Potential for Osseous Regeneration of Platelet Rich Fibrin: A Comparative Study in Mandibular Third Molar Socket

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Abstract

Aims: To evaluate the efficacy of autologous platelet-rich fibrin in regeneration of bone and to assess clinical compatibility of the material in mandibular third molar extraction socket.

Materials and Methods: This study was conducted in 20 patients visiting the outpatient department of Oral & Maxillofacial Surgery, Subbaiah Institute of Dental Sciences. Patients requiring extraction of bilateral symmetrical mandibular third molars were taken for the study. Following extraction, platelet rich fibrin prepared from patients own blood was placed in one extraction socket. The patients were assessed for postoperatively pain, periodontal pocket depth and bone blending and trabecular formation. Radiological assessment of the extraction site was done for a period of 6 months to evaluate the change in bone density.

Results: All the local signs and symptoms of inflammation were mild to moderate and subsided in normal course of time. Pain was less in study site compared to control site. Soft tissue healing was better in study site. Evaluation for bone blending and trabecular bone formation showed earlier in study (prf) site compared to control(non prf) site in 10 patients. The evaluation of bone density by radiological assessment showed the grey level values calculated at 4 months at the prf site were comparatively higher than the average baseline value of bone density at extraction site in control site.

Conclusion: The study showed that autologous PRF is biocompatible and has significant improved soft tissue healing, bone regeneration and increase in bone density in extraction sockets. However a more elaborate study with a larger number of clinical cases is very much essential to be more conclusive regarding its efficacy.

Keywords: Platelet rich fibrin, Mandibular third molar extraction socket, Pain, Soft tissue healing, Bone trabeculae, Bone density

INTRODUCTION

The management of the osseous and soft tissues distal to the second molars as a result of the surgical removal of impacted third molars can be a challenge. Management is usually directed at periodontal maintenance of the area and at osseous defects created by the surgical removal of the third molar. Osseous defects distal to the second molar can also be a result of the eruption pattern of the third molar. The reasons for third molar removal are varied. Third molar loss (and disruption of the tooth socket) may result from pericoronitis, infection, root resorption of adjacent teeth, pain associated with tooth, cyst or tumor formation, or to facilitate orthodontic treatment. Bone loss after tooth extraction will take place with resorptive patterns of the alveolar bone directed palatally and lingually, as well as apically.¹

A number of augmentation procedures are performed today, including preservation and repair of wall defects of the alveolar ridge after tooth extraction. Partial and full ridge augmentation may be performed concurrently with the extraction procedures or delayed until a later time.² Bone grafting to augment skeletal healing has become one of the most common surgical techniques in recent years. However, the morbidity and limited

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availability associated with autografts, and the potential for disease transmission, immunogenic response, and variable quality associated with allograft, have led to a wide variety of alternative materials. The Platelet rich fibrin (PRF) is a second generation platelet concentrate. Platelet rich fibrin (PRF) was first developed in France by Choukroun et al. Platelet rich fibrin (PRF) is an autologous fibrin matrix used to enhance bone regeneration. Platelet rich fibrin (PRF) has very different effects from Platelet rich plasma (PRP), which would have massive, uncontrollable, and short term effect, because of high thrombin rates initiate fast polymerization, which makes intimate incorporation of cytokines in the fibrin matrix difficult. Platelet rich fibrin (PRF) offers several advantages including promoting wound healing, bone growth and maturation, graft stabilization. Wound healing, haemostasis, and improving the handling properties of graft materials. Platelet rich fibrin PRF can also be used as a membrane. Clinical trials suggest that the combination of bone grafts and growth factors contained in Platelet rich fibrin PRF may be suitable to enhance bone density.

### MATERIALS AND METHODS

The present study has been under taken on an out patient basis in the Department of Oral and Maxillofacial surgery in Subbiah Institute of Dental Sciences, Shimoga. Patient with bilateral identical impacted mandibular third molars were selected for the study.

