Research Article

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Comparative Evaluation of Wound Healing and Bone Regeneration Using CBCT in Post Extraction Sockets with and Without Platelet Rich Fibrin (PRF)

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ABSTRACT

Aim: The aim of the study was to evaluate and compare wound healing and bone regeneration in extraction sockets with and without Platelet Rich Fibrin (PRF).

Materials and Method: The present study was carried out on 25 patients from Department of Oral & Maxillofacial Surgery at the Dr.D.Y.Patil Dental College & Hospital, Pune on patients undergoing extraction of maxillary or mandibular teeth simultaneously for split mouth study.

Result: Patients with PRF group had better healing index when compared to without PRF group. Use of PRF showed a comparable increase in bone density suggesting possible early rehabilitation in sockets.

Conclusion: Appreciable wound healing and bone regeneration was seen in the experimental group when compared to the control substantiating the use of PRF as an inexpensive autologous material for socket preservation and future rehabilitation. Our study also showed that minimal operator expertise was required when compared to bone harvesting form distant sites. The shorter duration between extraction and rehabilitation obviates the need for a second procedure.

Keywords: Wound healing, bone regeneration, CBCT, PRF.

INTRODUCTION

In today's world of advanced dentistry there are various aspects of restorative, aesthetic and surgical processes. One of the most important competencies is the preservation of the residual alveolar ridge after routine exodontia procedures, failure of which often leads to the compromise of future placement of the implants and further rehabilitation.[1] Prevention of alveolar bone loss post extraction was first described by Greenstein (1985) and Ashman and Bruins during the same year. Healing of an extraction socket comprises of bone as well as soft tissue remodelling, with maximum dimensional changes occurring during the first 3 months.

Platelet Rich Plasma (PRP) was initially developed in the 1970's. PRP was shown to increase the rate of bone maturation and to improve bone density also promoting wound healing and tissue sealing. However, controversies in literature regarding the benefits and clinical outcome of use of PRP can't be

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neglected. Platelet-rich fibrin (PRF) was first developed in France for use in the field of oral and maxillofacial surgery as a therapeutic alternative to PRP and to overcome many of its limitations. PRF is easy to prepare, non-toxic or biocompatible to living tissues and economically cheap.[2]

Extraction sockets undergo resorption and remodelling of the alveolar crest. The repair process results in marked changes in the height and width of the alveolar ridge with an average of 0.7-1.5 mm of vertical bone resorption and 4.0-4.5 mm of horizontal bone resorption reported. Most of these dimensional alterations take place in the first 3 months following tooth extraction.[3] The bone resorption of jaws after the loss of teeth is seen greatest during the first year; although up to four-fold variations have been reported across individuals over a 14 month period.[4] Many methods have been used during the past two decades to maintain the architecture of residual alveolar ridge like the use of bone, bone substitutes & collagen plug packed into the extraction sockets sealed with or without isocyanoacrylate.[4]

Autologous fibrin concentrates are considered the best choice to avoid cross-infection, but their use remains very limited owing to the lack of operator competency and a comprehensive understanding about the inherent processes. Hence, the aim of the study was to evaluate and compare wound healing and bone regeneration in extraction sockets with and without Platelet Rich Fibrin (PRF).

MATERIALS AND METHOD

The study was carried out on 25 patients undergoing extraction of maxillary or mandibular teeth simultaneously for split mouth study. Fifty sites were selected in 25 patients and were divided into Group A (Control Group) treated without PRF and Group B (Experimental Group) treated with PRF. The research protocol described here was approved by the University Ethical Committee governing the use of human subjects in clinical experimentation. Healthy patients between the age group of 20 and 50 years of age with chronic periodontal conditions and who have teeth indicated for extraction were included. Patients with immunologic diseases, unstable diabetes mellitus, ongoing chemotherapy or radiotherapy, traumatic extractions or other contraindicating systemic conditions were excluded.

