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

International Journal of Dental Science and Innovative Research (IJDSIR)
IJDSIR : Dental Publication Service
Available Online at: www.ijdsir.com
Volume – 5, Issue – 1, February - 2022, Page No. : 180 - 187

Evaluation of the feasibility of extraction socket preservation using I-PRF & hydroxyapatite matrix

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Citation of this Article: Dr. Sudeep Shrivastava, Dr. Shaji Thomas, Dr. Shubhanshi Kangloo, Dr. Kanchan Dahare, Dr. Monica Gupta, "Evaluation of the feasibility of extraction socket preservation using I-PRF & hydroxyapatite matrix", IJDSIR- February - 2022, Vol. – 5, Issue - 1, P. No. 180 – 187.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

In day-to-day life, one faces numerous injuries, which are mostly clinically negligible. The body is constantly at work for healing & restoration. The healing of both hard and soft tissue, is facilitated by an extensive range of events, which is regulated by various signaling proteins. Platelets are a mainstay of hemostasis following injury, and also play a crucial role in healing process. Presently, studies have revealed its application in various disciplines of dentistry. Healing with PRF was found to be satisfactory and showed excellent results.

The study was designed as a prospective randomised case control study on 60 (30 study and 30 controls) patients with clinical and radiological evidence of bone loss. After exodontia, i-PRF with hydroxyapatite bone graft particulate material was placed in group A patients and only i-PRF was placed in the extraction sockets in group B patients.

The results revealed that the incorporation of bone graft in i-PRF substantially increased the quality and quantity of bone.

Keywords: exodontia, healing, hydroxyapatite bone graft, i- PRF, platelets.

Introduction

Tissue healing is defined as the act or procedure of curing or of restoring living tissue to health. In day-to-day life, one faces numerous injuries, which are mostly clinically negligible. The body is constantly at work for healing & restoration. The healing of both hard and soft tissue, is facilitated by an extensive range of events, which is regulated by various signaling proteins[1].

Platelets are a mainstay of hemostasis after any injury, and they also play a crucial role in healing process[2]. They stimulate cell division and proliferation, increase synthesis of collagen, promote angiogenesis, initiate cell differentiation and eradicate necrotic tissue, to hasten the wound repair and tissue regeneration.[1]

Components of blood provides ample amount of healing factors which leads to the healing of the wounds[3]. Fibrin meshwork present in coagulated blood contains many nutritional substances which are responsible for healing [4,6]. For surgical use, platelet concentrates have been used since many years[4]. The primary concept of these autologous preparations was to accumulate platelets and its growth factors and to deliver it to the operative site, in order to enhance local healing.[5]This was the idea behind developing PRF.

Conceptually, PRF assisted healing should be more rapid and effective as compared to spontaneous healing[7]. PRF (Platelet rich fibrin) is a type of fibrin matrix in which, platelet cytokines,[8-11] cells and growth factors are trapped and released after certain time and this serve as resorbable membrane. Autologous platelet rich fibrin (PRF) is considered to be healing biomaterial[10].

Studies have highlighted the application of PRF in various fields of dentistry. Healing with PRF was found to be satisfactory and showed excellent results[9]. PRF is produced employing a simple method, in low cost and readily available, which has been applied in many different fields, peculiarly oral and maxillofacial, orthopaedic and plastic surgery.[1]

The production procedure of PRF attempts to collect the platelets and released cytokines in a fibrin clot[12]. These platelets and leukocyte cytokines play a great role as biomaterial, but fibrin matrix supporting these is very helpful in constituting the influential elements responsible for real therapeutic potential of PRF[5]. Cytokines are immediately used and destroyed in a healing wound.

Aims and Objectives

To evaluate the feasibility of extraction socket preservation using I PRF & hydroxyapatite matrix.

Objectives:

1. To enhance post extraction healing.
2. To study the efficacy of indigenously prepared i-PRF.
3. To preserve bone following extraction.
4. To reduce the post extraction complications.

Materials and Method

This study was designed as a prospective randomised case control study on patients requiring exodontia and further rehabilitation.

