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Original Research Article

Platelet rich plasma or platelet rich fibrin: which is better in post extraction immediate implant placement followed by immediate loading?

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ABSTRACT

Background: The study aimed to compare the clinical efficacy of platelet rich plasma (PRP) and platelet rich fibrin (PRF) used with phosphosilicate putty during immediate post extraction implant placement and immediate loading.
Methods: A prospective comparative clinical study was conducted on 20 adults. Two groups were made with 10 patients in each by random selection. Each patient required tooth extraction and replacement with immediate implantation and immediate loading. In Group 1 PRP was prepared from the patient's blood, mixed with alloplastic graft, and packed in peri-implant space and similarly in Group 2 PRF was prepared from the patient's blood and mixed with alloplastic graft in peri-implant space. All the patients were evaluated for postoperative pain, soft tissue analysis, implant mobility, and crestal bone height changes were observed for up to 6 months, using paired/independent t-test, and Chi-square test.
Results: It was seen that for pain on 1st postop day Group 1 had shown superior results than Group 2 after 7 days both groups showed good soft tissue healing. No significant difference was found in both groups when seen for implant mobility. The difference in crestal bone height gain in the first 3 months of Group 2 showed a remarkable height gain than in Group 1. And at 6th month overall crestal height gain difference between both groups was non-significant.
Conclusions: The autologous PRF can present new possibilities for enhanced healing and functional recovery over PRP during immediate post extractive implantation and immediate loading.

Keywords: Immediate implants, Immediate loading, PRP, PRF

INTRODUCTION

The placement of dental implants for replacing missing teeth is a well-established treatment option. Instead of following the original Branemark's protocol, Immediate implant placement has shown successful results, by the reduction in alveolar bone resorption.[1-3] Dr. Linkow established the protocol for immediate loading of root form implants, which reduces the treatment visit, eliminates second stage surgery, and provides prosthesis

immediately for the patient's aesthetic, and psychological well-being.[4]

Primary implant stability is an important factor in achieving predictable treatment outcomes in early/immediate loading protocols. So, Insertion torque values more than 35 N-cm and ISQ value more than 65 have been chosen as thresholds for immediate non-functional loading.[5-7]

The mainstay of the success of the procedure depends on the peri-implant bone remodelling. Platelet concentrates are being continually used for early bone and soft tissue healing, most commonly used are PRP and relatively newer PRF. Platelets release substances that promote tissue repair and influence the reactivity of vascular and other blood cells in angiogenesis in the time required for implant stabilization.[8]

Soft tissue healing is also substantially improved through the application of PRP, by increasing collagen content and regulating key cellular processes, such as mitosis, cell differentiation, and metabolism.[9]

Platelet-rich plasma (PRP) is an autologous concentrate of platelets suspended in plasma. It is a proven source of growth factors such as platelet-derived growth factors (PDGFs) and transforming growth factor-beta 1 and 2; vascular endothelial growth factors positively influence the repair and regeneration of tissues. By combining calcium chloride and thrombin with PRP, PRP releases these growth factors. PRP gel also contains a native concentration of fibrinogen. As a result of its fibrin content, PRP gel help to stabilize the clot thereby favouring regeneration of the osseous defects particularly in the early stage.[10]

Numerous reports have claimed promising results with platelet-rich plasma while others support the use of platelet-rich fibrin.[6,10,11]

PRF has a dense fibrin network with leukocytes, cytokines, structural glycoproteins, and also growth factors. Concentrated leukocytes in the PRF scaffold play an important role in growth factor release, immune regulation, anti-infectious activities, and matrix remodelling during wound healing. The slow polymerization mode of PRF and cicatricial capacity creates a physiologic architecture favourable for wound healing. Yelamali and Saikrishna found better and faster wound healing and bone formation with PRF and also stated preparation of PRF is simpler than PRP.[12]

Since there haven't been records for any study in which researchers have compared the efficacy of PRP and PRF in immediate implant placement followed by immediate loading.

So, we decided to conduct a comparative study on immediate implant placement followed by immediate loading with calcium and phosphosilicate alloplastic graft (Novabone) with either platelet-rich plasma (PRP) or platelet-rich fibrin (PRF).

