Original Article

Use of autologous platelet-rich fibrin in osseous regeneration after cystic enucleation: A clinical study

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ABSTRACT

Aims and objectives: The aim of this study was to evaluate the efficacy of PRF in osseous regeneration after enucleation of cystic lesions. The objectives of this study were as follows: (1) to evaluate osseous regeneration radiographically with the use of PRF in intrabony defects after cystic enucleation. (2) To evaluate the degree of bone density in intrabony defects with the use of PRF postoperatively after 1st, 3rd, and 6th months.

Subjects and methods: 20 cases of cystic lesions were treated using PRF after cystic enucleation. Follow-up radiographs (orthopantomogram) were taken 1st, 3rd, and 6th months postoperatively. Bone density was measured with grayscale histogram using Adobe Photoshop 7.0 software.

Results: The subsequent follow-up examinations revealed progressive, predictable, and significant radiographic osseous regeneration.

Conclusion: The use of PRF in management of cystic lesions seems to be a novel therapeutic approach promoting faster osseous regeneration within 6 months postoperatively; however, further study is required with larger sample size and with a control group.

1. Introduction

Maxillofacial reconstructions, oral implants, esthetic facial procedures, regenerative procedures, etc. are highly dependent on successful regeneration of tissues. Healing of both hard and soft tissues has become one of the greatest challenges faced in clinical research in the development of bioactive surgical additives responsible for regulating inflammation and increasing healing. Bone regenerative techniques, including graft materials, protein, and barrier membrane, are often used to increase the bone quality. Healing in tissue is mediated by a variety of signaling proteins. Understanding of this process at microcellular level is still not complete, but it is a proven fact that platelets do play an important role in wound healing.¹ Bone grafts and bone regenerative materials are commonly used today for treating intrabony defects in periapical surgery with varying degrees of success. Autograft is associated with high degree of donor site morbidity and allograft is associated with risk of disease transmission, which pushed the clinicians toward opting for more promising autologous material,

such as platelet-rich plasma (PRP) and platelet-rich fibrin (PRF), for more predictive results.² Platelet-rich fibrin (PRF) represents a new step in the platelet gel therapeutic concept with simplified processing minus artificial biochemical modification. Platelet-rich fibrin (PRF) was first introduced by Choukroun et al.³ in 2001. Platelet-rich fibrin is an immune and platelet concentrate collected on a single fibrin membrane containing all the constituents of blood favorable for healing and immunity. The fibrin matrix supports them and is responsible for angiogenesis and immunity control. The growth factors present in it are biologically active substances that are involved in tissue repair mechanisms, such as chemotaxis, cell proliferation, angiogenesis, extracellular matrix deposition, and remodeling.⁴ PRF releases (through degranulation) at least seven different growth factors, as well as cytokines, that stimulate bone and soft tissue healing. Thus, PRF is an easy and cost-effective way to obtain high concentrations of growth factors for soft and hard tissue regeneration in wound healing.

2. Materials and methods

This study was conducted in the Department of Oral and Maxillofacial Surgery, Govt. Dental College and Hospital, Srinagar. 20 patients (13 male and 7 female) were diagnosed with cystic

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lesions based on clinical and radiographic findings with age groups ranging from 20 years to 55 years. Exclusion criteria involved medically compromised patients, known mentally challenged patients, patients unable to communicate, pregnant and lactating women, patients with insufficient platelet count for PRF preparation, and those having history of coagulation defect or under anticoagulant treatment. Informed consent was taken from all the patients. According to standard surgical protocol, all cystic lesions were enucleated and PRF was placed in the bony defects. 10 ml of blood is drawn into test tubes without an anticoagulant and centrifuged immediately. Blood is centrifuged using a tabletop centrifuge for 12 min at 3000 rpm. The resultant product consists of the following three layers:

- Top most layer consisting of acellular plasma
- PRF clot in the middle
- Red blood cells at the bottom

Because of the absence of an anticoagulant, the blood begins to coagulate as soon as it comes in contact with the glass surface. Therefore, for successful preparation of PRF, speedy blood collection and immediate centrifugation, before the clotting cascade is initiated, are absolutely essential. Periapical radiographs and orthopantomograms (OPG) were taken preoperatively and on 1st, 3rd, and 6th months postoperatively to access radiographic bone density at the site of PRF placement. Bone density was measured with the help of grayscale histogram study of OPG images of bony defects obtained through Adobe Photoshop 7.0 software (By Adobe systems incorporated in United States. Copyright 1990–2002).

Fig. 1. Average bone density after PRF.

