

Role of Platelet Rich Fibrin in Odontogenic Cystic Defects

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ABSTRACT

Background: Successful management of post enucleation cystic defects poses a significant challenge to maxillofacial surgeons. A variety of grafts have been used post-surgically for hard-tissue regeneration. In this current study, platelet-rich fibrin (PRF), a second-generation platelet aggregate, was assessed for its effectiveness in promoting hard tissue healing in various post-surgical osseous defects. This study is to evaluate the efficacy of Platelet-rich Fibrin in osseous regeneration of post-surgical osseous defects. This prospective study was conducted on 20 cases with cystic lesions who were treated accordingly, followed by the placement of PRF in the resultant bony defect, patients with Odontogenic keratocysts, dentigerous cyst, Radicular cysts. Follow-up panoramic radiographs were taken after 1st, 3rd, and 6th months postoperatively. Bone regeneration was assessed by grayscale histogram using Adobe Photoshop 7.0 software.

Keywords: Platelet-rich Fibrin, Platelet-Rich Plasma, Growth Factors, Wound Healing, Osseous regeneration.

INTRODUCTION

Wound healing is a complex biological process in which many cellular events take place simultaneously, leading to the repair or regeneration of damaged tissues. The platelets play a prominent role during early hemostasis and fibrin clot formation. They have also been shown to secrete a number of essential growth factors capable of stimulating the activation and proliferation of cells involved in the wound healing process. Enhancing the concentration of platelets in the wound area and thereby increasing the concentration of growth factors may facilitate more rapid healing and regeneration of denser bone.

Supra physiological doses of platelets (platelet-rich plasma) were initially developed to increase the concentration of platelets at defect sites. Later in 2001, a second-generation concentrate called platelet-rich Fibrin (PRF), which is an autologous platelet and fibrin matrix, was developed by

Choukron, providing three fundamental keys for tissue engineering, namely cells, i.e., Platelets and Leukocytes, growth factors, and a scaffold. As cytokine and growth factors are gradually released from PRF, it induces collagen synthesis and bone formation. PRF is synthesized without any biochemical treatment and releases growth factors for a more extended period than PRP.²

Platelet-rich Fibrin is considered an immune organizing node. Its defence capabilities against infections are pretty significant due to the chemotactic properties of these cytokines and their capacity to facilitate access to the injured site. It also contains inflammatory retro control cytokines, particularly Interleukin-4. This study aims to evaluate the efficacy of Platelet-Rich Fibrin in the osseous regeneration of post-surgical bony defects. The Objectives of this study include:

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(1) To assess the effectiveness of PRF by evaluating the changes in pain, swelling, and bone formation after the 1st, 3rd, and 6th months.

(2) To evaluate osseous regeneration radiographically after placing PRF in surgical bony defects.

Preparation of PRF:

PRF preparation was done in the time frame between the completion of the surgical procedure and suturing. During this time, patients' intravenous blood was collected in a 10-ml Vacutainer tube without adding any anticoagulant and immediately centrifuged in a centrifuge machine at 3000 rpm for 10 min to prepare fresh autologous PRF (Fig.1). PRF clot, thus formed (Fig.2), was meticulously separated from platelet-poor plasma and Red blood cells and was transferred to the surgical site in aseptic conditions.

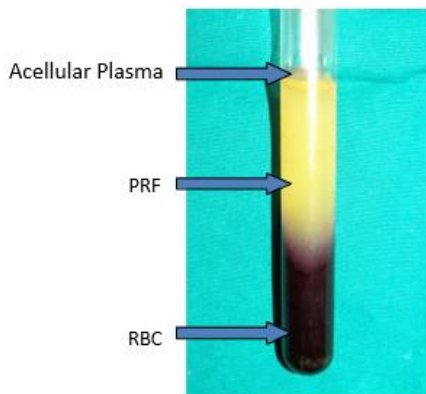


Fig 1: PRF



Fig 2: PRF Clot

The surgical procedure in all the patients was performed by the same surgeon in all the patients in aseptic conditions under local or general anaesthesia. Freshly prepared PRF is placed in the bone defect and secured with sutures.

Here we presented a case of odontogenic keratocyst,

A 23 years old male patient came to the department of oral and maxillofacial surgery with a chief complaint of pain and swelling in the lower jaw region on both sides for six years. Which was Slow growing, painful swelling and on Clinical examination Non-vital teeth in relation to 34,35,43,44,45 and Buccal cortical expansion irt 43,44 (fig 3).