60 patients (30 cases and 30 controls) with clinical and radiological evidence of bone loss were equally divided into two groups. Following exodontia, i-PRF with hydroxyapatite bone graft particulate material was placed in group a patients and only i-PRF was placed in the extraction sockets in group B patients.

Inclusion Criteria

1. Patients requiring bone formation for implants and other prosthetic rehabilitation, post extraction.
2. Patients aged 18 or above.

Exclusion Criteria

1. Patients suffering from systemically debilitated conditions.
2. Patients' refusal for informed consent.

Procedure

Under aseptic measures, blood was withdrawn from the patient using 5ml syringe and transferred to vacutainers. The vacutainers were centrifuged at 3000 RPM for 65 seconds. i-PRF was sucked out of vacutainer by means of another 5ml syringe. If it is mishandled than the product formed is of no use and should be discarded. This i-PRF was taken into sterile stainless-steel bowl in which Hydroxyapatite particulate bone graft material was sprinkled. It is mixed for 9-12 minutes to form bone graft in the form of stiff semisolid mass of whitish colour.

Surgical exposure

Following extraction of indicated tooth/teeth, a bare empty socket is visible (Fig. 2). It was thoroughly irrigated with betadine and 0.9% saline. Prepared bone graft was taken placed inside extraction socket (Fig. 3 & 4). Surgical site closure was done by placing 3-0 silk suture. Sutures were removed after 7 days.

Post-operative care of the patient

All patients were kept on antibiotics and analgesics for 5 days and looked for any post-operative complications. Post-operative intraoral periapical radiographs were taken on regular intervals to assess graft position.

Following parameters were assessed in a CBCT:

- Height of ridge – distance from highest point of crest to lowest point at lower border.
- Width of ridge – distance from buccal cortex to lingual cortex.
- Density of bone – at 3 different points i.e., upper cortex, middle region and lower region.

All patients were followed up after 1 month, 3 months and 6 months post operatively. Healing was assessed during first 2 follow up visits. Radiological bone density, height and width was assessed 6 months post op with a follow up CBCT.

Statistical analysis

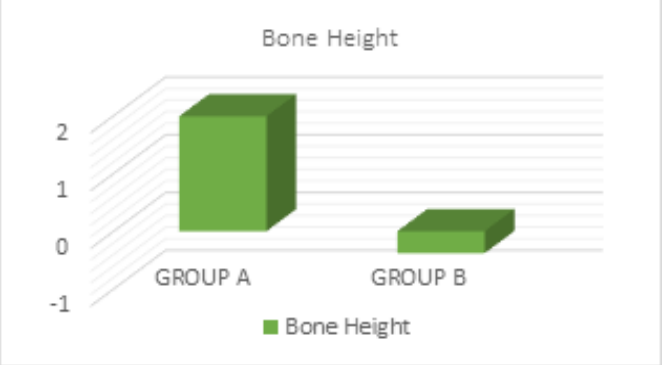
Collected data was analysed by SPSS statistical package on computer. The significant test used for the analysis was paired t test.

Results

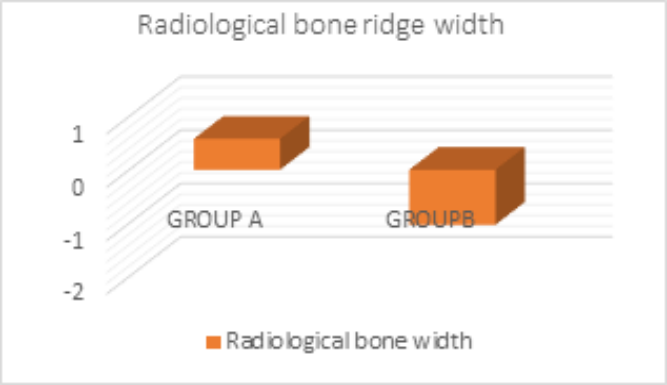
60 patients involved, were divided into 2 equal groups A & B, in which 28 (46.7%) were males and 32 (53.3%) were females. Mean age of participants in the study was 45.5 where, 45.3 in group A and 46.3 in group B.