METHODS

A prospective comparative clinical study was performed on 20 patients (12 females and 8 males) of age between 18 to 38 years, requiring extraction with permanent tooth replacement employing immediate implantation followed by immediate loading in the Department of Oral and Maxillofacial surgery of DJ College of Dental Sciences and Research, Modinagar, Uttar Pradesh from August 2014 to September 2016. Ethical clearance was taken from the institutional ethical board. 20 patients were selected who met the inclusion and exclusion criteria. Written informed consent was obtained from all the selected patients in the prescribed format

Inclusion criteria

Patient requiring immediate replacement of tooth due to untreatable carious lesion, endodontic treatment failure, tooth fracture; patients with ASA class I and ASA class II status; adequate distance between the apex of the socket and the associated vital structures; patients with proper oral hygiene.

Exclusion criteria

Patients with any debilitating systemic disorders, uncontrolled diabetes, immuno-compromised patients, patients on bisphosphonate therapy; parafunctional habits; presence of pathologic lesion at the apex or furcation area; acute dentoalveolar infection (with purulent discharge or fistula formation); chronic smokers.

A total of 20 patients were selected and were randomly assigned to 2 groups.

Group 1

10 implants were placed in a fresh extraction socket along with platelet rich plasma and phosphosilicate Putty graft followed by immediate loading.

Group 2

10 implants were placed in a fresh extraction socket along with platelet rich fibrin and phosphosilicate Putty graft followed by immediate loading.

After proper clinical examination, the impression of the patient mouth was made using alginate impression material; a cast was poured and the Patient's occlusion was determined both clinically and on the cast. Intraoral periapical radiographs with grid were taken pre operatively (Figure 1g and 2g) and post-operatively using the long cone paralleling technique in all the cases with radiographic safety precautions.

All the patients were operated on under aseptic conditions using sterile instruments and drapes. 2% lignocaine with adrenaline local anaesthetic was used in all cases. Before surgery patient's mouth was rinsed using 2% chlorhexidine mouthwash. The flap was raised using molt number 9 periosteal elevator on the buccal and palatal side then atraumatic extraction was carried out using luxators. The socket was thoroughly irrigated using normal saline. Using the depth gauge the length of the socket was measured. Then using sequential drilling along with a copious amount of cold saline irrigation the site was prepared less than the diameter of the implant selected and also vertical drilling was done so at least 2 mm of the bone could be engaged by the implant apex. Then selected implant was placed into the prepared site and tightened. After getting sufficient torque cover screw is placed (Figure 1b and 2b), a resonance frequency analyser transducer was tightened and the ISQ value was recorded.

Preparation of platelet rich plasma for Group 1

20 ml of venous blood from the antecubital region was withdrawn and transferred to a vacutainer containing citrate dextrose, centrifuge the blood using a 'soft' spin. 2000 rpm for 10 minutes, then transfer the supernatant plasma containing platelets into another sterile tube (without anticoagulant). Centrifuge tube at a higher speed (a hard spin) to obtain a platelet concentrate. 3000 rpm for 10 minutes according to Jo et al.[13] The lower 1/3rd is PRP and the upper 2/3rd is platelet-poor plasma (PPP). At the bottom of the tube, platelet pellets are formed. Remove PPP and suspend the platelet pellets in a minimum quantity of plasma (2-4 ml) by gently shaking the tube. Then we added 10% calcium chloride [1 ml of NELCIUM 10% $CaCl_2$ to prep and let it settle for 2-3 mins. Then the graft is mixed with PRP in a petri dish. (Figure 1c)

Preparation of platelet rich fibrin for Group 2

10 ml venous blood was withdrawn from the antecubital region and blood is collected in the glass tube without any anticoagulants in it, Blood is centrifuged at 3000 rpm for 10 mins in a tabletop centrifuge, PRF is removed from the tube using sterile tweezers and separated from the RBC base using scissors, Each PRF clot started to release clot exudate and was ready for compression into the membrane. Then using 2 glass slabs PRF is made into a membrane by keeping glass slabs one over another with PRF in between (Figure 2c). Then a small amount of PRF membrane is cut into small pieces and mixed with the graft in a petri dish and the rest of the membrane is placed surrounding the implant and rest of the graft.

In each patient, a mixed graft was compressed along the sides of the implant in the bony socket using a graft carrier and probe and then the cover screw is replaced by an abutment to achieve proper aesthetics and function abutment was being trimmed, then buccal and palatal flaps were approximated and sutured using 3-0 silk. Then again, an impression was made using additional silicone putty and poured using dental stone and immediate post-op grid intraoral periapical radiographs were taken.

