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Effects of autologous platelet rich fibrin in bone regeneration in post-extraction mandibular sockets

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Abstract

Background and objectives: Preservation of bone after extraction is of prime importance. Good and sound bone present is useful for further prosthodontic rehabilitation or implant placement. Various bone grafts are available for restoring the continuity of bone which are either autogenous or allogenic. PRF being autogenous and drawn from individual's blood serves as a good substitute for bone reconstruction. The aim of this study is to assess the effects of PRF in extraction socket healing after tooth extraction.

Materials and methods: Thirty patients of age group between 15-55 years visiting the dept of oral and maxillofacial surgery needing single tooth simple extractions were included in the study. PRF was prepared with blood drawn from individuals using standard technique. PRF was placed in extraction sockets followed by pressure application and suturing was done. Radiographic assessment of socket was done using IOPA. Ridge width was assessed using cast. The clinical follow up assessments were performed at 1, 4 and 12 weeks.

Results: 18 males and 12 females were included in the study mean age of the patients was 35.43 years. The alveolar width for sockets were 11.33 ± 3.43 mm, 10.85 ± 3.23 mm and 10.45 ± 3.32 mm at 1, 4 and 12 weeks with loss in alveolar bone height being 0.4 ± 0.13 mm, 0.7 ± 0.17 mm and 0.8 ± 0.12 mm at 1, 4 and 12 weeks. The bone fill was measured by mean of gray level histogram values of IOPA of the extraction sockets obtained through Adobe Photoshop 7.0 software. It was $68.66 \pm 2.36\%$, $80.34 \pm 3.18\%$ and $93.23 \pm 2.07\%$ at 1, 4 and 12 weeks respectively.

Conclusion: Platelet-rich fibrin (PRF) placement after extraction procedure improves the bone width and bone height and quality of bone. The good amount of bone serves as an important precursor for future implant placement or prosthodontic rehabilitation of tooth.

Keywords: Platelet rich fibrin, post extraction socket, bone regeneration

Introduction

Choukroun *et al* first described platelet-rich fibrin gel in France. PRF is easy to prepare and is autogenous in nature^[1]. PRF is harvested from venous blood. It does not lead to immune rejection^[2, 3]. PRF is a platelet concentrate with leukocytes in dense fibrin matrix. PRF is rich in fibrin, platelets, white blood cells, growth factors, cytokines, and other components which help in tissue repair^[2, 4]. The cytokines include interleukin-1, -4 and -6, and other growth factors including platelet-derived growth factor, epithelial growth factor and vascular endothelial growth factor^[4], effective in regulating the proliferation, differentiation and apoptosis of repair-related cells, and subsequently regulating and promoting tissue repair. It is prepared from autogenous non-coagulated blood when centrifuged^[1].

Tooth extraction is a common dental procedure. Post extraction there is loss in dimensions both horizontal and vertical planes in the residual alveolar ridge. Replacement of lost teeth in future with implant is complicated by the loss of bone volume required for successful implant treatment. So, there is a need for post bone-grafting procedures. This grafting restores the proper volume, function and esthetic of the post extracted socket for implant placement⁵.

PRF having autogenous growth factors can hasten socket wound healing after tooth extraction and increased bone fill and reduced bone resorption. This study aims to study the effects of PRF on the bone density and bone height following tooth extraction in mandibular arch.

Materials and Methods

This study was done on thirty patients of age group between 15-55 years who reported to the Department of Oral and maxillofacial surgery requiring extraction of mandibular teeth.

Inclusion criteria - Patients requiring extraction of mandibular teeth. Patients between 15-55 years of age. General good health and patient should not be medically compromised. Areas where primary closure is possible.

Exclusion criteria – Tooth having acute infection at the time of extraction. Patients with any major systemic illness which alters the healing. Patients with a history of head and neck radiation therapy. Patients with pre-existing calcium metabolic disorder like hypercalcemia. Transalveolar extraction cases.

