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SURGICAL MANAGEMENT OF PERIAPICAL LESION USING APICECTOMY & PLATELET RICH FIBRIN: A CASE SERIES

Maxillofacial Surgery

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ABSTRACT

Aim: The purpose of this prospective clinic- radiographic observational study is to illustrate the effectiveness of Growth-Factor-Impregnated PRF (gf-PRF) in enucleated bony cystic cavities. To provide the breadth of view on preparations of PRF. **Materials and Methods:** This study was performed after obtaining written informed consent from the patients participated in the study. Baseline clinical and radiographic examination was recorded of all the enrolled patients. **Inclusion Criteria:** Patients in the age group of 18–40 years undergoing gf-PRF treatment in periapical lesions for various indications such as necrotic pulp due to trauma or dental caries associated with or without periapical lesion and with or without associated intraoral sinus tract. **Exclusion Criteria:** Patients with significant medical comorbidity of bleeding disorders and those patients who were lost to follow-up. **Results:** Using gf-PRF in post-surgically enucleated cystic cavity have acted as adjuvant in treatment of bony defect formed following cystic enucleation. **Conclusion:** Based on the literature and the clinical cases presented, it can be concluded that endodontic therapy in combination with periapical surgery has a very good prognosis with the appropriate use of bone formation promoting materials such as PRF, which can be one of the ideal bio graft materials for filling bony defects while performing periapical surgeries.

KEYWORDS

INTRODUCTION

Radicular cysts are the most common inflammatory odontogenic cysts localized in the jaws. They remain asymptomatic and the patient usually becomes aware of the cyst when a swelling becomes clinically obvious. Conventional orthograde root canal treatment is the regular approach for the management of the cyst. [1] Although endodontic care typically is successful, in approximately 10% to 15% of cases, symptoms can persist or spontaneously reoccur. [2] However, the treatment of radicular cysts can be performed non surgically or by surgical methods such as marsupialization and enucleation, depending on the size and location of the cyst, bone integrity of the cystic wall, and proximity to vital structures. The periapical surgery would result in formation of wide surgical defect following enucleation; hence the bony defect needs to be addressed following surgery. [3,4]

Recent scientific evidence suggests that platelets could play a new role in tissue repair and in vascular remodelling, other than being active factors in inflammatory and immune responses. Platelets release biologically active proteins and other substances, able to influence a series of processes, favouring cell intake, growth and morphogenesis. However, literature pertaining to the technical aspect of centrifugation speed (revolution per minute, RPM), timing of centrifugation, PRF tube (glass, glass-coated plastic or plastic tubes), and relative centrifugal force (RCF, G-force), is still contentious.

Platelet-rich Fibrin (PRF)

Platelet-rich fibrin (PRF) is a tissue engineering product developed in France by Dr. Choukroun et al in 2001[5] As the PRF preparation technique does not involve any additives (anticoagulants, thrombin, or calcium chloride), the cascade of wound healing is preserved and further eliminates the risks involved in the utilization of bovine thrombin. In addition, the production and standardization of PRF are more reliable and economical when compared with PRP production. Since its inception as second-generation platelet concentrate continuous evolution and modifications in centrifugation protocols have been suggested. Refinement of PRF preparation techniques aims to preserve as much of the white blood cells and platelets and exclude as much of the red blood cells as possible.

PRF is prepared with small and light table centrifuge in which there are risk of vibrations and resonance during centrifugation, which can be perceived easily by hearing and via tactile sensation with hand during centrifugation. Quantum and quality of PRF obtained definitely depends on the technical components of the centrifugation including centrifugal machine, centrifugation protocol as well as the material tube in which it is prepared.

Table 1: Preparations of PRFs and its Protocols.

S. No	Types of PRF	RPM	Time minutes	Force (g)	Temp	Contents
1.	Standard PRF (S-PRF)	2700	12	200 – 700	21 – 24◦C	TGF-1, PDGF-BB, and IGF-1
2.	Advanced PRF (A-PRF)	1500	14	N/A	21 – 24◦C	bFGF, PDGF-BB, TGF-1, IGF-1, and VEGF, EGF CD61+ Platelets cells in clot and CD15+ Platelets cells in gel.
3.	Advanced PRF Plus (A-PRF+)	1300	8	N/A	21 – 24◦C	bFGF, IGF-1, and VEGF, EGF in higher concentration and collagen1 mRNA on 3rd and 7th day PDGF-BB, TGF-1 on 7th and 10th day.
4.	Leucocyte rich PRF (L-PRF)	2700	>12	N/A	21 – 24◦C	TGF-1, VEGF, and MPO for first 7 days CXCL4, IGF-1, PDGF-AB, and VEGF for 28 days
5.	Injectable PRF (i-PRF)	700	3	700	21 – 24◦C	PDGF, VEGF, TGF-, IGF, FGF, and EGF for 15 days mRNA expression of PDGF after 72 hours TGF- after a week. Collagen 1 expression within a week
6.	Titanium PRF (T-PRF)	2800	12	N/A	21 – 24◦C	TGF-1, CXCL4, IGF-1, PDGF-AB, and VEGF for prolonged duration
7.	Growth factor impregnated PRF (gf-prf)	2400 to 3300	Varied time	N/A	21 – 24◦C	PDGF, VEGF, TGF-, IGF, FGF, and EGF
8.	Albumin PRF (Alb-PRF)	Variable rotations	8	700	75◦ C	PDGF, VEGF, and FGF 2

