ORIGINAL RESEARCH

Efficacy of PRF vs PRF + Biodegradable Collagen Plug in Post-extraction Preservation of Socket

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Abstract

Aim: To compare the clinical sequelae of the efficacy of PRF vs PRF + collagen plug in soft tissue healing and preservation of the socket width, height, and bone density in patients reporting for extractions of maxillary or mandibular anterior or posterior teeth and patients who desired replacement of teeth with dental implants in future.

Materials and methods: The study included 54 patients who were divided randomly into 3 groups consisting of 18 patients in each group: in group I, no preservation of extraction socket; in group II, PRF was used; and in group III, PRF + collagen plug was used for preservation of extraction socket. Assessment of the soft tissue healing, bone density, bone height, and width was done on 1st, 8th, 12th, and 16th weeks, postoperatively.

Result: Both PRF and PRF + Collaplug are comparable to each other in preserving the bone height, bone density, and also similar soft tissue healing; however PRF + Collaplug is better than PRF alone in preserving the bone width 4th month postoperatively, indicating that the resorbable Collaplug® does play an additional role in preserving the socket width.

Conclusion: PRF + Collaplug® has better clinical outcome in socket preservation in comparison to PRF alone. However, as results were not statistically significant, subjecting a larger sample size with PRF + Collaplug® for socket preservation may result in statistical critical values to substantiate our observations.

Clinical significance: PRF and Collaplug® can help in ridge preservation after extraction and also avoid additional bone grafting procedures in future implant placement for the patients.

Keywords: Collagen plug, Platelet-rich fibrin, Socket preservation.

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Introduction

The success of any implant therapy depends not only on ideal implant position but, to a larger extent, also on quality and quantity of sufficient alveolar bone.[1] After extraction of any tooth, the estimated alveolar bone resorption is about 40% and 60% of pre extraction alveolar ridge volume.[2,3] On average, 0.7–4.5 mm of vertical and horizontal bone resorption[4–6] have been reported following extraction.

Preservation of socket is done immediately after extraction, which helps minimize alveolar bone resorption and increase bone quality within the socket.[3] Platelet-rich fibrin (PRF) is derived by centrifuging autologous blood without adding anticoagulants and they contain platelet-rich concentrate and growth factors that favors healing and plays a key role in microvascularization and cell migration in the extraction socket post-extraction. Choukroun et al. described PRF as a newer-generation platelet concentrate rich in growth factors derived from anticoagulant-free autologous blood.[7] Tsai et al. demonstrated the ability of PRF to stimulate the differentiation and proliferation of osteoblasts, leading to angiogenesis.[8]

In this study, an absorbable collagen sponge (Collaplug®, Zimmer Dental, Carlsbad, USA) was used in combination with PRF consisting of 85–95% type I and 5–15% type III collagen. This collagen plug basically prevents the ingrowing of surrounding soft tissues into the extraction socket and thus aids in the preservation of socket dimensions. The aim of this study was to evaluate the effect of PRF or PRF + collagen plug in socket preservation and soft tissue healing.

Materials and Methods

This study was done at the Department of Oral and Maxillofacial Surgery in Sri Rajiv Gandhi College of Dental Sciences and Hospital, Bengaluru on 54 patients reporting for extractions of maxillary or mandibular anterior or posterior teeth and patients who desired replacement of teeth with dental implants in future.

Inclusion Criteria

- Patients in the age range of 18 years and above.
- Patients requiring extractions of maxillary or mandibular teeth and who desire replacement of teeth by dental implants.
- ASA (American Society of Anesthesiologists) physical status I.
- Patients willing to be a part of the study and ready to give their consent in writing for the same.

Exclusion Criteria

- Patients not willing to be a part of the study.
- Patients who are immune compromised.

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- Patients who have the habit of smoking.
- Pregnant and lactating women.

Methodology

All the patients who reported to Department of Oral and Maxillofacial Surgery in Sri Rajiv Gandhi College of Dental Sciences and Hospital, Bengaluru and who met the inclusion and exclusion criteria were enrolled for this study. Ethical Committee clearance was taken for this study and informed consent, case history, and relevant data were recorded. The duration of study was from 1st December 2015 to 1st September 2017. Randomized sampling method was applied. A sample of 54 patients were divided randomly into 3 different groups, with 18 patients in every group. Group I is control group, group II is PRF group, and group III is PRF + Collaplug® group.