The instruments used to compare bilateral flap designs are:

1. **Wiliams probe**: Used to measure pocket depth. Probing pocket depth (PPD) is a measurement of the distance between the gingival margin and the base of the Probable crevice.
2. **Visual analog scale of 0 to 10** was used to estimate pain by subjectively asking the patient to rate the nociceptive experience.
3. **Bone density** was assessed by comparing bone formation on both sides using panoramic radiographs (OPG) obtained in the immediate 1st postoperative day, 3rd postoperative and 6th postoperative month. The measurement of bone neoformation was performed subjectively, recording the score in a radiopaque increasing scale as per the following.
   - (i) Minimal radiopaque bone formation
   - (ii) Maximum radiopaque bone formation.
4. **Swellings** was assessed by measuring the distance between the:
   - (i) Tragus notch and a reproducible soft tissue pogonion along the skin surface.
   - (ii) Tragus notch to angle of mouth.
   - (iii) Tragus notch to ala of the nose.
   - (iv) Tragus notch to outer surface on lateral wall of eye.
   - (v) Angle of mandible to outer surface of lateral wall of eye.

The mean difference between the preoperative and postoperative measurements was calculated. A comparative non-randomized study was conducted, 20 patients who fulfilled the requirements were included in the study. Athorough clinical examination, orthopantamograph, routine hematological examinations were carried out prior to surgery. The nature of the study was explained to each patient and signed an informed consent.

### PREPARATION OF PRF

10 ml of venous blood was collected from the patients by vein puncture from the antecubital vien. Blood was collected into 10 ml test tubes without an anticoagulant and centrifuged immediately. Blood was centrifuged by using table top centrifuge machine. The blood sample collected from the patients was centrifuged at 2700 rpm for 12 min, The result was a product of the following layer:

- Topmost layer was consisting of a cellular Platelet poor plasma (PPP)
- Platelet rich fibrin clot was in the middle (PRF)
- Red blood cells was at the bottom (RBC).

Topmost layer consists of cellular platelet poor plasma was discarded by using a micropipette. Platelet rich fibrin from the middle fraction of centrifuged blood was separated by using dropper, 2 mm below the lower dividing line (Figure 1a-d).

### Transalveolar Extraction of Right and Left Mandibular Third Molars (Figure 2)

The procedure of transalveolar extraction of bilateral mandibular third molar was done under proper aseptic precautions. A single operator carried out all the procedures. The patient was made to lie supine on the dental chair. All the patients were advised chlorhexidine mouth wash for oral rinsing before the procedure. Standard scrubbing and painting procedures were done with Betadine. Standard draping procedures were followed. Intra orally both side inferior alveolar nerve blocks along with lingual and buccal nerve block was done with lignocaine 2% with adrenaline 1:200,000. A standard mandibular third molar incision was placed distal to second molar continued over the alveolar crest (if tooth is completely embedded)/along the buccal gingival sulcus of third molar, up to the distal of the first molar if needed for better exposure. A full thickness Mucoperiosteal envelop flap was raised and the crown of the third molar exposed. With the help of the micro motor
straight hand piece and using straight and round burs sufficient bone was removed forming a gutter on the mesial, buccal and distal aspect of the tooth. In some cases tooth was elevated with gentle elevation. In some cases tooth was sectioned and the halves retrieved. The socket was carefully examined for remnants of tissue and then follicular tissue if present was curette out from the socket. The socket was irrigated with saline. One part of PRF was placed in the bottom of the right socket then left socket kept empty on consecutive transalveolar extraction. The wound was closed with 3-0 mersilk. Routine post extraction instructions were advised. Antibiotics (Augmentin 625mg BD) and analgesic (Divon P) were also prescribed for 5 days. Sutures were retrieved on the 7th postoperative day.

Post operatively evaluation was done as following:

- First postoperative day: Pain, swelling and bone density (OPG).
- First postoperative week: Pain, swelling, wound dehiscence.
- At the end of third post operative month: Pocket and bone density (OPG).
- At the end of sixth post operative month: Pocket and bone density (OPG).

RESULTS

Results of Clinical Assessment

Assessment of swelling: All the patients had mild to moderate swelling on grafted side on first post-operative day. Swelling was maximum on 2nd and 3rd post-operative day and decreased gradually towards normal. By the end of first week post-operative, swelling was nil. In case of non-prf side, all patients had moderate to severe swelling on first post-operative day. Swelling was maximum from 2nd to 4th post-operative day and then started decreasing towards normal. By the end of first week post-operative, slight swelling was still present.

Assessment of pain: All the patients had mild to moderate pain on grafted side on first post-operative day. Pain was maximum on 2nd post-operative day and decreased gradually and almost nil by the end of 4th post-operative day. In case of non-prf side, all patients had moderate to severe pain on first post-operative day. Pain was maximum from 2nd to 4th post-operative day and then gradually decreased but slight pain was there at the end of first post-operative week.