Mean and Standard deviation of difference in radiological height of ridge in study group between pre-operative & six-month post-operative period was found to be 1.99 ± 1.17 and for control group it was -0.384 ± 0.463 which when compared were found to be significant ($p < 0.005$) (Graph 1) (Fig. 5, Fig. 6).

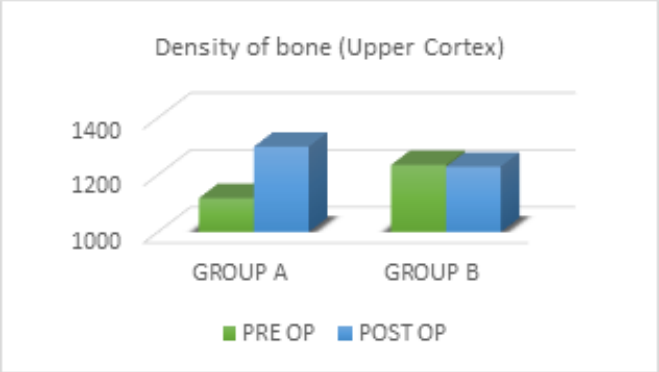
Mean and standard deviation of difference between radiological bone ridge width of group A between pre-operative & six-month post-operative period was 0.580 ± 0.161 and group B was -1.03 ± 0.798 which showed significant increase of width in group A when compared to group B ($p < 0.005$) (Graph 2) (Fig. 7, Fig. 8).



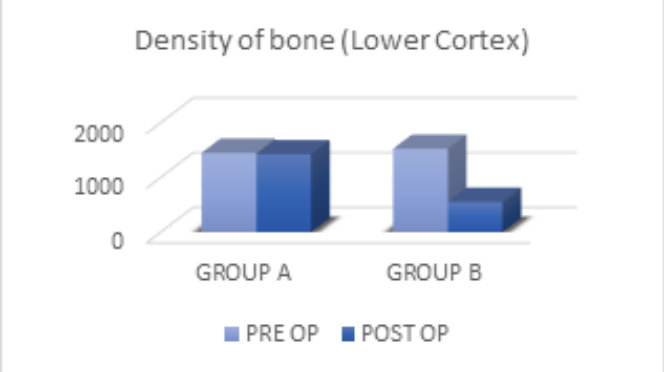
Graph 1: Difference in the Pre & post-operative radiological bone height in both groups.



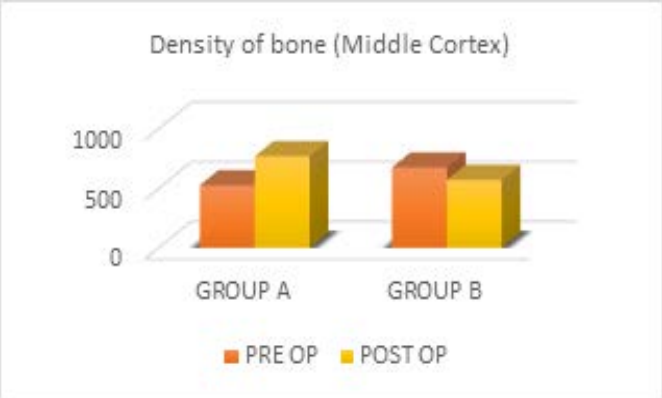
Graph 2: Difference between the Pre & post-operative radiological bone ridge width in both groups.



Graph 3: Difference between the Pre & post-operative density of bone in the upper cortex in both groups.



Graph 4: Difference between the Pre & post-operative density of bone in the middle cortex in both the groups.



Graph 5: Difference between the Pre & post-operative density of bone in the lower cortex in both the groups.