PREPARATION OF THE PATIENT:

All the selected patients were explained about the surgical procedures, frequency of visits, importance of oral hygiene maintenance and follow up visits. A detailed case history of the patient was recorded. After achievement of satisfactory oral hygiene, patients signed a written consent form regarding the extraction procedure followed by placement of PRF on one side and the other site as a control group.

PREPARATION OF PLATELET RICH FIBRIN:

1. The required quantity of blood (10ml) was drawn from each patient by vein-puncture of the antecubital vein into 10ml test tube without an anticoagulant. (fig. 1a)

2. Blood was centrifuged in a centrifugal machine for 10 min at 3000 rpm.

3. The resultant product consisted of the following three layers- (fig.1b)

   A. Top most straw coloured layer consisting of acellular, PPP.

   B. PRF clot in the middle.

   C. RBCs at the bottom

4. The uppermost PPP layer was discarded with pipette

5. Fibrin clots were removed with a tweezer and transferred to sterile dapen dish and RBCs were gently scraped away and discarded. (Fig.1c)

Surgical Technique and Postoperative Management

Atraumatic extraction of teeth was performed .The Group A sockets were debrided and sutured. (fig.2a-c) The Group B sockets were debrided and PRF was grafted and sutured. Simple interrupted sutures were given to close the site (fig.3a-d). Post-operative antibiotics and analgesics were prescribed. Patients were monitored postoperatively to observe soft tissue healing.

Fig 1a: Withdrawal of 10ml of blood.

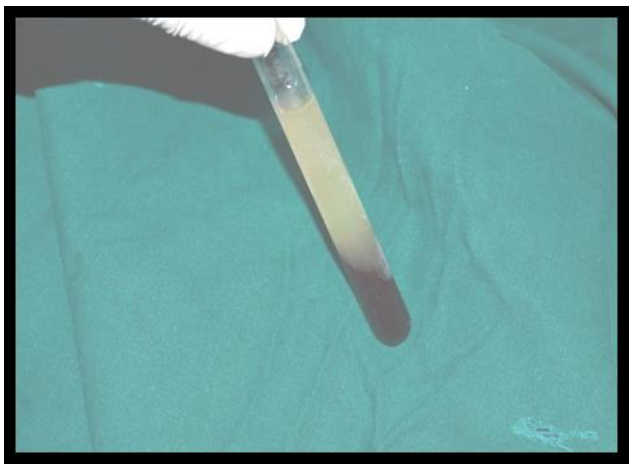


Fig 1b: Layers of platelet concentrate.

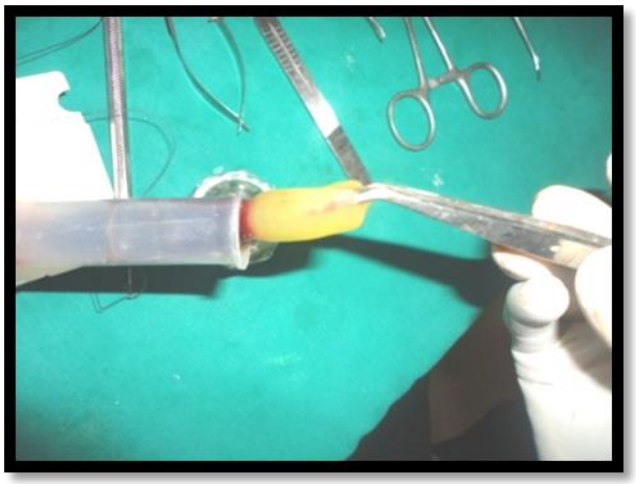


Fig 1c: Removal of PRF with tweezer.

Fig 2a: Root piece with upper right first premolar.

Fig 2b: Immediate post-operative site.

Fig 2c: Soft tissue healing after 1 week.

Fig 3a: Root piece with upper left first premolar.

Fig 3b: Socket filled with PRF.

Fig 3c: Immediate post-operative.

Fig 3d: Soft tissue healing after 1 week.