Surgical Technique

Preoperative radiovisiographs were taken for the patients to assess the bone density, height, and width. Standard precaution for asepsis were carried out for all patients and the affected tooth was extracted under lignocaine 2% LA. The socket was thoroughly debrided and irrigated with the normal saline solution. In the control group, the socket was left empty after the extraction. In the group II, autologous PRF was obtained by drawing 10 mL of blood from the patient and centrifuging at 3,000 rpm for 10 minutes and it was separated from blood with sinus forceps and separating it with scissors and then placed in the extraction socket. The socket was closed using simple interrupted 3-0 black braided silk sutures. In group III, the collagen plug was preformed into the shape of extraction socket before the collagen plug was packed in the socket followed by placement of PRF and then secured in place with horizontal mattress or figure-of-eight suture. Pressure pack was applied over the surgical site. Postoperative instructions and analgesic drugs were prescribed to the patients, and were recalled on 1st, 3rd, and 7th day postop for evaluation of soft tissue and 8th, 12th, and 16th week for radiographic evaluation.

Clinical Evaluation

All the clinical and radiographic evaluation was done by a single operator. Clinical parameters such as the soft tissue healing index was evaluated and graded using Landry et al. soft tissue healing index,[9] on 1st, 3rd, and 7th days postoperatively and scores were given accordingly as healing index 1: very poor; healing index 2: poor; healing index 3: good; healing index 4: very good; healing index 5: excellent. Assessment of bone density was done using RVG and a software of Adobe Photoshop elements (version 6.0) using the gray scale histogram, and the assessment of bone height and width will be done using RVG and a software of CDR Dicom for windows (version 4.5) preoperatively and on the 1st, 8th, 12th, and 16th week postoperatively.

The bone height was measured from the crest of alveolar bone to the tip of the root taking adjoining tooth as a guide on the midbuccal region. The bone density was measured by using the gray scale histogram and the grid scale, in which four grid squares were included to cover the coronal, middle, apical, mesial, and distal wall of socket area and the bone density covered by these four grids was considered as the bone density. Each measurement was repeated thrice and the mean value was recorded.

Methodology of Data Analysis

For statistical analysis, data were entered in Microsoft Excel and analyzed using SPSS (Statistical Package for Social Science Version 17.0) package. Data was analyzed using the Chi-square test for age frequency, gender distribution, and soft tissue analysis; paired "*t*" test, one-way ANOVA test, and *post hoc* test were used for evaluating the bone height, bone width, and the bone density.

Results

A total of 54 patients in the age range of 18–45 years were included in the study (Table 1). Data were subjected to different types of statistical analyses such as paired "*t*" test, Chi-square tests, one-way ANOVA tests, and *post hoc* tests.

The soft tissue healing on postoperative day 7 was very good in 86.7% cases in the control group (I), 94.1% cases in the PRF group (II) and 88.2% in the PRF + Collapug group (III), indicating that soft tissue healing was better in PRF group alone (Fig. 1). A reduction of bone height of 2.12 ± 0.69 mm was seen in the control group (I) and 0.17 ± 0.44 mm in the PRF group (II); however, a gain in the bone height of 0.14 ± 0.38 mm was seen in PRF + Collaplug group (III) (Fig. 2). The changes in bone height were statistically highly significant in control vs PRF and control vs PRF + Collaplug ($p < 0.001$) (Table 2). A reduction in bone width of 1.71 ± 0.49 mm was seen in the control group and 0.47 ± 0.36 mm in the PRF group and a gain in bone width of 0.16 ± 0.35 mm in the PRF + Collaplug group. The changes in bone width are highly significant in PRF vs PRF + Collaplug ($p < 0.001$), indicating PRF + Collaplug are superior to control and PRF groups in preserving the alveolar width (Table 3). A reduction in bone density of 1.45 ± 0.51 was seen in control group (I) and 0.44 ± 1.21 in the PRF group (II) and a gain of bone density of about 0.13 ± 0.74 was seen in the PRF + Collaplug group (III).