Mean and standard deviation of difference in radiological density of bone at upper cortex pre-operatively in Group A was 1119 ± 255, & six months post-operative was 1299 ± 205 and in group B it was 1235 ± 201 pre-operative and 1229 ± 194 six months post-operative where p value was significant in group A (0.0038) when compared to group B (0.90) (Graph 3), on further evaluation of density at different levels, the radiological density of bone at middle cortex pre-operatively in Group A was 526 ± 220, & six months post-operative was 768 ± 154 and in group B it was 674 ± 152 pre-operatively and 570 ± 134 six months post-operative and p value was significant in group A (0.0001) when compared to group B (0.0068) (Graph 4) and lastly, the radiological density of bone at lower portion of jaw pre-operatively in Group A was 1450 ± 276 & six months post-operative was 1424 ± 250 and in group B was 1523±181 pre-operatively and 1552 ± 157 six months post-operative, here the p value was insignificant in group A (0.62) when compared to group B (0.51) (Graph 5).

Discussion

Post extraction resorption is a physiologic process in which the resorption of bone occurs after the tooth exfoliates or is extracted. Resorption makes the future rehabilitation complicated. Platelet concentrates have

always been enigmatic for researchers. Literature shows numerous clinical studies on PRP. Finally, Choukroun's[4] idea of PRF led to a revolution. According to Sunitha V et al., placing a graft along with platelet rich fibrin heals it at a faster rate, and shows osteogenic properties[2] which makes prosthetic rehabilitation easy. Another experimental study by Sanchez et al.[17] was done in which osteoblastic cell culture was used to determine the effect of PRP and PRF on osteoblastic proliferation and differentiation. According to this study, it was observed that the osteoblast cells possess superior affinity towards PRF membrane[17]. PRP was considered to be efficacious for healing but no evidence for bone formation was observed.

A clinical study by Aghaloo et al[8] was performed in which conclusion was made that no significant improvement, radiographically orhistomorphometrically, was seen with the incorporation of PRP in the formation of bone in noncritical sized deformities in the cranium of the rabbit. A substantial increase in the density of bone was also observed in bone along with PRP in comparison with PRP alone at 1 and 4 months ($P < 0.02$ and $P < 0.05$, respectively).

Complete edentulous ridge tends to resorb at a faster rate as compared to partially edentulous ridge. Delay in prosthetic rehabilitation will not give the expected results. Along with healing, some osteoconductive material was required before implant placement to form adequate bone. Literature shows PRF has osteoconductive properties[9]. A study was done by Joseph Choukroun et al[10] in which histologic effects of PRF on bone allograft material was placed, results of which showed that when FDBA was incorporated with PRF, the time of healing was reduced to 4 months. Histology showed formation of new bone at a faster rate[10].

A similar study conducted by Ziv Mazor et al[16]. in which PRF membrane was used in sinus lift procedure to preserve the Schneiderian membrane prior to implant placement[16]. After the positioning of implant, the cavity was packed with PRF. Result of the study showed formation of bone 6 months postoperative. Many other studies were performed using same concept using PRF to augment sinus floor[12]. Jensen TB et al[15] performed the augmentation of sinus floor using osteotome followed by which the surgical cavity was closed with PRF[15].

Xuzhu et al[18] performed a study, in which a new liquid platelet formulation formed without any anticoagulants (i-PRF) in comparison to standard platelet rich plasma (PRP) along with gingival fibroblasts that developed on plane and roughed surfaces of titanium implant. The results showed that i-PRF commenced significantly higher cell migration, in addition to higher messenger RNA (mRNA) levels of PDGF, TGF-β, collagen1 and fibronectin when compared to PRP[13,14].

Mustafa et al[19] conducted a study, where chondrocytes were primarily examined for their capability of proliferation and differentiation in response to PRP and i-PRF. They concluded that, i-PRF prepared by low-speed centrifugation concept considerably enhanced activity of chondrocyte cells & further enhanced regeneration of cartilage when compared to PRP.

In the present study, results showed the formation of bone with i-PRF alone, though not significant which suggests that i-PRF has osseogenic potential. Even though in some cases bone formation was not evident post operatively, the level of bone height in most of the cases was maintained. Thus, it can be said that i-PRF prevents alveolar bone resorption post extraction.

Conclusion

The result of the study showed that in both groups healing time was reduced and quality of bone formed

was adequate. The results of the present study showed that placing bone graft along with i-PRF reduces healing time and enhances bone formation. It must be hypothesized that incorporation of bone graft creates a scaffold in which i-PRF can create a nidus for bone formation. It has been observed that i-PRF possess good osseogenic potential owing to the presence of several growth factors essential for bone formation but owing to its lack of 'form' it is not enough to form significant amount of bone. These outcomes are based on this preliminary study, although to validate the facts gained from the present study, and more accurate results and scientific details can be achieved by further research studies.

