OPEN ACCESS
Global Journal of Research in Dental Sciences
ISSN: 2583-2840 (Online)
Volume 05 | Issue 01 | Jan. – Feb. | 2025
Journal homepage: https://gjrpublication.com/gjrds/
Research Article

Role of Platelet – Rich Fibrin (PRF) In Accelerated Osseous Regeneration Post Cystic Enucleation in Maxillo-Mandibular Complex – A Prospective in-Vivo Case Series

[1]Dr. Deval Mehta, [2]Dr. Sonal Madan, [3]Dr. Shrey Chauhan, [4]Dr. Harsh Bhatt*

[1]Dean, HOD, Dept. of OMFS, CDSRC, Bopal, Ahmedabad, Gujarat, India.
[2]Professor, Dept. of OMFS, CDSRC, Bopal, Ahmedabad, Gujarat, India
[3]Director, Atmiya Dento-Facial Care, Vadodara, Gujarat, India
[4]Post Graduate Resident & corresponding author, Dept. of OMFS, CDSRC, Bopal, Ahmedabad, Gujarat, India

DOI: 10.5281/zenodo.14770246 **Submission Date: 28 Dec. 2024 | Published Date: 30 Jan. 2025**

***Corresponding author: Dr. Harsh Bhatt**
Post Graduate Resident & corresponding author, Dept. of OMFS, CDSRC, Bopal, Ahmedabad, Gujarat, India

Abstract

Background: Bone healing after surgical intervention of cystic pathology is mainly by callus formation and remodelling. PRF stimulates rapid osseous regeneration economically and with high efficiency as compared barrier membranes with graft materials which are costly & skill dependent. Aim of this study was to evaluate if PRF can be used, for effective osseous regeneration compared to spontaneous bone formation with objectives to compare osseous regeneration radiographically and evaluating post operative sequelae during healing.

Materials and Methods: This randomized prospective study consisted of 10 patients with cystic pathology who were randomly divided into 2 groups and underwent surgical enucleation procedure either followed by PRF placement (study group) or closure without graft (control group). All patients were clinico-radiographically followed up for 3 months.

Results: All patients were clinically evaluated at 3rd, 7th, and 15th day post-operatively showing significantly reduced analgesics consumption (p=0.003), pain perception and better soft tissue healing (p=0.014) and radiographically bone formation was compared based on volumetric & dimensional reduction of bone defect 3 months post-operatively revealing ~40.8% regeneration in study group versus ~23.5% in control group.

Conclusion: PRF shows superior and accelerated healing in both soft and hard tissues after surgical enucleation procedures & a more economical and easily accessible graft modality for patients.

Keywords: *Platelet-Rich Fibrin (PRF), Radicular Cysts, Cystic Enucleation, Osseous Regeneration, Cone-Beam Computed Tomography (CBCT).*

1.Introduction

Since the time when Kramer defined cysts in 1974[(1)], they are generally treated with surgical enucleation and curettage of the surrounding bone. The importance of healing period is to check for recurrence of pathology and formation of new bone in defect which is a long process.[(2)] Wound healing is a complex biological process where many simultaneous cellular events take place and many attempts have been made in the field of tissue regeneration with the aim of predictably repairing, regenerating, or restoring damaged and diseased tissues.[(3)] Various treatments like use of bone grafts & substitutes, guided tissue regeneration (GTR) using barrier membranes, and growth factors have been proposed to promote bone regeneration.[(4)] These include strategies with foreign materials often derived from allografts, xenografts, or synthetically produced alloplasts to regenerate tissues.[(3)] Bone grafts and regenerative materials are commonly used for treating intrabony defects in periapical surgery with varying degrees of success. Autograft is associated with donor site morbidity and allograft, with risk of disease transmission. [(5)] These drawbacks of autogenous grafts have led to production of large numbers of alternative bone substitutes. Their biological behavior depends upon their chemical composition and physicochemical structure. The osteoinductive substitutes are able to induce an environment to form new bone because of their ability to stimulate and support the proliferation and differentiation of mesenchymal