INITIAL CBCT EVALUATION

Post-operative CBCT was taken within 24 hours of extraction followed by a CBCT at the 3rd month of extraction. The CBCT at 24 hours was to study the density of healthy bone in the apical region of extracted tooth and the socket height. This value obtained served as a baseline for further assessments. The density obtained was then compared to the bone formed at the end of 3 months in the extraction socket with and without PRF. The bone density was calculated by taking mean readings[5], in grey level scale measurements from the peri-apical region. Bone density in the Periapical region: readings were noted within 4mm perimeter beyond the lamina dura/ socket wall not including the same. Alveolar bone height was calculated by using the stable landmarks. They were Nasal Spine, Infra-orbital foramen, Maxillary Sinus in maxilla and genial tubercle, mental foramen, inferior alveolar canal in mandible respectively (figure. 4-5).

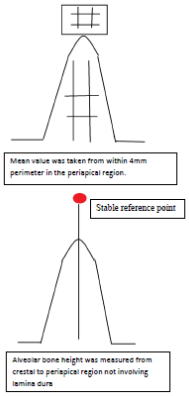


Fig 4: Diagrammatic representation of the maxillary socket and periapical region.

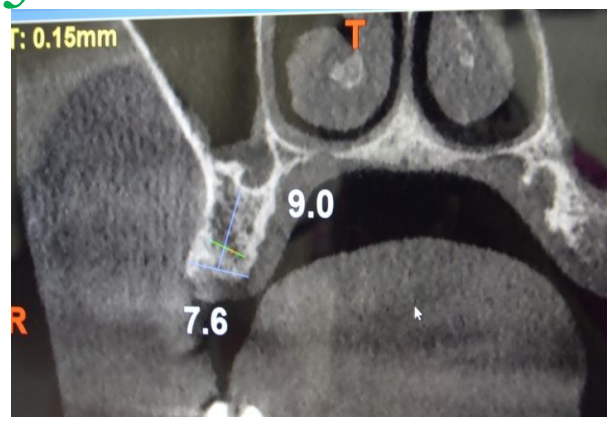


Figure 5a: Socket height

Figure 5b: Bone density in the socket in grey scale unit

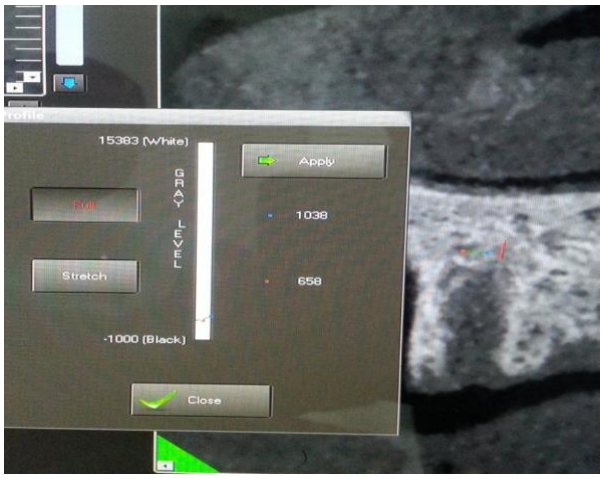


Figure 5c: Bone density in periapical region

POST-OPERATIVE SOFT TISSUE ASSESMENT:

One week after surgery sutures were removed and the area was irrigated thoroughly with saline. Symptoms regarding discomfort, pain and sensitivity were taken in account. Any signs of swelling, infection, flap displacement, hematoma and necrosis were noted. Wound healing was assessed using Landry, Turnbell and Howley index and a score was given ranging from 1-5 where, 1– very poor and 5- excellent healing .[5]

RESULTS

In total, 25 patients underwent bilateral extraction of maxillary/ mandibular teeth simultaneously for split mouth study.

Wound Healing:

Significantly higher proportion of subjects with PRF group had better healing index when compared to without PRF group. (fig.2 & 3)

Bone Density:

The average 3rd month bone density in socket region in Group A was 299.26±102 & Group B was 566.11±117.13 which showed a significant difference between the two groups. The average 3rd month bone density in periapical region in Group A without PRF was 618.48±210.89 and Group B without PRF was 728.4±200.59 which showed no significance difference.