Table 1: Age of patients and gender distribution

	Control group	*PRF group*	*PRF + Collaplug group*
Male	11	10	11
Female	7	8	7
Age group			
18–25	3	4	2
26–35	9	8	13
>35	6	6	3

Fig. 1: Collaplug in package

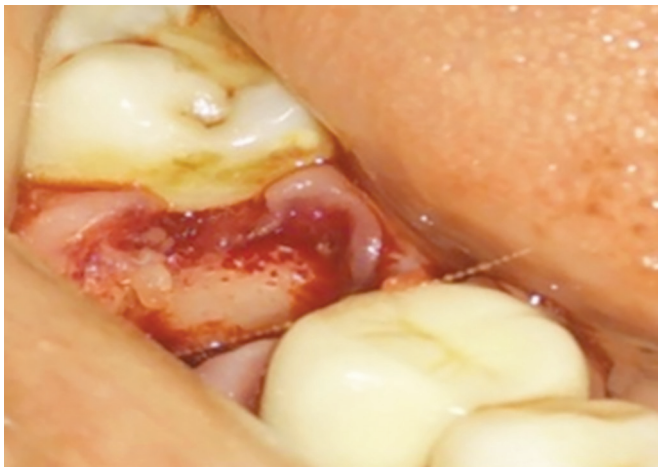


Fig. 2: PRF + collagen plug placed in the socket

The changes in bone density were highly significant between the control and PRF + Collaplug group ($p < 0.001$), indicating PRF + Collaplug are superior to control group in preserving the bone density (Table 4).

Discussion

The alveolar bone undergoes dimensional changes following tooth extraction. Seven days following extraction granulation tissue fills the socket and replaces the clot followed by osteoid deposition and subsequent mineralization from the base of the socket progressing coronally over the next 2–3 weeks.[10] Flugge et al. have demonstrated that post-extraction sockets that do not undergo socket preservation procedures often require bone grafting during implant placement, when compared with post-extraction sockets treated with preservation methods.[11] PRF is a natural fibrin-based biomaterial, which aids in microvascularization and wound healing.[12] Peck et al. successfully demonstrated the use of L-PRF (leucocyte-PRF) in an alveolar ridge preservation procedure.[13] Collagen (especially type I collagen) can be used as a scaffolding material as it is known to promote cell migration, wound healing, and tissue regeneration.[14] Collagen scaffold materials usually have open pores and a highly porous structure in order to allow ingrowth of cells to promote neovascularization (Fig. 3).[15]

Schropp et al. studied bone healing and soft tissue changes following a single posterior tooth extraction using clinical and radiographic means and found an average of 50% loss of alveolar ridge width with two-thirds of this reduction occurring within 3-months

Table 2: Comparison of bone height

Group	*Pre-op*	*4-month postoperatively*	*Change*	*p value*
Control	13.06 ± 2.38	10.94 ± 2.67	2.12 ± 0.69	<0.001*
PRF	11.72 ± 2.81	11.55 ± 2.71	0.17 ± 0.44	0.134; NS
PRF + Collaplug	11.46 ± 1.83	11.60 ± 1.74	−0.14 ± 0.38	0.159; NS
p value	0.142; NS	0.695; NS	<0.001*	
Control vs PRF	0.262; NS	0.751; NS	<0.001*	
Control vs PRF + Collaplug	0.150; NS	0.722; NS	<0.001*	
PRF vs PRF + Collaplug	0.943; NS	0.999; NS	0.202; NS	

One-way ANOVA and *post hoc* test. $p > 0.05$ not significant; *$p < 0.001$ highly significant