Finally, a non-functional acrylic temporization was formed over the cast and the crown was fixed over the abutment using luting type Glass ionomer cement within 24 hours of implant placement in a fresh extraction socket. (Figure 1f and 2f)

Patients were prescribed amoxycillin 500 mg TID for 7 days. Suture removal was done after 7 days.

The follow-up period was 1st postoperative day, 7th day, 1 month, 3 months, 6 months post-op after implant placement during which patients have prospectively evaluated for the following parameters clinically: presence of any signs of pain, swelling, wound dehiscence, and infection; implant mobility. Radiographically with grid intra-oral periapical radiograph using long cone paralleling technique vertical bone measurements from the mesial and distal shoulder of the implant to the first bone-implant contact level in an axis parallel to implant (IS-BIC) were recorded, that reflected the crestal bone level changes around the implant; as well as using resonance frequency analyser (at immediate post-op and after 6 months) for determining the implant stability.

Statistical analysis

The data for the present study was entered in microsoft excel 2007 and analyzed using Statistical package for social sciences (SPSS) Statistical software 19.0 version. The descriptive statistics included mean and standard deviation. The intragroup comparison for different time interval was done using paired t-test to find the difference between individual time intervals. Level of significance for present study was fixed at 5%. The intergroup comparison for the difference of mean scores between two independent groups was done using paired/independent t-test, and Chi-square test.

RESULTS

A total of 20 patients were included in our and were assigned into two groups equally, Group 1 and Group 2. In Group 1 platelet rich plasma was used as an adjunct and in Group 2 platelet rich fibrin as an adjunct to synthetic bioactive glass graft placed in peri-implant space during immediate implant placement in fresh extraction socket followed by immediate loading.

The comparison of pain scores reported by patients in either group postoperatively, between the two groups on 1st postoperative day and the 7th day, and readings were recorded for post-op evaluation of pain due to any soft tissue and hard tissue infection afterward for 1st month,

3rd month and 6th months. On the first postoperative day, Group 2 (1.50±0.70) reported higher pain values than group 1 (1.40±0.51) which was statistically significant, p=0.722. No pain was reported on the 7th postoperative day, 1st month, 3rd month, and 6th month in both the groups (Figure 3).

Table 1: Soft tissue analysis-gingival swelling.

	Group I (%)		Group II (%)		Chi square value	P value
	Present	Absent	Present	Absent		
1st day	03 (30)	07 (70)	06 (60)	04 (40)	1.818	0.034 (Significant)
7th day	00 (00)	10 (100)	00 (00)	10 (100)	-	1.000 (Non-significant)
1st month	00 (00)	10 (100)	00 (00)	10 (100)	-	1.000 (Non-significant)
3rd month	00 (00)	10 (100)	00 (00)	10 (100)	-	1.000 (Non-significant)
6th month	00 (00)	10 (100)	00 (00)	10 (100)	-	1.000 (Non-significacnt)

Table 2: Soft tissue analysis- pain.

	Group 1	Group II	T value	P value	Significance
Post op	0.30±0.48	00.80±0.78	1.709	0.105	Non significant
1st month	00.00±0.00	00.00±0.00		1.000	Non-significant
3rd month	00.00±0.00	00.00±0.00		1.000	Non-significant
6th month	00.00±0.00	00.00±0.00		1.000	Non-significant

Table 3: Soft tissue analysis- wound dehiscence.

	Group I (%)		Group II (%)		Chi square value	P value
	Present	Absent	Present	Absent		
1st day	00 (00)	10 (100)	00 (00)	10 (100)	-	1.000 (Non-significant)
7th day	00 (00)	10 (100)	00 (00)	10 (100)	-	1.000 (Non-significant)
1st month	00 (00)	10 (100)	00 (00)	10 (100)	-	1.000 (Non-significant)
3rd month	00 (00)	10 (100)	00 (00)	10 (100)	-	1.000 (Non-significant)
6th month	00 (00)	10 (100)	00 (00)	10 (100)	-	1.000 (Non-significant)

Table 4: Comparison of crestal bone height changes between different time intervals (mean).