Fig 3: Pre-operative pictures.

Radiographic findings: Well defined unilocular radiolucency involving the apices of 34,35,43,44 and 45 (fig 4).

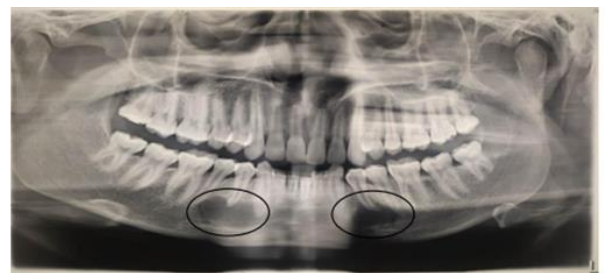


Fig 4: Pre-operative opg.

Diagnosed as Odontogenic Keratocyst with Incisional Biopsy proven

Treatment done: Root canal Treatment irt 34,35,43,43,45 and Apicoectomy Complete enucleation of the Cystic lesion followed by placement of PRF on the right side surgical Procedure was carried out under Local anaesthesia, the surgical site was isolated in an aseptic environment, enucleation was done meticulously leaving no remnants followed by chemical

cauterization using Carnoy's solution. Then freshly prepared PRF clot was placed in the intrabony defect on one side, i.e., the right side resulted from the surgical procedure. Finally, suturing was done with 3-0 vicryl, and postoperative instructions were given (fig 6) Post-surgical Biopsy revealed as Para-keratinized Odontogenic Keratocyst.



Fig 6: Intraoperative pictures.



Fig 7: Postoperative pictures.

This postoperative orthopantomography is shown below first-month fig 8, third-month fig 9, sixth-month fig 10.



Fig 8: 1st month postoperative.

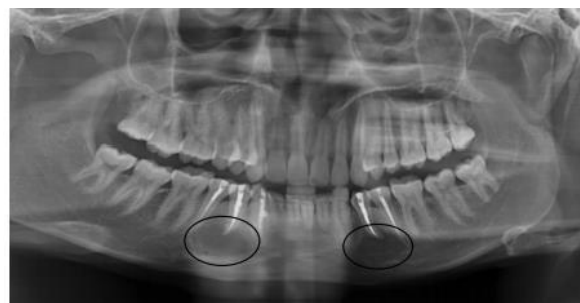


Fig 9: 3rd month postoperative



Fig 10: 6th month postoperative.

Postoperative assessment

Postoperative soft tissue parameters were evaluated at intervals of post-surgical 1st day, 3rd day, 7th day and 15th day. Hard tissue parameters were assessed at the intervals of postoperative 1st month, 3rd month, and 6th month. These include

Bone Density

They were assessed with the help of a grayscale histogram study of OPG images of bony defects obtained through Adobe Photoshop Elements 2020. (By Adobe systems incorporated in the United States. Copyright 2020). (Fig.11)

RESULTS

A total of 20 patients were selected, among which diagnosed with Odontogenic cyst, mainly odontogenic keratocyst and dentigerous cyst. All the cases were associated with a post-surgical bony defect, which was of small to medium size. All patients measured severe pain on day one on the visual analogue scale, but there was a significant fall in the pain score after the third postoperative day. The swelling, which was more on the 1st post-PRF placement day, also significantly decreased by the 5th day.

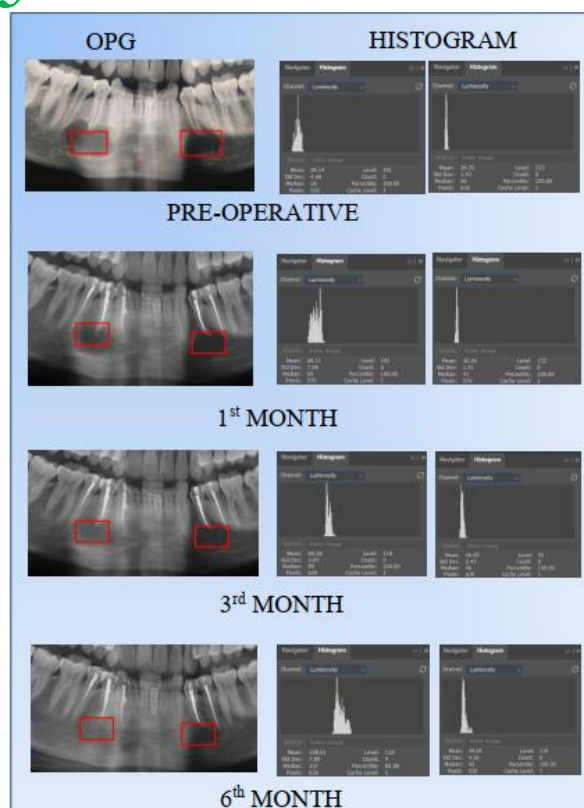


Fig 11: Grey scale reading by software.