progenitor cells of the host tissue when implanted in ectopic sites, together with the induction of bone formation.[4] While many have shown promise in regenerative medicine, notably all create a "foreign body reaction.[3] Healing is mediated by variety of signaling proteins including platelets which are proven to play an important role in wound healing.[5] These drawbacks of other graft genotypes pushed the clinicians towards more promising autologous material, such as platelet-rich plasma (PRP) and platelet-rich fibrin (PRF), for more predictive results.[5] PRF is a second generation platelet concentrate with cicatricial properties containing seven fundamental protein growth factors. Its production protocol attempts to accumulate platelets and release cytokines in a fibrin clot containing all the constituents of blood favorable for healing and immunity. [6] The bone regeneration post cystic enucleation can be evaluated using a variety of methods like clinical examination as well as radiographic images taken like intraoral radiovisiograph (RVG) and extraoral techniques such as cone-beam computed tomography (CBCT). Today, CBCT is increasingly being used in dentistry for evaluating mineralized tissues, because it provides adequate image quality associated with a lower exposure dose. [7] This study evaluates the potential of PRF in accelerated osseous regeneration by increased release of growth factors, the outcome of which is further evaluated using CBCT scans.

2.Materials and methods

This prospective clinico-radiographic study consisted of 10 patients (6 male and 4 female) with mean age of 32.5 years (17-67 years), who reported to the Department of oral and maxillofacial surgery at College of dental science and research Centre, with diagnosed periapical cystic pathologies between 2020 and 2023. The patients were selected irrespective of age, gender and socio-economic status. All patients underwent surgical enucleation and curettage (Partsch II) procedure followed either by PRF as filling material (study group) or direct closure without graft (control group) and followed up for 3 months.

2.1 Inclusion criteria:

1. Patients' willingness
2. Age 15-70 years
3. ASA I health criteria.
4. Well defined radiolucent lesions likely to be radicular cyst in either jaw.

2.2 Exclusion criteria:

1. Patients with reduced hemoglobin & platelet count
2. Patients with bleeding disorders or on anti-thrombotic agents
3. Patient with known history of osseous diseases
4. Uncontrolled systemic co-morbidities
5. Pregnant or lactating females
6. Patients presenting with cysts larger than 3cm in size, or cysts in relation to 3rd molars or which are doubtful to be of dentigerous, keratocyst, or other variants.

3. Procedure:

A pre-decided proforma was used to collect all the necessary data about the patient and informed consent about the study and procedure was acquired after inclusion of all patients. Routine pre-operative blood investigations and CBCT scans were acquired along with pre-operative, intra-operative and post-operative photographic records were maintained. Same prophylactic medications were started in all patients and continued upto 5 days of course completion post-operatively. All surgical procedures were performed by same oral surgeon under strict aseptic protocols. Local infiltration was administered and extractions of teeth with poor prognosis were carried out; in cases where teeth were salvageable, endodontic therapy and apicoectomy were planned. Mucoperiosteal flap were raised, bone cavity was carved out using burs and / or removal of thin bone over the cystic pathology and was de-roofed, followed by use of curettes and periosteal elevators to detach the tissue from surrounding bone and the cystic pathology was removed from the cavity and sent for histopathological examination. Hemostasis was achieved and cavity was debrided, irrigated and closed using interrupted sterile silk sutures for approximation in control group (Fig.1). In study group, before closure of flap, 10ml of patient's autologous blood was drawn using venipunction and centrifuged in clot activator test tubes using Choukroun's protocol [8] to acquire PRF clot. Which was placed inside the bone cavity and closure was achieved. In case of histopathological reports positive for any variant of cystic pathology other than radicular cyst, the case was not included for the current study purpose (Fig. 2).

Postoperatively, soft diet and strict medicinal regimen started preoperatively was prescribed and patients were called for follow-up on 3rd day, 7th day, 15th day, and 3 months post-operatively to perform appropriate clinical and radiographic evaluations by same blinded senior oral surgeon.

4.Post-operative assessment:

Clinically, Pain (10-point VAS index [9]), Number of analgesics consumed for relief, Healing of soft tissues (Healing Index [10]) and incidence of infection were evaluated.

Radiographically, volumetric size of bone defect was quantified using measurements in all 3 dimensions of the cavity on a CBCT scan and compared from 3rd month post-operative scans to the immediate post-operative and pre-operative scans of patients. Finally, the mean reduction of bone defect (actual bone formation) was compared between the study and control group to obtain results.