	Group I	Group II	T value	P value	Significance
Immediate post op-1 month	-0.10±1.71	-1.51±1.95	1.978	0.045	Significant
1-3 month	-1.95±0.81	-0.95±1.50	2.206	0.040	Significant
3-6 month	0.00±0.72	0.10±0.96	0.318	0.754	Non-significant
Post op-6th month	-2.06±0.76	-2.56±0.66	0.622	0.542	Non-significant

The comparison of postoperative infection among 2 groups at different time intervals. On the 1st post-operative day, both groups displayed mild swelling and redness in associated regions in 50% of cases. None of the patients in both groups displayed any sign of purulent discharge, fever, or abscess throughout our study period. this implies the use of both PRP and PRF are equally effective in the reduction of postoperative inflammation (Figure 4).

The comparison of postoperative soft tissue analysis among two groups at different time intervals. On the 1st post-operative day Group 1 displayed mild inflammation in 50% of cases whereas in Group 2 70% of cases displayed mild inflammation, but statistically, the difference was insignificant. None of the patients in both groups displayed any sign of purulent discharge, fever, or abscess throughout our study period. this implies the use of both PRP and PRF are equally effective in the reduction of postoperative inflammation (Tables 1-3).

The comparison of implant mobility in both the groups at different time intervals postoperatively 1st day, 7th day, 1st month, 3rd month, and 6th months. None of the implants were mobile in both the groups throughout our study period, representing no difference between Group 1 and Group 2 suggesting an equal effect of PRP and PRF on implant mobility.

The intergroup comparison of mean crestal bone height changes between 2 groups at different intervals of time post-operatively. Changes from immediate postoperative to 1st month (-1.51±1.95) values were compared showing a significant difference (p=0.045) between 2 groups suggesting more bone formation in Group 2 than Group 1 during 1st month. Crestal bone height gain was recorded between 1st month and 3rd month for Group 2

(-0.95±1.50) was more than Group 1 (-1.95±0.81) showing a significant increase (p=0.040) in crestal bone height in group 2. Crestal bone height difference between 3rd month and 6th month in both groups was statistically insignificant (p=0.754). The overall crestal bone height gain compared between the 2 groups was non-significant (p=0.542) when calculated from the immediate postoperative day to the 6th month (Table 4, Figure 5).

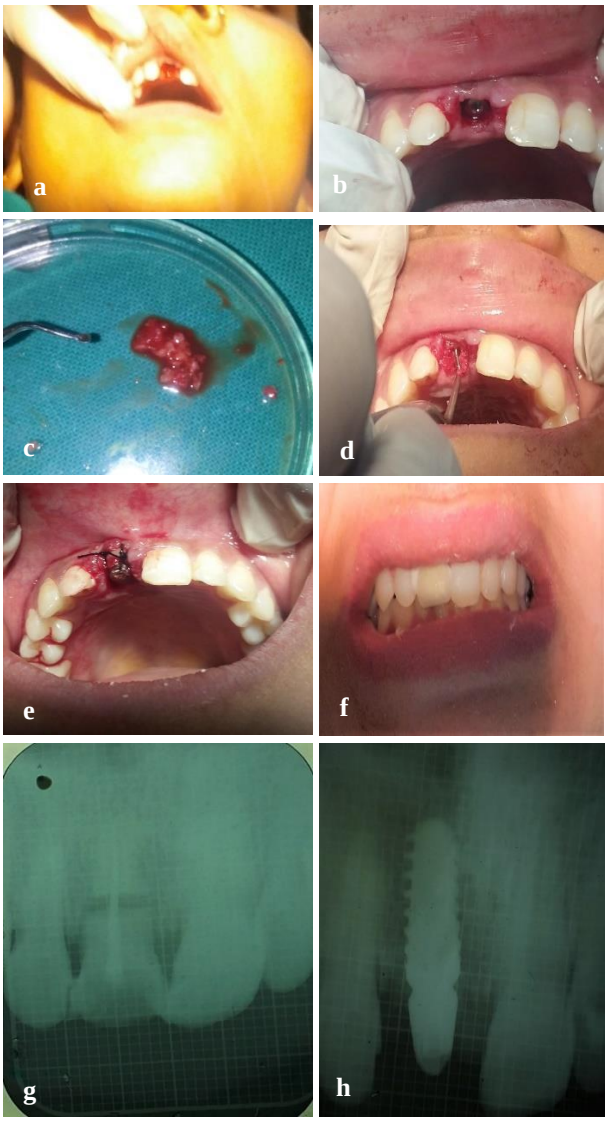

Figure 1: Steps followed for placement of implant in Group 1 (immediate implant placement in tooth #11) (a) atraumatic extraction, (b) implant placement after sequential drilling, (c) PRP mixed with phoshosilicate graft, (d) packing of graft in jump space, (e) abutment adjusted and placed and sutures placed, (f) non functional temporisation given, (g) preoperative grid radiograph, (h) 6th month post operative radiograph.