The Inter-Group Comparison revealed that the average 24-Hrs socket region bone density differed significantly between Group A and Group B (P-value<0.05). The average 24-Hrs periapical region bone density did not differ significantly between Group A and Group B (P-value>0.05).

The average 3-Month post-treatment socket region bone density differed significantly between two study groups (P-value<0.05). The average 3 Month periapical region bone density did not differ significantly between Group A and Group B (P-value>0.05).

The average percentage (%) increase in socket region bone density at 3-Month follow-up differed significantly between two study groups (P-value>0.05). The average % increase in periapical region bone density at 3-Month follow-up did not differ significantly between Group A and Group B (P-value>0.05). (Table 1).

Bone Density	Group 1 (n=15) [With PRF Group]	Group 2 (n=15) [Without PRF Group]	P-value (Group 1 vs. Group 2)
Socket region			
24-Hrs [Mean±SD]	309.35± 116.27	198.35± 106.53	0.036 (S)
3-Months [Mean±SD]	566.11±117.13)	299.26±102	0.001 (S)
% Change at 3-Months (Mean)	45.4%	33.7%	0.05 (S)
Periapical region			
24-Hrs [Median [Mean±SD]	551.9±184	505.88±258.89	0.372 (NS)
3-Months [Mean±SD]	728.4±200.59	618.48±210.89	0.419 (NS)
% Change at 3-Months (Mean)	24.3%	18.28%	0.443 (NS)

Table 1: The inter-group comparison of Bone Density

- P-values are obtained by Mann-Whitney U test (Un-Paired Analysis by Non-Parametric Methods). P-value less than 0.05 are considered to be statistically significant.

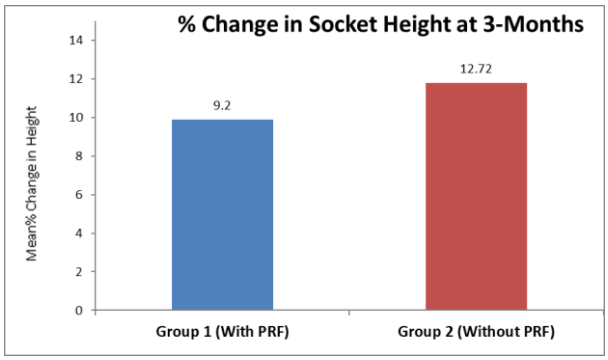
S: Statistically Significant, NS: Statistically Non-Significant.

- % Change at 3-months is calculated using formula: $\frac{(3Months\ Post\ tretament - 24Hrs)}{24Hrs}\ x\ 100$

Socket Height:

The average 24-Hrs and 3rd month socket height did not differ significantly between Group A and Group B which were site with PRF and site without PRF (P-value>0.05) Regardless of the reasons for socket preservation, there seems to be a consensus that sufficient alveolar bone volume and favorable architecture of the alveolar ridge are essential to achieve ideal functional, esthetic and prosthetic reconstruction following implant therapy.

In summary, the average 24-Hrs and 3rd month socket height did not differ significantly between Group A and Group B which were site with PRF and site without PRF (P-value>0.05) (Graph 1)



Graph 1: The distribution of % change in Socket Height across Two study groups.

DISCUSSION

PRF is a second-generation platelet concentrate collected on a single fibrin membrane that contains all the constituents favorable to healing and immunity. It is a gel-like matrix that contains high concentrations of non-activated, functional, intact platelets, contained within a fibrin matrix, that release, a relatively constant concentration of growth factors over a period of 7 days. On filling of a tooth socket by PRF, neovascularization forms through the PRF clot, and an epithelial covering develops.[3]

The results of our study was in favour of the above study which showed that PRF interferes and stimulates soft tissue healing process seen clinically, when applied to a fresh extraction socket. In addition, it seemed to reduce alveolar ridge resorption following tooth extraction and to positively influence socket healing over a 3-month period.