2.1. Overall density score

- +2 = Severe increase in radiographic density
- +1 = Mild to moderate increase in radiographic density
- 0 = Within normal limits
- 1 = Mild to moderate decrease in radiographic density
- 2 = Severe decrease in radiographic density

2.2. Trabecular pattern scores

- +2 = All trabeculae substantially coarser
- +1 = Some coarser trabeculae; milder degrees
- 0 = Within normal limits

Cystic defect

PRF placement

Closure

Pre operative OPG

Post operative 6th month

Fig. 2. Preparation of PRF.

- 1 = Delicate finely meshed trabeculations
- 2 = Granular, nearly homogenous patterns; individual trabeculations essentially absent

3. Results

There were no signs of infection or rejection, untoward reaction, wound dehiscence, or extrusion of material in any of the patients, and an uneventful soft tissue healing was achieved. Patients were followed up on 1st, 3rd and 6th months postoperatively. Follow-up radiographic examination by grayscale histogram study revealed progressive, predictable, and significant radiographic osseous regeneration and an increase in bone density. Radiographically, all patients showed that PRF promotes faster osseous regeneration within the 3rd postoperative month, and within 6th postoperative month, complete bone regeneration was seen [Figs. 1–3]. This indicates that PRF may be considered as a novel surgical additive, which can be used to accelerate osseous regeneration in intrabony defects.

4. Discussion

One of the latest achievements in dentistry is the use of platelet-rich fibrin (PRF) for the improvement of reparation and regeneration of the soft and hard tissues after different surgical procedures.

Platelet-rich fibrin is concentrated platelets in a small volume of plasma. During platelet degranulation, many biologic active substances are released, which participate in the primary hemostasis and help the following reparation and regeneration of the soft and hard tissues.⁵ Choukroun et al. (2001) developed a method of collection of platelets. The protocol aimed at collection of platelet and release of cytokines in a fibrin clot. Here, the fibrin matrix is the key for this product, as it supports cell during the initial healing phase.⁶ The proteins derived from platelets include platelet-derived growth factor (PDGF), transforming growth factor (TGF- β), vascular endothelial growth factor (VEGF), and epidermal growth factor (EGF). Plasma contains certain natural growth factors in the name of insulin-like growth factor (IGF) and hepatocyte growth factor (HGF).⁷ 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, implantology, cleft lip and palate, ulcer management, and bisphosphonate-related osteonecrosis of the jaw. The two most important of these growth factors are platelet-derived growth factor or PDGF and transforming growth factor- β or TGF- β . Numerous studies, including some dental research have shown that PDGF, TGF- β , and IGF-I are found in PRF, and because of their impact on wound healing, the use of these factors has led to promising results.⁸ Whitman et al.⁹ used platelet gel in the area of reconstructive oral and maxillofacial surgery in conjunction with

Collection of blood

Centrifuge machine

Layers of centrifuged blood

PRF membrane

Fig. 3. Use of PRF in cystic defects.

ablative surgery of the maxillofacial region, mandibular reconstruction, and surgical repair of alveolar clefts and associated oroantral and oronasal fistulas, adjective procedures related to the placement of osteointegrated implants. The study has shown better results of clinical trials and showed encouraging results. Dohan et al.¹⁰ proved a slower release of growth factors from PRF than PRP and observed better healing properties with PRF. They all concluded that PRF offers many advantages as follows: it decreases the frequency of intraoperative and postoperative bleeding at the donor and the recipient sites, facilitates more rapid soft tissue healing, aids in the initial stability of the grafted tissue at the recipient sites, may promote rapid vascularization of the healing tissue by delivering growth factors, and in combination with bone replacement materials, induces regeneration.¹¹ PRF is efficacious clinically and radiologically in treatment of intrabony defects after enucleation of various periapical lesions, where complete bone regeneration is seen within 6th months postoperatively.⁴ In our study, 20 cases of cystic lesions were treated using PRF after cystic enucleation to evaluate the efficacy of PRF in osseous regeneration of defects left after enucleation, which showed promising, progressive, predictable, and significant radiographic osseous regeneration in all the cases, as was reported by Vikas et al.¹² Satisfactory osseous regeneration was observed on 3rd postoperative month, and within 6th postoperative month, complete bone regeneration was seen and good bone density was noticed. The use of PRF in intraoral bony defects after cystic enucleation promotes faster regeneration because of gradual release of growth factors lodged in the fibrin matrix.

5. Conclusion

Uneventful and enhanced wound and bone healing is desirable and critical in ascertaining quality of life after surgery. This will continue to attract the attention and priority of many clinicians and researchers. This study examined the effect of PRF on healing and bone regeneration potential after cyst enucleation. The results

of the present study suggest that application of autologous PRF gel has a beneficial effect on bone regeneration after cyst enucleation. However, long-term comparative studies with control group and adequate sample sizes comparing PRF with other regenerative treatment modalities are essential for better perspectives on this promising biomaterial.

Conflicts of interest

The authors have none to declare.

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