9.	Horizontal PRF (H-PRF)	Variable rotations	Varied time period	N/A	Variable	TGF-1, VEGF, IGF-1, PDGF

MATERIALS AND METHODS

Patients were selected from OPD, who reported with a complaint of swelling and discolouration of tooth. Pre-operative evaluation of patients was done using peri-apical radiographs, panoramic and CBCT evaluation. Due to the persistency and the extent of lesion, it was recommended that periapical surgery of the endodontically treated tooth would be the treatment of choice. The procedure was explained to the patient and written consent was obtained for the same.

Procedure

Under all aseptic conditions surgical enucleation of cystic cavity is done. Root end resection is carried out for the tooth involved, depending upon the extent of the periapical pathology and the defect was copiously irrigated with betadine and saline. Then 8-10 ml of patient's venous blood is collected and transferred to plain glass tubes without anticoagulants. The tubes were subjected to centrifugation at 3000 rpm for 12 minutes with a centrifugation machine (REMI C 852). The obtained platelet rich fibrin (gf-PRF) is removed from the tube using sterile collet and placed into the bony defect immediately. The flap then repositioned and sutured back using 3-0 black braided silk. Analgesics, antibiotics and 0.2% chlorhexidine mouthwash were prescribed to the patient for a week. Sutures were removed one week later when the surgical site has healed satisfactorily. The diagnosis of all the specimens is confirmed by histopathologic examination as radicular cysts. The healing of the surgical site is evaluated with the help of radiographs in consecutive follow up of 3 months.

Case No	Gender	Age	Involved Tooth	Clinical Features At Time Of Presentation	TOP +ve	Radiological Features At Time Of Presentation	Treatment Done
						Peri-apical radiolucency	Rootend resection with gf-PRF
1.	F	31	21,22	Discolored teeth, Labial swelling.	✓	✓	✓
2.	F	23	21,22	Discolored teeth, intraoral sinus tract, and Labial swelling.	✓	✓	✓
3.	F	30	21,22	Discolored teeth, intraoral sinus tract, and Palatal swelling.	✓	✓	✓
4.	M	27	21,22,23	Discolored teeth, intraoral sinus tract, and Palatal swelling.	✓	✓	✓

Note: All the patients were treated with same surgical procedures

RESULTS

The radiographic evaluation shown the adequate amount of bone formation post-surgical enucleation followed by gF-PRF placement. Radio opacity is seen, suggestive of bone formation at the bony defect and no widening of PDL noted.

Using gf-PRF in post-surgically enucleated cystic cavity have acted as adjuvant in treatment of bony defect formed following cystic enucleation.

Figure 1: Case 1 Surgical Procedure, Intraoperative Pictures And Radiographs

DISCUSSION

Endodontic microsurgery is a resource used in cases of refractory peri radicular pathology that does not heal after non-surgical retreatment and is based on the use of equipment, instruments and materials that combine biological concepts with a practiced clinical outcome due to the production of predictable results in healing lesions of endodontic origin. Therefore, different biomechanical responses can be observed when microsurgery is performed to remove the lesion associated with apical resection of a tooth with periodontal support. Jansson L et al found that endodontic surgery had a survival rate of 68 % in molars and 77 % in single-rooted teeth over a 10-year period. [6]

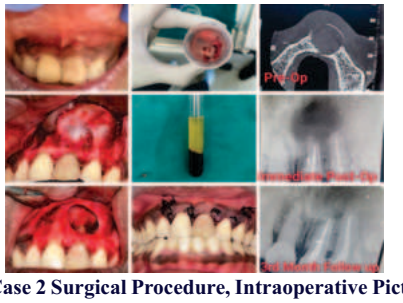

Figure 2: Case 2 Surgical Procedure, Intraoperative Pictures And Radiographs

Figure 3: Case 3 Surgical Procedure, Intraoperative Pictures And Radiographs

Figure 4: Case 4 Surgical Procedure, Intraoperative Pictures And Radiographs

The PRF are easy manipulation, cost effectiveness, no bio chemical handling of patient's blood samples, supportive to the immune system, and relatively better wound healing potential due to lower degree of polymerization. The PRF reduces patient's discomfort during early period of wound healing and can be used alone or in combination with various bone grafts. [7] The fibrin matrix in the PRF is better organized and thus it is more efficient in direct stem cell migration, bone healing, hemostasis, wound healing, and graft stabilization.