Suggesting that more crestal bone height gain was seen in Group 2 than in Group 1 till the 3rd month.

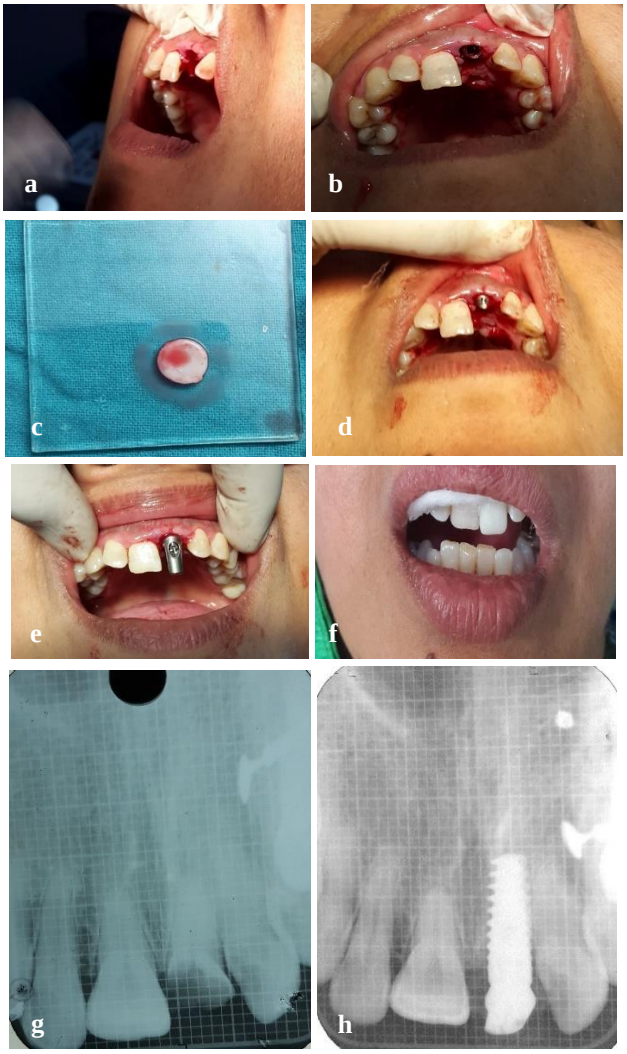

Figure 2: Steps followed for placement of implant in Group 2 (immediate implant placement in tooth #21) (a) atraumatic extraction, (b) implant placement after sequential drilling, (c) PRF compressed into membrane, (d) packing of graft in jump space, (e) abutment adjusted and placed and sutures placed, (f) non-functional temporisation given, (g) preoperative grid radiograph, (h) 6th month post operative radiograph.

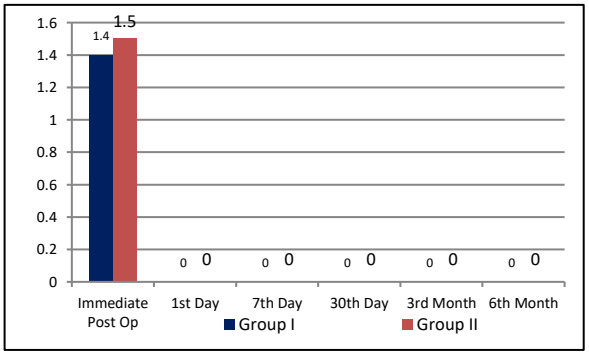

Figure 3: Intergroup comparison for pain.