There were no signs of post-surgical infection or graft rejection, untoward reaction, or extrusion of PRF clot in any of the patients, and an uneventful soft tissue healing was achieved. There was no evidence of localized osteitis. No wound dehiscence was evident.

Radiographic evaluation revealed rapid bone regeneration with denser trabeculae in PRF placed sites without the requirement of bone graft, which was proved with the help of grayscale histogram study of OPG images of bony defects, which were obtained through Adobe Photoshop Elements 2020 at postoperative 1st month, 3rd month and 6th month.

Pain decreased gradually from day 1 to day three and day 7. There is no pain after day 15. The rapid improvement in bone regeneration within three months is statistically significant in all the patients.

DISCUSSION

Four critical factors that influence bone regeneration are primary wound closure, space maintenance, angiogenesis, and wound stability. Several allografts, xenografts, or alloplastic graft

materials are being commonly used for bone regeneration procedures for years. They include Demineralised freeze-dried bone grafts, bioactive glass, hydroxyapatite crystals. These biologically active materials are said to possess excellent osteoconductive and osteoinductive properties. Still, the risk of disease transmission and unpredictable outcome led to the search for new materials that can independently produce predictable bone regeneration or improve these graft materials' properties.^{4,5}

The use of Platelet concentrates become increasingly popular during the last 20 years. The initial development of platelet concentrate technology offered simplified and optimized production protocols for a new type of fibrin-adhesive platelet-rich plasma (PRP). However, bovine additives' complicated preparation procedure and requirement as anticoagulant led to further research to find another biocompatible material.⁶ Later, in 2001, a second-generation

platelet concentrate named platelet-rich Fibrin (PRF) was introduced in France by Dr Choukroun⁷. It acts as fibrin membranes enriched with platelets and growth factors. Platelet-rich Fibrin induces cell migration, proliferation, and cicatrization. It is thought to help with wound healing, expedite the process of angiogenesis and epithelialization, regulate the mechanism of inflammation and release growth factors (Platelet-derived growth factor (PDGF), transforming growth factor (TGF), vascular endothelial growth factor (VEGF), and insulin-like growth factor (ILGF) (13) as well as cytokines (e.g., (interleukin (IL)_IL-1 β , IL-6, IL4, and tumour necrosis factor- α)).⁸

A normal platelet count in a healthy male ranges from 150,000 to 450,000 platelets per microliter of blood, which will be available in the target area to provide essential growth factors for wound healing. By the PRF placement, we are enhancing the quality and number of functional platelets up to fivefold, which undoubtedly hastens the overall soft and hard tissue healing. PRF in gel form can be used in conjunction with bone grafts, promoting wound healing, bone growth and maturation, graft stabilization, and wound healing and hemostasis. PRF can be potentially used as a membrane to protect the graft materials. Recent clinical trials suggested that the combination of bone grafts and

growth factors in the PRF may enhance bone density.⁴

The chief advantages of PRF over PRP include no biochemical handling of blood (strictly autologous), simplified and cost-effective process, no requirement of use of bovine thrombin and anticoagulants, favourable healing due to the slow polymerization process, more efficient cell migration and proliferation, supportive effect on the immune system, faster release of growth factors and also helps in hemostasis. Hence, in the present study, PRF was preferred over PRP.⁹

The ability of PRGF in accelerating soft and hard tissue healing has stimulated the research of its clinical applications in various areas of oral and maxillofacial surgery, which includes healing of extraction sockets including impacted tooth, Dry Socket management, Periodontal regenerative procedures, Implantology, cleft lip and palate, bisphosphonate-related osteonecrosis of the jaw, facial cosmetic procedures, nerve regeneration, Hair transplantation procedures and various soft tissue closure procedures. In maxillofacial surgery also has its implications in periodontology, orthopaedics, dermatology, plastic surgery, burn wounds, diabetic foot, and wherever regeneration is required.