Table 3: Comparison of bone width

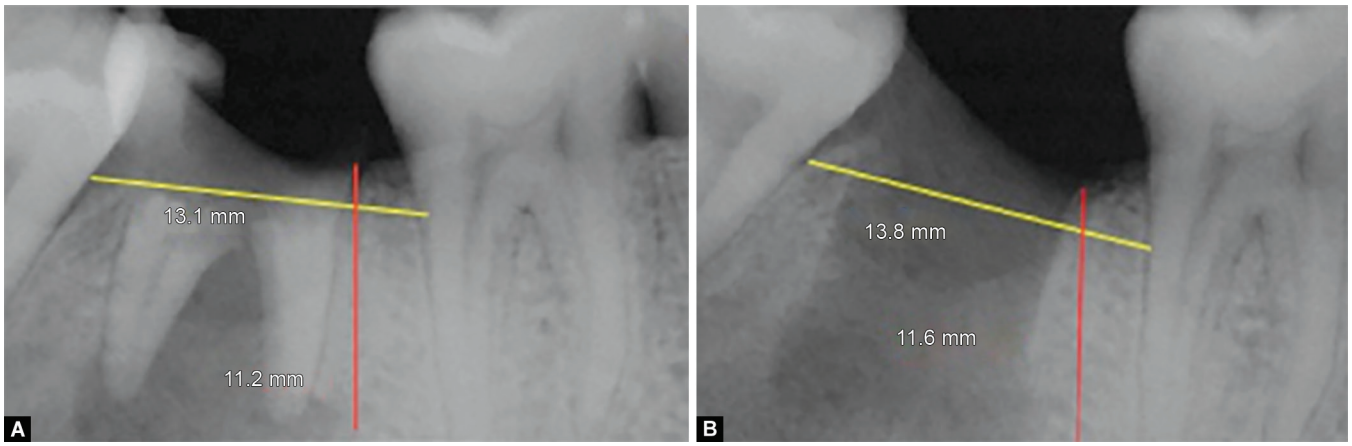
Group	*Pre-op*	*4-month postoperatively*	*Change*	*p value*
Control	11.47 ± 1.23	9.77 ± 1.32	1.71 ± 0.49	<0.001**
PRF	10.96 ± 1.66	10.49 ± 1.69	0.47 ± 0.36	<0.001**
PRF + Collaplug	11.38 ± 1.68	11.54 ± 1.72	−0.16 ± 0.35	0.084; NS
p value	0.602; NS	0.011*	<0.001**	
Control vs PRF	0.621; NS	0.414; NS	<0.001**	
Control vs PRF + Collaplug	0.985; NS	0.008*	<0.001**	
PRF vs PRF + Collaplug	0.708; NS	0.146; NS	<0.001**	

One-way ANOVA and *post hoc* test. $p > 0.05$ not significant; *$p < 0.05$ significant; **$p < 0.001$ highly significant

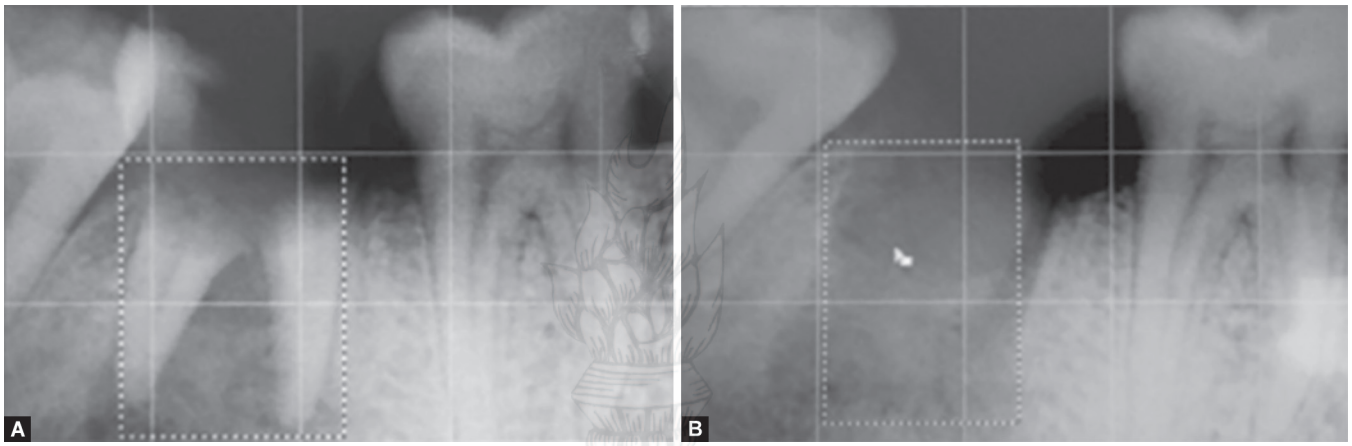
Table 4: Comparison of bone density

Group	*Pre-op*	*4-month postoperatively*	*Change*	*p value*
Control	34.76 ± 6.48	33.31 ± 6.73	1.45 ± 0.51	<0.001**
PRF	34.80 ± 6.88	34.36 ± 6.29	0.44 ± 1.21	0.158; NS
PRF + Collaplug	34.48 ± 6.36	34.60 ± 6.26	−0.13 ± 0.74	0.493; NS
p value	0.988; NS	0.835; NS	<0.001**	
Control vs PRF	1.000; NS	0.888; NS	0.006*	
Control vs PRF + Collaplug	0.992; NS	0.837; NS	<0.001**	
PRF vs PRF + Collaplug	0.989; NS	0.994; NS	0.165; NS	