Materials used

Normal saline [0.9%], Perioguard mouthwash (Colgate Palmolive INDIA LTD), IOPA (Radiograph), Standard armamentarium for extraction of teeth, Sterile Surgical Gauze pieces (4x4cm), PRF, Suturing needle and 3-0 Black braided silk.

Postoperatively: Capsule AMOXICILLIN 500 mg [CIPMOX 500mg,Cipla] thrice daily for 5 days and Tab DICLOFENAC SODIUM [REACTIN 50mg, Cipla] 50 mg thrice daily for 3 days.

To record Bone density; IOPA, Computer/Laptop, Adobe photo shop 7 software for Gray Scale measurement.

To record Bone width and height; Endodontic file with rubber stopper (No 20 size), Alginate impression material. Upper and lower impression trays. Dental stone. Digital Vernier caliper (accuracy of 0.01 mm, mitutoyo, Tokyo, Japan) to measure bucco-lingual and mesio-distal widths.

Methodology

Patients were selected as per the inclusion criteria. 30 patients between age group ranging 15-55 years were included in the study subjects. Informed consent of subjects willing to participate in the study was obtained prior to the treatment. A detailed medical and drug history was obtained from each subject. Pre-operative evaluation was done using IOPA. Atraumatic extraction was done after standard draping and mouth rinse with perioguard mouth wash. All patients were treated using 2% lignocaine hydrochloride with adrenaline in 1:80000 concentrations. Once tooth was removed smoothening of bone margins, irrigation of socket with normal saline was done. Hemostasis was achieved. PRF was made by the following procedure-

5 ml of venous blood was drawn into the tube without anticoagulant and was immediately centrifuged at 3000 rpm for 10 min. After which it was separated into the following three layers: upper straw-colored acellular plasma, the middle layer containing the PRF, and the red-colored lower fraction containing red blood cells (RBCs). The upper straw-colored layer was removed and the PRF was collected 2 mm below to the lower dividing line. Post extraction instructions were given and patients were recalled for follow-up on 7th post-operative day and also after 4th and 12th week.

Clinical parameters

Evaluation of Bone density: IOPA was taken preoperatively, followed by 4th and 12th week post operatively. Bone density were measured by mean of gray level histogram values of IOPA of the extraction sockets obtained through Adobe Photoshop 7.0 software.

Evaluation of bone width: Socket width measurement- Pre-operatively, alginate impression of the corresponding arch was made and cast was poured. Soft tissue width assessment will be done with the help of endodontic files. Bone mapping was performed using markings of the soft tissue width assessment. The same procedure was repeated on the 4th and 12th week post operatively.

Evaluation of alveolar bone height resorption: it was done clinically preoperatively and post-operatively after and 12th week from the occlusal surface of the mandibular teeth to superior most point in mandibular ridge caliper and endodontic files and stopper and bone mapping.