Our study results indicated that there was early osseous regeneration in the areas where the Platelet-rich Fibrin clot is placed. This can be attributed to the better biological properties of Platelet-rich Fibrin. Though the results of the present study are preliminary, it shows promising, progressive, predictable, and significant radiographic osseous regeneration in almost all the cases. Osseous regeneration was observed on the third postoperative month, and within the sixth postoperative month, complete bone regeneration was seen, and good bone density was recorded. The grayscale histogram revealed a rapid increase in mean bone density in the surgical bony defect. The use of Platelet-rich Fibrin in intraoral bony defects after cystic enucleation promotes faster regeneration because of the gradual release of growth factors lodged in the fibrin matrix. The pain was evaluated in the postoperative period by using a VAS of 10 mm after the surgery, and patients were instructed to note their postoperative discomfort and pain on that scale, which was designed as 0,

indicating no pain, whereas 10 showing the worst pain ever experienced.

In the current study, there was a significant reduction in pain values after the placement of Platelet rich Fibrin. The probable cause for the pain reduction PRF could be attributed to reduced inflammation because of the Platelet concentrates. The exact mechanism would require further biochemical studies. Similar study done by J.V.Dos S.Canellas et al.¹⁰ reported that the use of PRF in mandibular third molar surgery is an alternative method to decrease postoperative pain and swelling, and the application of PRF in the extraction socket may reduce the risk of alveolar osteitis developing after mandibular third molar surgery. Manzoor Dar et al.¹¹ evaluated the efficacy of PRF in Osseous regeneration and concluded that the use of PRF in intraoral surgical bony defects after the enucleation of cystic lesions promotes faster regeneration within six months postoperatively because of the gradual release of growth factors present in the fibrin matrix. They also concluded that PRF decreases the frequency of intraoperative and postoperative bleeding, promotes rapid vascularization, and facilitates rapid soft tissue healing and faster bone regeneration. Dr. Arkadas et al.¹², Vijaya Dhote et al.¹³, Sindhura et al.¹⁴ reported few cases of periapical cysts which they have successfully managed by enucleation followed by the placement of Platelet-rich Fibrin as a grafting material for bone regeneration and concluded that the Platelet-rich Fibrin had induced the rapid rate of bone regeneration clinically and radiographically in the treatment of large periapical lesions. We also achieved similar results in our study with complete regeneration by the third month, showing the effectiveness in osseous regeneration.

V Sadesh Kannan et al.¹⁵ studied the osteoblastic activity of Platelet-rich Fibrin by placing PRF mixed with bone graft in the post enucleation defect of Keratocystic odontogenic tumor following chemical cauterization and concluded that rapid healing is promoted, secondary infection is decreased by obliterating the dead space using platelet concentrate mixed with bone graft and the inferior dentoalveolar bundle can be preserved which shortens the operating time and reduces the donor site morbidity. It was also tried successfully in the management of Solitary bone cyst by Magremanne

et al.¹⁶ and large mandibular cysts with the combination of nano bone by R.M.Elbiany et al.¹⁷ and proved PRF as a potent inducer of rapid bone formation. Furthermore, V Y Shivashankar et al.¹⁸ in 2013 used PRF in conjunction with conventional HA crystals for the augmentation of a bone defect following the enucleation of a periapical lesion in the maxilla. They stated that the PRF/HA might have accelerated the graft crystals' resorption and would have induced the rapid rate of local bone formation.

In our study, 20 cases of various bone defects were treated using Platelet-rich Fibrin to evaluate the efficacy of PRF in osseous regeneration. Though the current study results are preliminary, PRF showed promising, progressive, predictable, and significant radiographic osseous regeneration in almost all the cases. Satisfactory osseous regeneration was observed on the 3rd postoperative month, and within the 6th postoperative month, complete osseous regeneration and good bone density were evident. The grayscale histogram study revealed a rapid increase in bone density in the bony defect. The use of PRF in intraoral bony defects after cystic enucleation promotes faster regeneration because of the gradual release of growth factors lodged in the fibrin matrix.

CONCLUSION

The improvement of soft tissue wound healing decreased postoperative pain, and rapid bone regeneration in this study signifies and highlights the use of Platelet-rich fibrin as a promising method in promoting and accelerating hard and soft tissue regeneration. PRF preparation is simple, cost-effective, and demonstrated excellent postoperative results. We suggest conduction of furthermore multicentre studies with larger sample size and histological examination of the surgical site for better assessment of the role of PRF in osseous regeneration.

CONFLICTS OF INTEREST

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

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