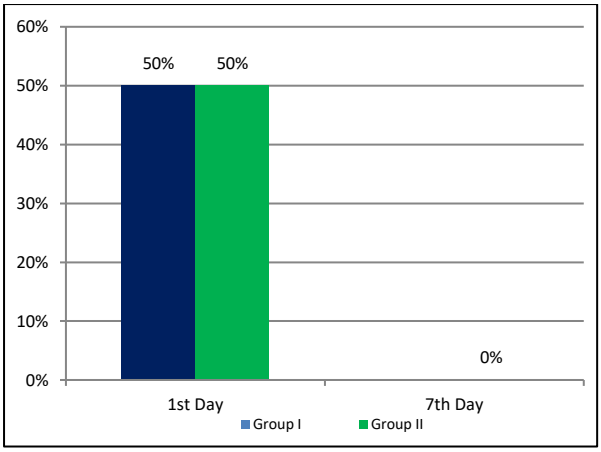

Figure 4: Intergroup comparison for postoperative infection.

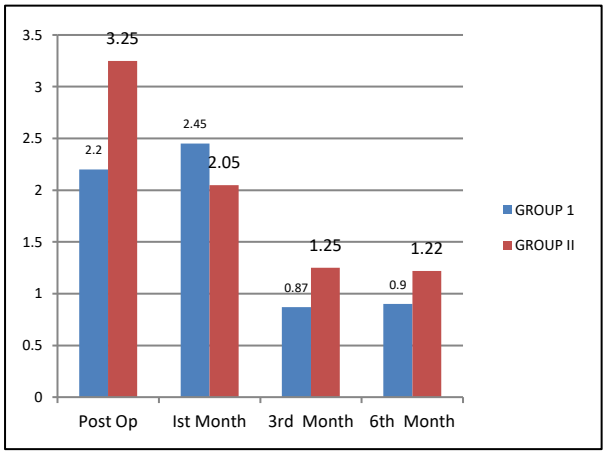

Figure 5: Intergroup comparison for mean bone-height changes.

The comparison of ISQ in both the groups at immediate post-op and at 6 months and there was no statistical difference between the values recorded on immediate postop p=0.960 and after 6 months (p-0.424) for both the groups. Suggesting PRF and PRP are equally effective (Figure 6).

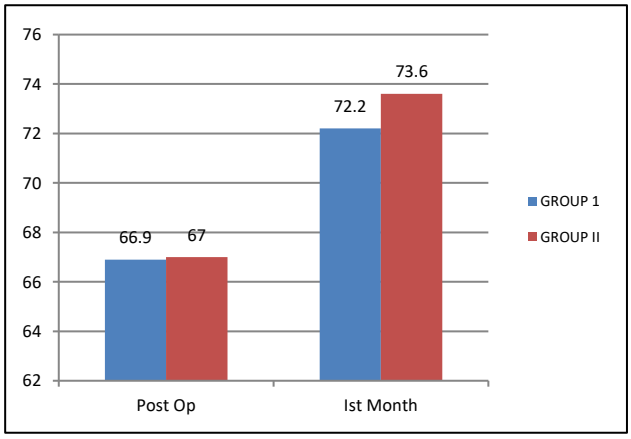

Figure 6: Implant stability.

DISCUSSION

According to the original Branemark1 protocol required a submerged healing period of 3-6 months to obtain osseointegration. In a retrospective study performed by Schwartz-Arad and Chaushu, immediately placed implants were studied over a period of 5 years, having a success rate of approximately 95%. They concluded that, following specific protocols, immediate placement of implants was a viable option.[14] The advantages of the procedure include fewer surgical sessions, elimination of the waiting period for socket healing, shortened edentulous period, reduced overall cost, as well as preservation of bone height and width. Several studies shown immediate implant and immediate loading as successful treatment several measures have been proposed to improve and accelerate osseous healing by increasing bone-to-implant contact including the application of autologous growth factors.[11,15-18]

Non functional loading means the restoration is at least 1mm out of occlusion.[7] To reduce the unwanted stress on the implant while initial stages of osseointegration, non-functional restoration was employed in our study.