Figures



Fig 1: Pre-operative

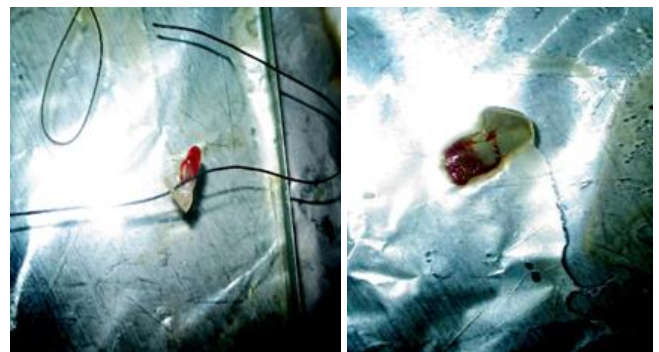


Fig 2: PRF being tied to thread and placed



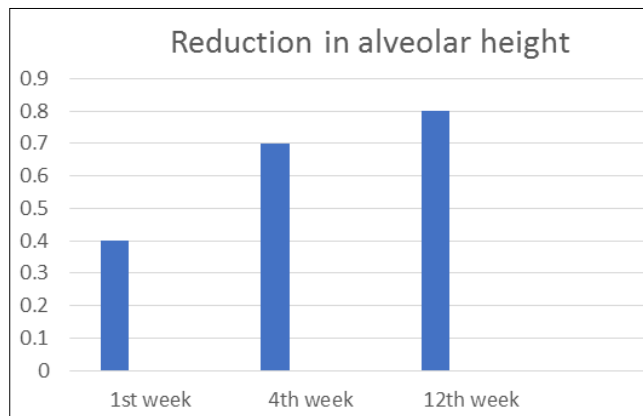
Fig 3: intra operative



Fig 4.4th: week post-operative

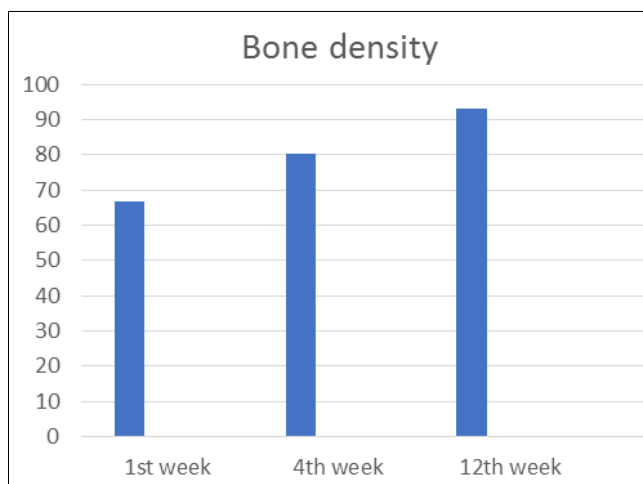


Fig 4-2th: week's post-operative



Graph 2: Reduction in alveolar height on 1st, 4th, 12th week follow up

Bone density: The bone fill was measured by mean of gray level histogram values of IOPA of the extraction sockets obtained through Adobe Photoshop 7.0 software. It was $68.66 \pm 2.36\%$, $80.34 \pm 3.18\%$ and $93.23 \pm 2.07\%$ at 1, 4 and 12 weeks respectively. Chi square test was done for comparing both sexes which was not statistically significant (p value > 0.05).

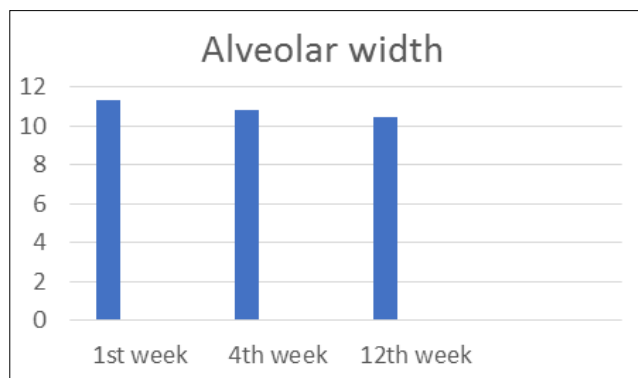


Graph 3: Increase in bone density on 1st, 4th, 12th week follow up.

Results

18 males and 12 females were included in the study mean age of the patients was 35.43 years.

Evaluation of bone width: The alveolar width was calculated with mean width of sockets and standard deviation at a particular time. The values were 11.33 ± 3.43 mm, 10.85 ± 3.23 mm and 10.45 ± 3.32 mm at 1, 4 and 12 weeks. Chi square test was done for comparing both sexes which was not statistically significant (p value > 0.05).



Graph 1: Reduction in alveolar width on 1st, 4th, 12th week follow up.