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Legend Figures

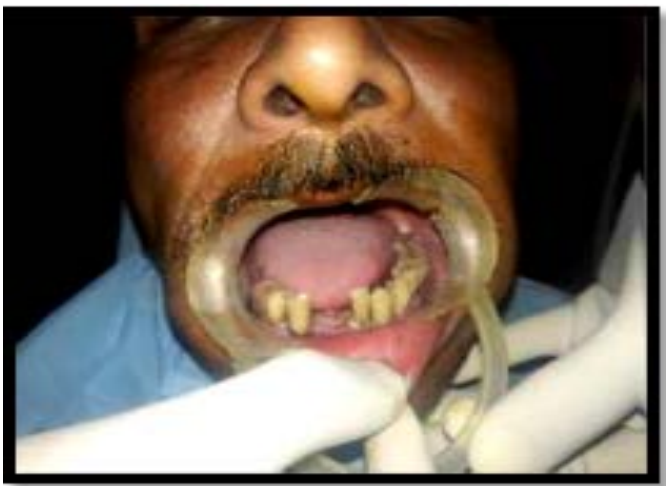

Figure 1: Pre-operative image

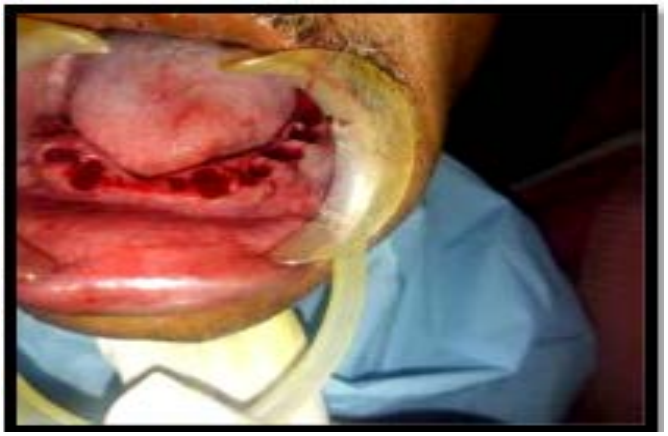

Figure 2: Fig.2. Extraction sockets

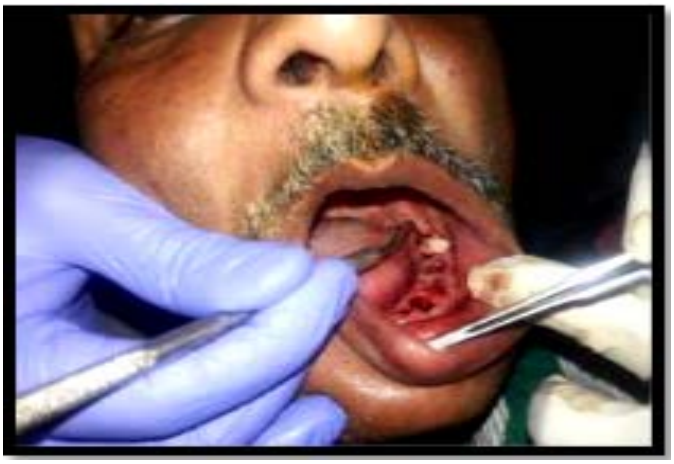

Figure 3: i-PRF along with bone graft prepared and is placed in socket.

