and DF. Surgical re-entry after 6 months.	Gp II showed significant PD reduction and CAL gain than Gp I. Defect fill was greater in Gp II (4.06 ± 0.8) than in the Gp I (2.21 ± 0.68 mm)
Thorat et al. 2011	RCT	32 patients with 32 sites	IBD	Gp I: OFD + PRF Gp II : OFD	PI, PD, CAL, SBI, GML, and IBD fill were recorded at baseline and 9 months.	Gp I showed significant defect fill than Gp II (46.92%versus 28.66%).

(*continued on next page*)

Table 1 (*continued*)

Author/ Year	Type of study	Sample size	Defect type	Study groups	Assessed clinical parameters	Results
Sharma and Pradeep, 2011a	RCT	42 patients with 56 sites	IBD	Gp I: OFD + PRF Gp II: OFD	PD, PAL and DF were recorded at baseline and after 9 months.	Gp I showed better PD reduction, PAL gain and bone fill (48.26% ± 5.72%) than Gp II 1.80% ± 1.56%).
Sharma and Pradeep, 2011b	RCT Split mouth	18 patients with 18 sites bilaterally	Grade II furcation	Gp I : OFD + PRF Gp II: OFD	PI, PD, CAL, SBI, GM, and RBF were recorded at baseline and 9 months.	Gp I showed significant improvement in all parameters than Gp II. Significantly vertical defect fill was observed for Gp I (50.8 ± 6.24) than Gp II (16.7 ± 6.42) at 9 months

PD: Probing depth, CAL: clinical attachment level, GCF: Gingival crevicular fluid, BF: Bone fill, BMP-2: bone morphogenetic protein-2, AP: Aggressive periodontitis, IL-1: insulin-like growth factor-1, IBD: Intrabony defect, IBDD: Intrabony defect depth, IBDDR: Intrabony defect depth reduction, PI: Plaque index, GI: gingival index, GR: gingival recession, VBL: vertical bone level, FGF-2: fibroblast growth factor-2, TGF-B: transforming growth factor-β1, PDGF-BB: platelet-derived growth factor-BB, RVAL: relative vertical attachment level, RHAL: relative horizontal attachment level, IBDD: Intrabony defect depth, TPRF: titanium platelet-rich fibrin, RBF: radiographic bone fill; ABG: autogenous bone grafting; DD: defect depth, DW: defect width, DA: defect angle, GML: Gingival margin level, RSV gel: Rosuvastatin gel, mSBI: modified sulcus bleeding index, rvCAL: relative vertical clinical attachment level, rhCAL: relative horizontal clinical attachment level, MF: Metaformin, EMD: Emdogain, Bovine porous bone mineral (BPBM), SBI: sulcus bleeding index, PAL: periodontal attachment level, RBF: radiographic bone fill, DF: defect fill.

enamel matrix derivatives (EMD; Aydemir Turkal et al., 2016; Gupta et al., 2014).

4. Discussion

This systematic review covers the application of PRF over the last 10 years and highlights the clinical benefits of using PRF as a means of enhancing periodontal regeneration. Table 1 shows the advantage of adding PRF in conjunction with OFD to treat IBDs.

Using PRF after OFD (Arabacı et al., 2017; Bajaj et al., 2017; Kizildağ et al., 2018; Pradeep et al., 2012; Sharma and Pradeep, 2011a; Thorat et al., 2011)have resulted in CAL gains, PD reductions, and bone fill level increases compared to performing OFD alone. These results could be attributed to the ability of PRF to enhance the proliferation and differentiation of cells such as osteoblasts, fibroblasts, and cementoblasts at the healing site, thus promoting tissue regeneration in addition to the repair that OFD offers alone. The process of tissue regeneration occurs when the sustained release of the applied PRF's 3D fibrin matrix produces a local concentration sufficient to form autologous PRF, which then acts as an effective substitute for any recombinant sources of growth factor or grafting materials. Combining medical drugs such as 1% metformin (Pradeep et al., 2015), 1.2% atorvastatin (Martande et al., 2016), or 1.2% rosuvastatin (RSV) gel (Pradeep et al., 2016) with PRF have shown better results than using either these medications or PRF alone. However, Aydemir Turkal et al. (2016) observed comparable results in CAL gain, PD reduction, and defect dimension decrease between patients treated with a combination of EMD and PRF and those treated solely with EMD. Furthermore, Gupta et al. (2014) observed significant bone regeneration and defect fill for patients treated with Emdogain rather than PRF.