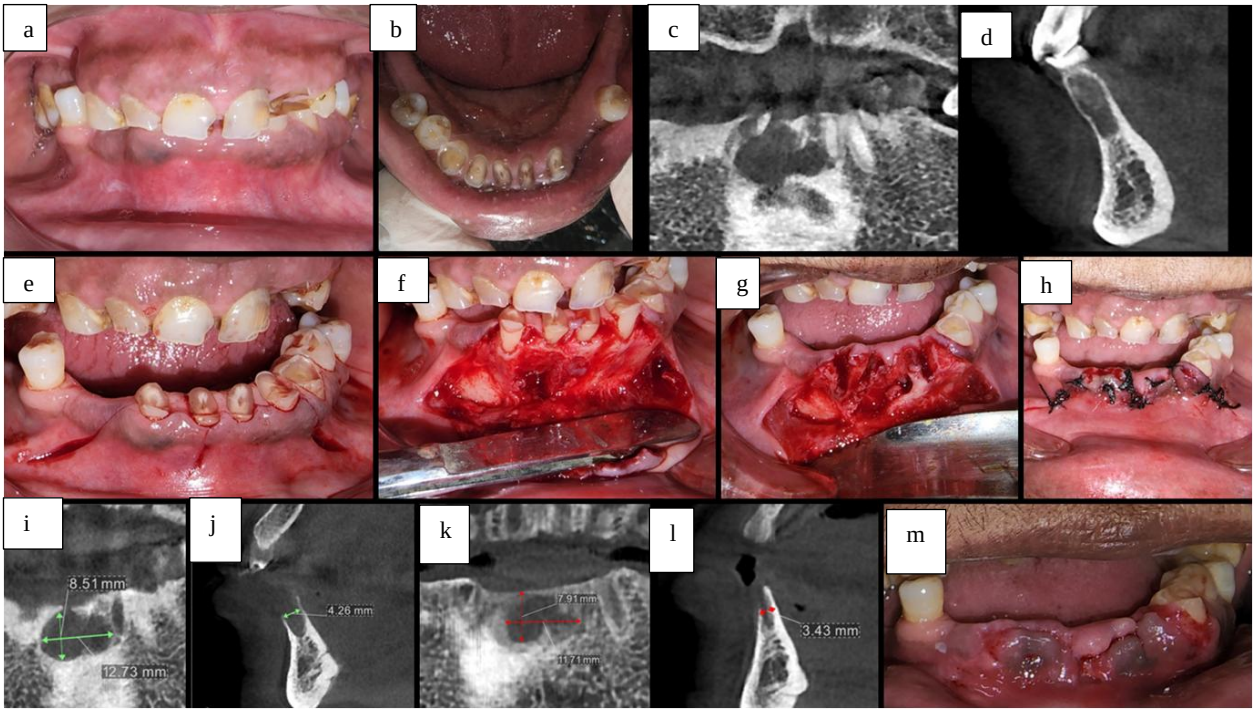

Fig. 1: Control group case – no P.R.F placement

a. PRE-OP INTRAORAL IMAGE
b. PRE-OP MANDIBULAR OCCLUSAL PHOTOGRAPH
c. PRE-OP CBCT PANORAMIC SLICE
d. PRE-OP CBCT CROSS SECTIONAL SLICE
e. TRAPEZOIDAL INCISION DESIGN
f. FLAP ELEVATION AND PATHOLOGY DEROOFING
g. EXTRACTION OF FOCI & CYST ENUCLEATION
h. PRIMARY CLOSURE OF FLAP
i. IMMEDIATE POST-OP CBCT PANORAMIC SLICE
j. IMMEDIATE POST-OP CBCT CORSS SECTIONAL SLICE
k. 3RD MONTH POST-OP CBCT PANORAMIC SLICE
l. 3RD MONTH POST-OP CBCT CROSS SECTIONAL SLICE
m. TISSUE HEALING ON 7TH DAY