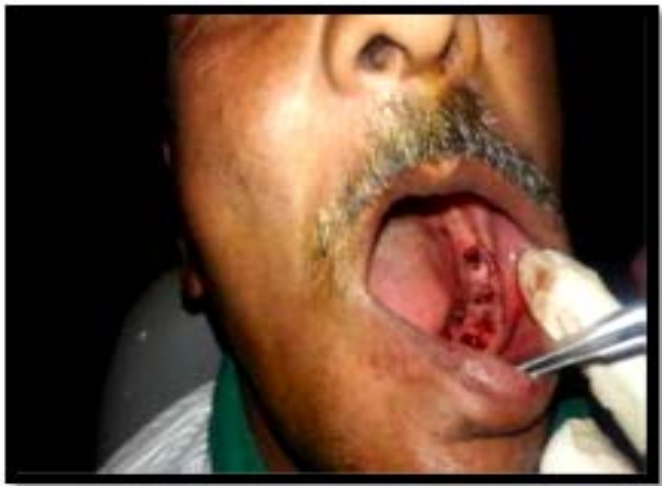

Figure 4: i-PRF along with bone graft prepared and is placed in socket.

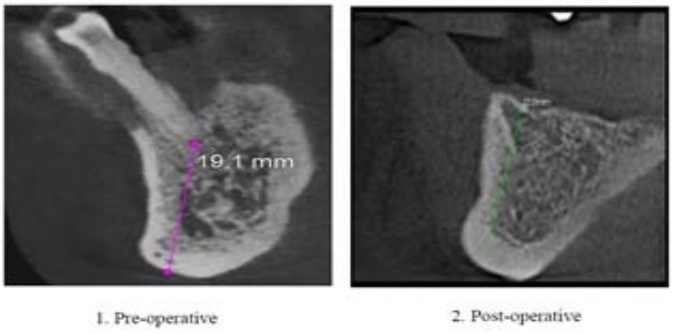

Figure 5: Radiological height in Group A

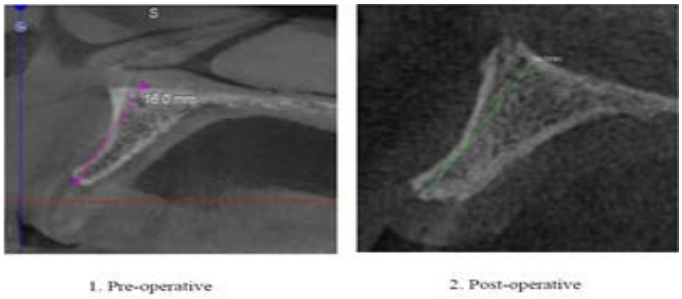

Figure 6: Radiological height in Group B

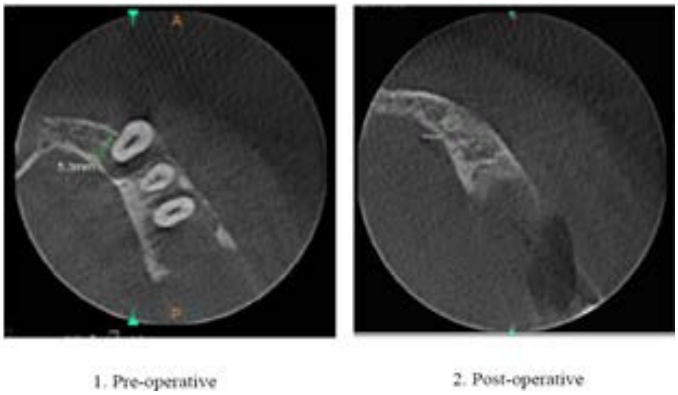

Figure 7: Radiological width in Group A

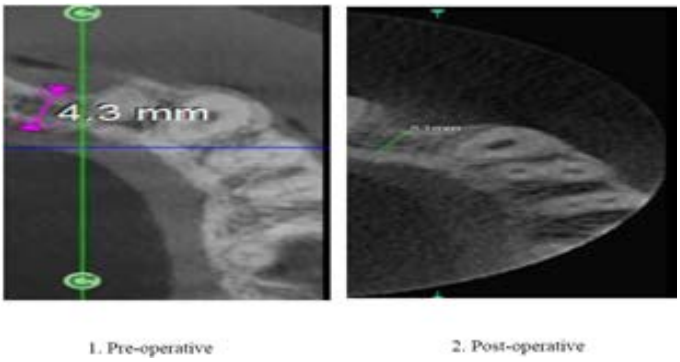

Figure 8: Radiological width in Group B