Clinical and radiographic measurements revealed that furcation defect sites treated with a combination of PRF and OFD showed better results compared to those treated solely with OFD. It is worth mentioning that utilizing a split-mouth design overcomes human factors that could influence the results. In their study comparing the effects of PRF with those of OFD, Sharma and Pradeep, 2011b measured the mean changes in gingival margin levels 9 months after treatment. They observed a mean change of 0.3 mm in the group treated with PRF, compared with a change of 0.7 mm in the control group. The results indicated that placing the PRF membrane slightly coronal to the gingival margin prevented gingival recession. As a material that promotes healing, PRF was shown to stimulate gingival connective tissue and provide the root surface with the fibronectin and vitronectin mandatory for cell migration. Moreover, PRF was found to stimulate healing when placed after OFD compared to using OFD alone. Adding PRF to bone grafts was also shown to accelerate healing more than treatments that relied solely on bone grafts. This result can be attributed to PRF's 3D fibrin network structure, which is absent in first generation PRP but allows PRF to be retained in the periodontal defect, acting as a slow-release local delivery system for growth factors.

When PRF was combined with porous hydroxyapatite (HA) and RSV 1.2 mg in situ gel to treat class II furcation defects (Pradeep et al., 2016), the most significant PD reduction (4.62 ± 1.03 mm), CAL gain (4.17 ± 0.70 mm), IBD depth reduction (3.68 ± 0.32 mm), and bone defect fill (61.94% ± 3.54%) were observed for the combination of 1.2 mg RSV gel combined with PRF and BG. This finding could be attributed to RSV's ability to decrease inflammatory markers, effectively reducing inflammation and gingival bleeding. Moreover, statins inhibit the osteoclastic differentiation that, in turn, favors bone formation and reduces bone resorption.

Several studies have focused on the efficacy of using PRF to treat IBDs. Lekovic et al. (2012) and Agarwal et al. (2016) both concluded that PRF accelerated the effect of bone grafts and improved the clinical parameters and apical bone fill in patients with IBDs. Similarly, Bajaj et al. (2017) observed a mean reduction in the same clinical parameters in treating patients with aggressive periodontitis with PRF compared to the control group treated with OFD alone. Pradeep et al. (2017)showed that the addition of PRF resulted in a significantly higher percentage of bone fill, which subsequently increased the regenerative effects of porous HA. Sezgin et al. (2017) also confirmed the positive effects of combining PRF with anorganic bovine bone mineral (ABBM) through a RCT that included 15 cases of IBDs. They noted a significant reduction regarding clinical and radiographic parameters. Meanwhile, Chatterjee et al. (2017) divided 90 patients with IBDs into the following groups: those treated with OFD alone (group I), those treated with OFD combined with autologous PRF (group II), and those treated with the combination of OFD and titanium-prepared PRF (group III). Group I showed less improvement when compared to groups II and III in clinical measurements, while no statistically significant difference was noted between groups II and III. Panda et al. (2016) found similar results when examining 32 paired IBDs in 16 patients. They treated their test group with a resorbable collagen membrane combined with PRF, while the control group was treated with collagen alone, and they reported a statistical significance in the clinical and radiographic improvements for the test group over the control. In another study, Agarwal et al. (2016) evaluated the additive effects of PRF when used with a demineralized freeze-dried bone allograft (DFDBA) to treat 60 IBDs in 30 patients with chronic periodontitis. When the group treated with PRF/DFDBA was compared to the group given DFDBA/saline at baseline and at a 12-month evaluation, all clinical and radiographic parameters showed favorable results in the group that received PRF.

While the studies discussed above each point to the beneficial effects of PRF, other researchers have concluded that PRF does not enhance the treatment of IBDs. For instance, Galav et al. (2016) tested the capability of using only PRF to treat IBDs in patients with chronic periodontitis. They determined that autogenous bone grafts showed higher radiographic bone fill measurements (30.34%) than treatments with PRF (20.22%). At the same time, Gamal et al. (2016) concluded that platelet concentrate did not add any significant clinical or radiographic effects when used with xenogeneic grafts.

5. Conclusion

Although the reviewed studies differ in their application of PRF and the manipulation protocols used in periodontal surgery, all contain a common factor: the ability of PRF to promote periodontal wound healing, as measured by clinical criteria (e.g., PD reduction and CAL gain) as well as increased levels of defect bone fill, which was investigated either radiographically or by surgical re-entry. We recommend that future clinical studies compare various PRF preparations and application protocols to gauge their simplicity of use and determine any significant differences these preparations and protocols may have on clinical outcomes.

Ethical statement

No ethical approval was needed for this Review study.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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