According to Jones JR Hench's Bioglass, current modifications of it and its use in vivo studies have shown that bioactive glasses bond with bone more rapidly than other bioceramics, and in vitro studies indicate that their osteogenic properties are due to their dissolution products stimulating osteoprogenitor cells at the genetic level.[19]

The physiological count of platelets circulating in the bloodstream ranges from 150,000 to 400,000 platelets/µl. PRP is a biological product defined as a portion of the plasma fraction of autologous blood with a platelet concentration above the baseline.[20] According to Marx: bone and soft tissue healing enhancement has been shown using PRP with 1,000,000 platelets/µl, it is this concentration of platelets in a 5 ml volume of plasma that is the working definition of PRP today.[21]

PRP induces a local inflammation. The proinflammatory mediators together with the growth factors are released from the granules of the cellular structures (platelets, neutrophils, monocytes, and lymphocytes) in PRP as described. These growth factors include PDGF, VEGF, FGF, EGF, KGF, IGF-1, IGF-2, TGF-β, CTGF, EGF, and IL-8.these growth factors trigger the wound healing cascade, resulting in the cellular migration and proliferation, glycosaminoglycan and collagen deposition, collagen maturation and remodelling of the healing tissue at different stages of wound healing.[2,22] The neutrophils and monocytes contain granules filled with myeloperoxidase, a substance that contributes to the antimicrobial activity of platelet-rich gel at the site of application.[16] Studies reported that local application of PRP increased the amount of newly formed bone around the implant and increased bone density.[11,23] In animal experiments, the PRP, which was used to support the

osseointegration of endosseous dental implants, resulted in significantly increased bone regeneration.[7]

PRF was first developed in France by Choukroun et al for specific use in oral and maxillofacial surgery. Dohan et al proved a slower release of growth factors from PRF than PRP and observed better healing properties with PRF.[10] it was observed that the cells can migrate from the fibrin scaffold, while Urist demonstrated that PRF may act as a supportive matrix for bone morphogenetic protein as well, the same fact has been proved in our study through a good quality of bone which is formed in the vicinity of implant where PRF had proven to be a scaffold for concentrating growth factors to allow osteogenic activity.[24,25]

According to Simonpier et al, PRF showed favourable healing due to slow polymerization, more efficient cell migration, and proliferation. PRF has a supportive effect on the immune system. PRF helps in hemostasis.[11]

In the present study, we have done the immediate placement of the implant in the fresh extraction socket and followed by immediate loading with bioactive glass graft mixed with autologous platelet concentrates to accelerate osseous healing and found a 100% success rate after 6 months follow up.

PRF and PRP both have been studied mainly for bone augmentation and soft tissue healing at other sites. However, a comparison between the potential of PRP and PRF to optimize peri-implant soft and hard tissue healing has not been investigated specifically. Hence, this prospective comparative clinical study was conducted to compare the efficacy of PRP and PRF on peri-implant tissues in the cervical region. Based on the observations of the above-mentioned authors.

In the present study, we found on comparing post-operative pain as reported by patients in either group, on 1st day, 7th day, 1st month, 3rd month, and 6th month. On the first postoperative day, Group 2 reported higher pain values than Group 1. No pain was reported on the 7th postoperative day, 1 month, 3rd month, and 6th month in both the groups. This supports the better role of PRP in the reduction of pain postoperatively than PRF. Similar results were found by Kundu et al.[26]

Both PRP and PRF are equally effective in the reduction of postoperative inflammation. Our results are consistent with the study by Georgakopoulos et al When implant mobility in both the groups was compared at different time intervals postoperatively up to 6 months.[27] None of the implants were mobile in both the groups throughout our study period, representing no difference between Group 1 and Group 2 suggesting an equal effect of PRP and PRF on implant mobility.

We compared mean crestal bone height changes between 2 groups at different intervals of time postoperatively. Changes from immediate postop to 1st month suggested more bone formation in Group 2 than in Group 1 during the 1st month. From 1st month and 3rd month Crestal bone height gain seen in Group 2 was more than Group 1. Crestal bone height difference between 3 rd month and 6th month in both groups was statistically insignificant. The result of our study was consistent with ArRejaie et al.[28]

Limitations

The design of this follow-up study has several limitations, making it difficult to compare the results with different clinical situations as the study involves a small sample size. A longer follow-up period and better investigation methods are required to evaluate the marginal bone loss and peri-implant mucosa.

CONCLUSION

Within the limitations of our study, we can conclude that PRP had shown superior results to PRF when checked for pain on the first post-operative day. But after 7 days both showed good soft tissue healing. The crestal bone height change in the first 3 months of PRF has shown remarkable height gain. As well ease of making PRF presents new possibilities for enhanced healing and functional recovery over PRP. So, we conclude that the PRF can produce better results than PRP during immediate post extractive implantation and immediate loading.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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