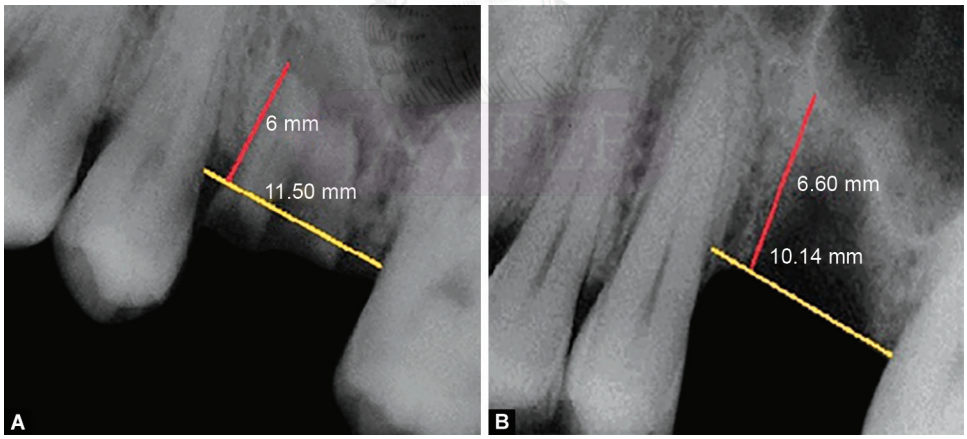
One-way ANOVA and *post hoc* test. $p > 0.05$ not significant; *$p < 0.05$ significant; **$p < 0.001$ highly significant



Figs 3A and B: (A) Preoperative bone height and bone width measurement (group III); (B) Postoperative bone height and bone width measurement (group III)



Figs 4A and B: (A) Preoperative bone density measurement (group III); (B) Postoperative bone density measurement (group III)



Figs 5A and B: (A) Preoperative bone height and bone width measurement (group II); (B) Postoperative bone height and bone width measurement (group II)

interval.[6] Becker et al. compared the efficacy of a demineralized freeze-dried bone against an autogenous bone in seven paired sites and recorded new bone formation at sites where the autogenous bone was placed, and concluded that the autogenous bone is the gold standard when it comes to socket preservation.[16] Guarnieri et al. reported 100% bone infill after three months in 10 extraction sockets packed with calcium sulphate without using barrier membrane (Fig. 4).[17]

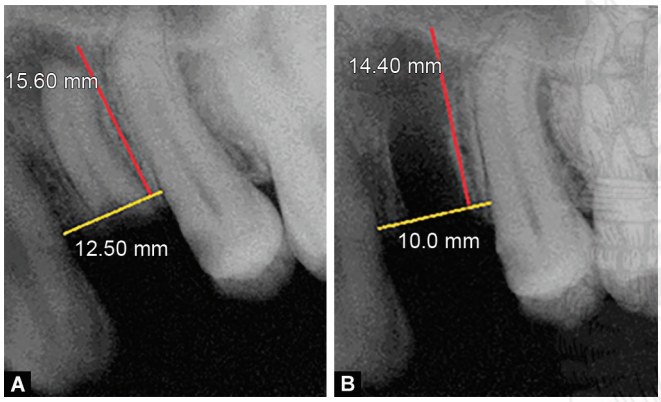
In our study also the control group in which there was no preservation of the alveolar socket done the reduction in bone height was 2.12 ± 0.69 mm and a loss of bone width of about 1.71 ± 0.49 mm was seen in agreement to the study carried out by Carmagnola et al., indicating that there is greater reduction of bone height and bone width in the absence of any alveolar preservation techniques (Fig. 5).[7]

In agreement to Lasella et al., our study also compared the naturally healed sockets with sockets filled with PRF + Collaplug and revealed similar results, the width of the socket in control group reduced by 1.71 ± 0.49 mm while the sockets filled with PRF + Collaplug® gained the width of the socket by 0.16 ± 0.35 mm and when comparing the bone height the control group had a reduction in height of the socket by 2.12 ± 0.69 mm and the PRF + Collaplug® group had a gain in height of the socket by 0.14 ± 0.38 mm. In essence, using PRF + Collaplug helps not only in ridge preservation but also in increasing the bone density by 0.13 ± 0.74 mm similar to Lasebelle et al. study (Fig. 6).[18,19]