Assessment of periodontal pocket: Prf side of all patients showed overlying mucosa has taken up well without any wound dehiscence or pocket formation distal to 2nd molar at 3 and 6 months post-operative except 2 patients who had periodontal pocket depth of 5 mm at 3rd month post op and was absent at 6th month post operative. In case of non-prf side, 4 patients had periodontal pocket depth of 5 mm and 2 patients had 7mm distal to 2nd molar at 3rd month postoperative. At 6th month postoperative results were same as that of grafted side.

Assessment of bone density: Bone density was assessed by comparing bone formation on both sites (prf and non-prf sides) using panoramic (OPG) radiographs at first post operativeday, 3rd and 6th month post-operative month. Mean difference of bone formation was highly significant in prf site at 3rd month post operative as compared to non-prf site. At 6th month post operative there was no significant difference between prf and non-prf site.

DISCUSSION

The mandibular third molars are the ones with the largest frequency of impaction necessating surgical removal. The risk of non-intervention may lead to lower anterior imbrications, development of pathological conditions like infections due to number of potential spaces around, and development of cysts and tumors. The management of osseous and soft tissue defect distal to second molars can be challenge and especially in older patients who are
more likely to heal slowly, with reduced bone volume. Tooth extraction socket healing is a complex process involving both tissue repair and regeneration. The cellular events responsible for healing are controlled and regulated by specific signaling molecules, growth factors and cytokines, TGF-β1 and PDGF-A are secreted by cells recruited to the healing extraction wound and are released in response to wounding stimuli detected at the cell surface. The platelet rich fibrin (PRF) was first described by Choukron et al in France. It has been referred to as a second generation platelet concentrate, which has been shown to have several advantages over traditionally prepared PRP. It eliminates the redundant process of adding anticoagulant as well as the need to neutralize it. The addition of bovine derived thrombin to promote conversion of fibrinogen to fibrin in PRF is also eliminated. The elimination of these steps considerably reduces biochemical handling of blood as well as risks associated with the use of bovine derived thrombin. The conversion of fibrinogen into fibrin takes place slowly with small quantities of physiologically available thrombin present in the blood sample itself. Thus, physiological architecture that is very favourable to the healing process is obtained due to this slows polymerization process.

The present study was undertaken to study the efficacy of PRF in regeneration of bone when grafted in right mandibular third molar socket with empty left contralateral third molar socket. Total of 20 patients were selected for the study and observation were entered in the data sheet, which included patient details, assessment of swelling and pain at 1st post operative day and 1st post operative week, periodontal pocket at 3rd and 6th month post operative and bone formation at 1st post operative day, 3rd and 6th month post operative. One of the limitations in the present study was use of plain conventional radiographs (OPG’s) which provided only limited information on callus formation and bone healing. OPG, through horizontal magnification may vary with head position but has been used for planning and evaluations in dentistry and has several advantages over other imaging technique. We have used OPG to evaluate the graft osseointegration in our study. With the use of OPG, it was easier to assess both right and left side graft materials simultaneously. OPG was economical and also reduced the patient exposure to radiation.

Today’s understanding of bone science recognizes the pivotal role of growth factors in clinical bone grafting success. PRF is autologous preparation introduced at the time of surgery which eliminates concerns about disease transmission and immunogenic reaction. It is an investigational biomaterial that demonstrates superior attributes of ease of application and osteointegration and osteo conductance. Our observations in the present study concluded that a faster and better consolidation of bone and a better osseointegration can be achieved with PRF. Growth factors in general and PRF in particular are part of a new biotechnology with already established efficacy and future potential. It is the responsibility of the clinician to gain a thorough understanding of this biotechnology and to use it correctly and wisely for the benefit of patients. Based on our observations and the other studies, with PRF, we hypothesized that PRF would lead to enhance revascularization and possibly faster consolidation of bone formation.

CONCLUSION

Our observations in the present study concluded that a faster and better consolidation of bone formation can be achieved with PRF. Growth factors in general and PRF in particular are part of a new biotechnology with already established efficacy and future potential. It is the responsibility of the clinician to gain a thorough understanding of this biotechnology and to use it correctly and wisely for the benefit of patients. Based on our observations and the other studies, with PRF, we hypothesized that PRF would lead to enhance revascularization and possibly faster consolidation of bone formation.

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