Soft Tissue Changes Assessment:

An extraction socket contains both hard and soft tissue which heals concomitantly with a certain amount of lag in the healing processes. Towards the end of the first week, the clot contracts and breaks down as granulation tissue replaces the same. The granulation tissue covers the superior aspect of the alveolar bone ridge usually and the epithelium proliferates along the soft tissue wound margins. PRF compared with other platelet concentrates, including platelet-rich plasma does not require any anti-clotting or gelling agents, and the naturally

forming PRF clot has a dense and complex three-dimensional architecture that contains not only platelets but also leukocytes.

Healing index scores are based on the basis of redness, presence of granulation tissue, bleeding, suppuration and epithelialization. In our study during post-operative visits, the treated areas were evaluated using the using Landry, Turnbell and Howley index and a score was given ranging from 1-5 where, 1– very poor and 5- excellent healing (figure.5)[7]

The mean soft tissue change assessment showed that significantly higher proportion of cases from PRF group at 7th day showed better healing index when compared to cases from without PRF group.

Radiographic Assessment

Osteoid in an extraction socket is evident at the apical portion (at the base) of the socket as un-calcified bone spicules; after a vascular network is formed, and young connective tissue is found at the end of 1st week.

The American Association of Oral and Maxillofacial Radiology recommends cross sectional views for planning dental implants, and this in combination with the ease of accessibility, handling, and low radiation dose that the CBCT imaging offers. It has the potential for vertical scanning in a natural seated position, high-resolution (e.g., bone trabeculae, periodontal ligament (PDL), root formation) imaging, lower dose of radiation than Multi-slice Computed Tomography (MSCT), less disturbance from metal artifacts, reduced costs compared with MSCT, easier accessibility, in-office imaging, easier handling, small footprint, Digital Imaging and Communications in Medicine (DICOM) compatibility, user friendly post processing and viewing software, and better saving of energy when compared with MSCT.[8]

Suomalainen *et al.* found that the CBCT scans were more accurate than other conventional radiographs. Our study utilized the potential of the CBCT in the evaluation of bone formed in an extraction socket with use of PRF. **Athraa Y. et al** [9] and **Dohan et al., 2006** [10] in their study showed that sites treated with PRFM had complete osseous fill of the extraction socket in 3 weeks and similar observations were made in our experimental group with PRF which showed faster bone healing in the density form compared to the control group when evaluated on CBCT scans.

The inflammatory or foreign body reaction might cause resorption of the internal walls of the socket. In the coronal portions of the socket the width of osseous walls are thin, and internal resorption might lead to a reduction of the ridge after normal healing. With PRFM alone as the graft material, the healing process is more rapid and does not have an associated foreign body reaction adversely affecting the amount of bone formation.**Lekovic et al.**[11] quantified the changes in alveolar width and height and recorded a 0.38 mm (11.59%) loss of height after 4 to 6 months of healing. Study by **Schropp et al**[12] reported a loss of crestal bone height and width which mainly occurred within the first three months after tooth extraction, with no difference according to location (maxilla or mandible). Substantial vertical reduction has been noted by authors which is very close to approximately 2 mm.[13] Our study contradicts earlier studies and showed a mean radiographic measurement of socket height reduction of 0.06 ± 0.25 where in the average height did not reduce significantly at third month post-treatment follow-up with use of PRF with clinical significance. It however concurred with other studies as it did not obtain a statistical significance.

The density of bone in a normal socket achieves maximum at 5 weeks in histological sections.[14] the density of bone was compared to the bone formed at the end of 3 months in the extraction socket with and without PRF and also the influence of PRF if any in the apical area just adjacent to the placement of PRF. It showed a comparable increase in density suggesting possible early rehabilitation in sockets with use of PRF. The radiographic results obtained in our study indicated that a statistically significant bone fill was obtained in the experimental group compared to the baseline at 3 months post-operatively which were concurrent with the results from similar studies.[7,9,15,16,17]