Sasikarn et al.[20] compared baseline and 4 month re-entry values in socket preservation, with calcium phosphate and collagen membrane showed an increase of 8 mm width from CEJ compared to 1.0 mm in this study. They also reported a vertical loss of 0.5 mm bone in mid-buccal region, but in this study, we gained a vertical bone height of 0.14 ± 0.38 mm in the PRF + Collaplug® group.

Our study involved a comparison of not only soft tissue healing (Fig. 7) but also bone height, width, and density in three groups (Tables 2 to 4). Both PRF (group II) and PRF + Collaplug (group III) showed better healing postoperative day 7 when compared to controls (group I). PRF plays a role in soft tissue healing by release of growth factors and inflammatory cytokines. Preservation of bone height in PRF and PRF + Collaplug groups 4th month postoperatively are equal in comparison because PRF helps increasing new bone formation, promoting neovascularization of bone tissue, and preserving the bone height. Preservation of bone width was better in PRF + Collaplug group (III) 4th month postoperatively when compared to the PRF group (II).

The resorbable Collaplug® has a definite role in socket preservation by causing initial clot stabilization and preventing the surrounding soft tissue ingrowth into the socket during the normal healing and maintaining the socket width postoperatively when used in combination with PRF. The limitations of our study were assessment of bone quality could have been done using histomorphometric analysis by taking a bone biopsy; however it was not done to avoid additional surgical procedure. RVG was chosen as it is simple, cost effective, and has less radiation exposure to patients.



Figs 6A and B: (A) Preoperative bone height and bone width measurement (group I); (B) Postoperative bone height and bone width measurement (group I)

Conclusion

In conclusion, PRF + Collaplug® has better clinical outcome in socket preservation in comparison to PRF alone. However, as the results were not statistically significant, subjecting a larger sample size with PRF + Collaplug® for socket preservation may result in statistical critical values to substantiate our observations.

Clinical Significance

PRF and Collaplug® can help in ridge preservation after extraction and also avoid additional bone grafting procedures in future implant placement for the patients.

Acknowledgments

Approval to conduct the study was obtained by the Ethical Committee of Institutional Review Board. Informed consent and permission to use clinical data and photographs has been taken from patients for the purpose of further academic research and publication in scientific journals.