Loss in alveolar bone: The reduction in the alveolar bone height being 0.4 ± 0.13 mm, 0.7 ± 0.17 mm and 0.8 ± 0.12 mm at 1, 4 and 12 weeks. Chi square test was done for comparing both sexes which was not statistically significant (p value > 0.05).

Discussion

Extraction sockets mostly heals uneventfully. After extraction there is bone growth in the socket but there is resorption of the alveolar ridges also which is well-documented. The greatest amount of bone loss is in the horizontal dimension and occurs mainly on the facial aspect of the ridge. Loss of vertical ridge height has been described to be most pronounced on the buccal aspect⁶.

PRF is the second generation of platelet concentrate. It is prepared with a simple and inexpensive processing without biochemical blood handling⁷. A platelet-rich fibrin material, which does not use bovine thrombin as an activator, has been described as a platelet-rich fibrin matrix⁸. Study conducted by Carroll *et al.* demonstrated that the viable platelets in PRFM released six growth factors in about the same concentration for 7 days till the duration of study⁹. This study was conducted *in vitro*. PRF allows slow release of cytokines; TGF, PDGF, VEGF, and EGF which play a critical role on angiogenesis and tissue healing and cicatrization¹⁰. These components can be effective in regulating the proliferation, differentiation and apoptosis of repair-related cells, and subsequently regulating and promoting tissue repair¹¹. PRF has been reported to enhance angiogenesis, support immunity, and to enhance the coverage of injured tissues through its positive effect on epithelial cells and fibroblasts

[12]. Leukocytes found in PRF are able to release a large number of immune regulation-related cytokines in the process of fibrinolysis, and this process is persistent and progressive [13].

In our study we used PRF in the socket of extracted mandibular teeth. The use of PRF as socket preservation material enhances healing of soft tissue and reduce postoperative complications [14].

The hard tissue effects of using PRF were studied in our study. The alveolar bone height loss and the reduction of alveolar width with the radiographic bone fill was noted. Clinical studies have shown an average vertical bone resorption of 0.7 to 1.5 mm, as well as an average horizontal resorption of 4.0 to 4.5 mm after extraction in normal alveolar sockets [15]. In our study the average loss in alveolar bone height was 0.8 ± 0.12 mm after 12 weeks whereas the loss in alveolar ridge width was from 11.33 ± 3.43 mm to 10.45 ± 3.32 mm after 12 weeks. Loss of width of alveolus was quite less in our case. In the systematic review of Vander Weijden *et al.* the weighed means of the changes showed a clinical loss of horizontal dimension to be greater than the vertical dimension loss. The reduction in width of the alveolar ridges was 3.87 mm. The mean clinical mid-buccal height loss was 1.67 mm. The mean crestal height change as assessed on the radiographs was 1.53 mm. Socket fill in height as measured relative to the original socket floor was on an average 2.57 mm [16]. The clinical loss of alveolar height was less in our study. Study conducted by Li *et al* the height reduction of alveolar bone on labial and palatal sides was 1.9 and 1.1 mm, respectively [17]. The bone fill was $68.66 \pm 2.36\%$, $80.34 \pm 3.18\%$ and $93.23 \pm 2.07\%$ at 1, 4 and 12 weeks respectively in our study whereas study conducted by Varghese *et al* concluded that the average percentage bone fill of PRF category patients was 57.90 (SD \pm 26.789) and that of the non PRF patients was 46.74 (SD \pm 17.713) [18].

PRF reduces alveolar bone resorption as it stimulates the expression of phosphorylated extracellular signal-regulated protein kinase (p-ERK) and activates osteoprogenitor (OPG) production, which leads to new bone formation [19]. Authors have used PRF as a bone filling material after extraction and have reported good amount of bone formation [16, 18, 20]. This finding was in accordance with our study.

Conclusion

The study concluded that PRF accelerates socket wound healing by increased bone fill and reduced alveolar bone width and height resorption after tooth extraction. However in our study

the follow up period was 12 weeks further more studies are warranted with greater follow up to substantiate our results.

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