CONCLUSION

This study was designed to compare socket bone densities using CBCT that would aid in preservation of sockets for implant site management. Our study utilized the potential of the CBCT in determining the

densities as compared to the earlier methods for predictable outcomes with and without PRF. An appreciable amount of bone regeneration was seen in the experimental group when compared to the control substantiating the use of PRF as an inexpensive autologous material for socket preservation and future rehabilitation. It was also noted to have a greater inductive capacity when compared to the surrounding bone. Our study also showed that minimal operator expertise was required when compared to bone harvesting form distant sites. The shorter duration between extraction and rehabilitation obviates the need for a second procedure. Limitations in our study were with obtaining a statistical significance due to the limited number of participating subjects.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

1. Cohen. Socket Preservation. Atlas of Cosmetic & Reconstructive Periodontal Surgery 3rd edn.347-363.

2. Marrelli M, Tatullo M. Influence of prf in healing of bone and gingival tissues. Clinical and histological evaluation. Eur Rev Med Pharmacol Sci. 2013;17:1958-62.

3. Jiing H Z, Chung H T, Yu C C. Clinical and histologic evaluations of healing in an extraction socket filled with platelet-rich fibrin. J Dent Sci. 2011; 6: 116-22.

4. Hsun-Liang C,Guo-Hao L,Jia-Hui F,Hom-Lay W. Alterations in Bone Quality After Socket Preservation With Grafting Materials: A Systematic Review. Int J Oral Maxillofac Implants. 2013;28:710–720.

5. Villaescusa M, Perez S. Ridge alterations following tooth removal. Clin. Oral Impl. Res. 2010; 21: 237-42.

6. Del Corso M, Mazor Z, Rutkowski JL, Dohan Ehrenfest DM. The Use of Leukocyte- and Platelet-Rich Fibrin During Immediate Postextractive Implantation and Loading for the Esthetic Replacement of a Fractured Maxillary Central Incisor. J Oral Implantol. 2012; 38: 181-7.

7. Singh A, Kohli M, Gupta N. Platelet rich fibrin: a novel approach for osseous regeneration. J Maxillofac Oral Surg. 2012; 11: 430-4.

8. Jyoti Gupta, Syed Parveez Ali Cone beam computed tomography in oral implants National Journal of Maxillofacial Surgery 2013;4(1):2

9. Athraa Y. Alhijazi , Siba A. Mohammed. Evaluation the effect of platelet rich fibrin matrix on bone healing. J Bagh Coll Dentistry. 2011; 23: 65-70.

10. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, Gogly B. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part I: technological concepts and evolution. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006; 101:37-44.

11. Lekovic V, Milinkovic I, Aleksic Z, Jankovic S, Stankovic P, Kenney EB, Camargo PM. Platelet-rich fibrin and bovine porous bone mineral vs. platelet-rich fibrin in the treatment of intrabony periodontal defects. J Periodont Res. 2012; 47: 409–17.

12. Clozza E, Biasotto M, Cavalli F, Moimas L, Di Lenarda R. Three-Dimensional Evaluation of Bone Changes Following Ridge Preservation Procedures. Int J Oral Maxillofac Implants. 2012; 27: 770–75.

13. Agarwal G, Thomas R, Mehta D. Post-extraction maintenance of the alveolar ridge: Rationale and Review. Compendium of continuing education in dentistry 2005;23-6.

14. Amler MH. The time sequence of tissue regeneration in human extraction wounds. Oral Surg Oral Med Oral Pathol. 1969; 273:309-318.

15. Simon BI, Gupta P, Tajbakhsh S. Quantitative evaluation of extraction socket healing following the use of autologous platelet-rich fibrin matrix in humans. Int J Periodontics Restorative Dent. 2011; 31:285-95.

16. Pagni G, Pellegrini G, Giannobile WV, Rasperini G. Postextraction Alveolar Ridge Preservation:

Biological Basis and Treatments. Int J Dent. 2012; 15:10-30.

17. Kubilius M, Kubilius R, Gleiznys A. The preservation of alveolar bone ridge during tooth extraction. Stomatologija. 2012; 14: 3-11.