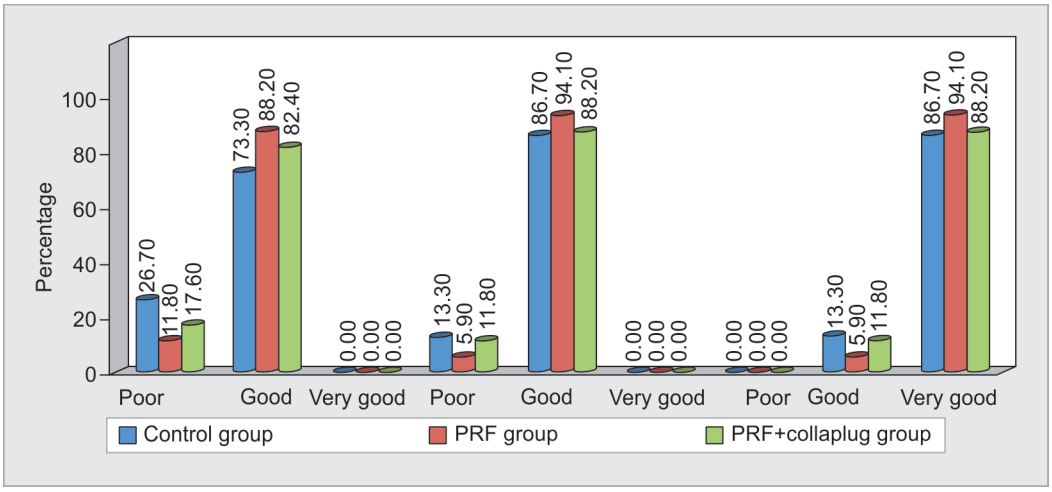


Fig. 7: Soft tissue healing comparison

References

1. Darby I, Chen S, et al. Ridge preservation: what is it and when should it be considered. Aust Dent J 2008;53:11–21. DOI: 10.1111/j.1834-7819.2007.00008.x.
2. Werbitt MJ, Goldberg PV. The immediate implant: bone preservation and bone regeneration. Int J Periodontics Restorative Dent 1992;12:206–217.
3. Chen ST, Wilson TG, et al. Immediate or early placement of implants following tooth extraction: review of biologic basis, clinical procedures and outcomes. Int J Oral Maxillofac Implants 2004;19(Suppl):12–25.
4. Lekovic V, Camargo PM, et al. Preservation of alveolar bone in extraction sockets using bioabsorable membranes. J Periodontol 1998 Sep;69(9):1044–1049. DOI: 10.1902/jop.1998.69.9.1044.
5. Lekovic V, Kenney EB, et al. A bone regenerative approach to alveolar ridge maintenance following tooth extraction. Report of 10 cases. J Periodontol 1997 Jun;68(6):563–570. DOI: 10.1902/jop.1997.68.6.563.
6. Schropp L, Wenzel A, et al. Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study. Int J Periodontics Restorative Dent 2003;23:313–323.
7. Choukroun J, Adda F, et al. PRF: an opportunity in perio-implantology. Implantodontie 2000;42:55–62.
8. Tsai CH, Shen SY, et al. Platelet-rich fibrin modulates cell proliferation of human periodontally related cells *in vitro*. J Dent Sci 2009;4:130–135.
9. Landry R, Turnbull R, et al. Effectiveness of benzydamine HCl in the treatment of periodontal post-surgical patients. Res Clin Forums 1988;10:105–118.
10. Del Fabbro M, Bucchi C, et al. Healing of Post-Extraction Sockets Preserved with Autologous Platelet Concentrates. A Systematic Review and Meta-analysis. J Oral Maxillofac Surg 2017 Aug;75(8): 1601–1615. DOI: 10.1016/j.joms.2017.02.009.
11. Flugge T, Nelson K, et al. 2 Dimensional changes of the soft tissue profile of augmented and non-augmented human extraction sockets: a randomized pilot study. J Clin Periodontol 2015;42:390–397. DOI: 10.1111/jcpe.12386.
12. Dohan DM, de Peppo GM, et al. Slow release of growth factors and thrombospondin-1 in Choukroun's platelet-rich fibrin (PRF): a gold standard to achieve for all surgical platelet concentrates technologies. Growth Factors 2009;27:63–69. DOI: 10.1080/08977190802636713.
13. Peck MT, Marnewick J, et al. Alveolar ridge preservation using leukocyte and platelet-rich fibrin: A report of a case. Case Rep Dent 2011;2011:345048. DOI: 10.1155/2011/345048.
14. Stevens MM. Biomaterials for bone tissue engineering. Mater Today 2008;11:18–25.
15. Serino G, Biancu S, et al. Ridge preservation following tooth extraction using a polylactide and polyglycolide sponge as space filler: a clinical and histological study in humans. Clin Oral Implants Res 2003;14:651–658.
16. Becker W, Becker BE, et al. A comparison of demineralized freeze-dried bone and autologous bone to induce bone formation in human extraction sockets. J Periodontol 1994;65:1128–1133. DOI: 10.1902/jop.1995.66.11.1013.
17. Guarnieri R, Pecora G, et al. Medical grade calcium sulfate hemihydrate in healing of human extraction sockets: clinical and histological observations at 3 months. J Periodontol 2004;75:902–908. DOI: 10.1902/jop.2004.75.6.902.
18. Carmagnola D, Adriaens P, et al. Healing of human extraction sockets filled with Bio-Oss. Clin Oral Implants Res 2003;14(2):137–143.
19. Iasella JM, Greenwell H, et al. Ridge preservation with freeze-dried bone allograft and a collagen membrane compared to extraction alone for implant site development: A clinical and histologic study in humans. J Periodontol 2003;74:990–999. DOI: 10.1902/jop.2003.74.7.990.
20. Sasikarn S, Swasdison S, et al. Esthetic alveolar ridge preservation with calcium phosphate and collagen membrane: Preliminary report. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;110:e24–e36. DOI: 10.1016/j.tripleo.2010.06.006.