Centrifugal machine (class II medical device, requiring general and special control) is used to separate substances (like blood cells from serum and plasma) of different densities in a liquid by rotating at a certain speed measured as revolutions per minute (RPM) by the generation of centrifugal force, termed as Relative Centrifugal Force (RCF or G-force). Although the common way of expressing centrifugation is rotor speed that is stated in terms of RPM, however it does not take into account the radius (i.e. distance of the tubes to the axis of rotation) of the centrifuge. Rotor radius plays an important role in the generation of G-Force. Centrifugal machine used for the preparation of PRF originally have a rotor distance of 5 cm. Under the influence of G-force, denser particles move outwards radially away from the axis of rotation and settle down at the bottom of the tube,

whereas low-density substances move to the top, drift towards the centre axis. The commonly used rotors are fixed angle rotor (33°), swinging bucket rotor and vertical rotor.

Kobayashi et al. indicated that low-speed centrifugation concept favoured an increase in growth factor release from PRF clots which in turn may directly influence the tissue regeneration by increasing fibroblast migration, proliferation, and collagen mRNA levels. Since high centrifugation forces are known to shift the cell population to the bottom of collection tubes, it was hypothesized that by reducing centrifugation g-force, an increase in leukocyte numbers may be achieved within the PRF matrix. The g-force tends to change based on the location at which it is calculated along the test-tube, but it has been proved that the g-force calculated at the end of the centrifugation tube does not subject to change owing to the centrifugation time, even when centrifuged at the exact same speed. El Bagdadi et al. studied the platelet distribution pattern and growth factor release by preparing PRF at different relative centrifugation forces (RCF) and centrifugation times and observed that the reduction of RCF, lead to increased growth factor release in leukocytes and platelets within the solid PRF matrices.

Growth-Factor-Impregnated PRF (gf-PRF) is a modified form of i-PRF. It is prepared by centrifuging the blood sample at a varying speed of 3000 rpm for a specific period (oscillating tubes) without anticoagulants. It can be used alone or in conjunction with bone grafts to help with haemostasis, bone growth, and maturation. Growth factors are the main substance found in PRF platelets. Among the many growth factors found, TGF-1 and 2, IGF, PDGF, epidermal growth factor (EGF), vascular EGF, and fibroblast growth factors are present. These factors are thought to be essential for bone metabolism and may even be able to control cell proliferation. Collagenase is activated by PDGF, strengthening the tissue that has healed. TGF is a fibroblast activator that encourages the production of procollagen, which then deposits collagen in the wound. In addition, it aids in reducing the local inflammatory response, which enhances healing. [8]

The decision to use gf-PRF as the sole grafting material in the present case series was made because these lesions indicated sites of chronic infection. Introduction of alloplastic materials, allografts, or xenografts at these sites may have introduced an added risk of infection. PRF, being an autologous fibrin scaffold, does not carry this risk. Additionally, there is evidence to show that such large intra-bony defects undergo spontaneous healing without the need for a graft. Keeping this evidence in mind, gf-PRF was used to expedite this process of spontaneous healing.

After the complete enucleation of a cyst, the cavity usually is filled quickly with blood. This clot is the physiological version of PRF. The physiological time of healing of the cystic cavity is from 6 months to 1 year, but when the cystic cavity is filled with gf-PRF, this phenomenon of physiological healing is accelerated, decreasing the healing period to three months. The platelet extracts (platelet-rich fibrin [PRF] and platelet rich plasma [PRP]) are known for their natural healing potential and have shown promising results in oral surgical procedures, periodontal regeneration, and bone tissues surgery.

Conclusions and Future Prospects

The PRF and plasma have emerged as a powerful therapeutic tool for management of soft and hard tissue healing and regenerative procedures, including implant osseointegration. The dual functions (tissue sealants and drug delivery systems to carry biomolecules and chemotactic growth factors) have helped the practitioners to treat the complicated oral conditions and tissues regeneration. The in vivo and in vitro results have opened a new avenue in the dentistry and medicinal care. This minimal invasive and cost-effective technique will raise the bar of clinical dentistry practiced at present.

Although, in most of the conditions the specificity for preparations of PRFs are not maintained, yet the resultant product of PRF have provided the excellent outcomes in various clinical applications. The outcome of most of the studies is very promising, further research and more clinical trials are needed in order to expand its applications in dentistry. Still, more research is required to use these platelets concentrate to their full potential for various clinical applications.

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