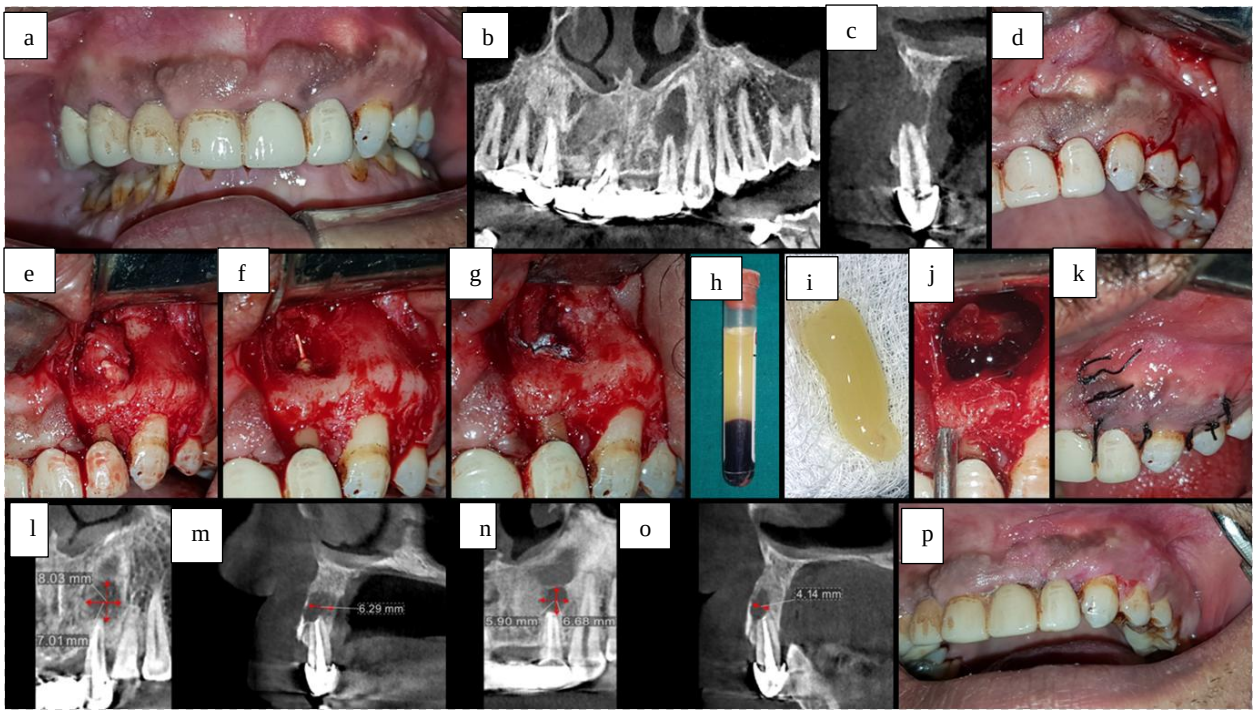

Fig. 2: Study group case – PRF placed after cyst enucleation

a. PRE-OP INTRAORAL IMAGE
b. PRE-OP CBCT PANORAMIC SLICE
c. PRE-OP CBCT CROSS SECTIONAL SLICE
d. TRAPEZOIDAL INCISION DESIGN
e. FLAP ELEVATION AND PATHOLOGY DEROOFING
f. CYST ENUCLEATION AND GUTTA PERCHA EXTENSION VISUALIZED
g. APICOECTOMY DONE AND RETROGRADE M.T.A FILLED
h. BLOOD COLLECTED AND CENTRIFUGED
i. P.R.F CLOT SEPARATED
j. P.R.F CLOT PLACED AFTER CAVITY DEBRIDEMENT
k. PRIMARY CLOSURE OF FLAP
l. IMMEDIATE POST-OP CBCT PANORAMIC SLICE
m. IMMEDIATE POST-OP CBCT CORSS SECTIONAL SLICE
n. 3RD MONTH POST-OP CBCT PANORAMIC SLICE
o. 3RD MONTH POST-OP CBCT CROSS SECTIONAL SLICE
p. TISSUE HEALING ON 7TH DAY

5.Results

5.1 Pre-operative data evaluation:

The study started with 14 patients fitting the inclusion criteria only to drop the data of 4 patients due to irregular follow-ups so as to reduce the effect on observed results. The mean age of 10 patients included in this study was 32.5 years (17-67 years) out of which 60% were males and 40% were females. 60% of cystic pathology were seen in maxilla and remaining 40%, in mandible. Most of the patients arrived to the institution with chief complain or painful swelling with or without associated pus discharge seconded only by accidental radiographic finding of deeply carious teeth.

5.2 Intra-operative data evaluation:

All the 10 patients were randomly allotted to either study group (n=5) in whom, PRF was formed from 10ml autologous blood and placed into the bony defect after cystic enucleation before closure, or control group (n=5) in whom direct closure was achieved after enucleation. Extractions were carried out in 6 patients and apicoectomy was carried out in rest 4 patients. No patients had any intraoperative complications during the procedure.

5.3 Post-operative data evaluation:

Post-operatively all patients were evaluated clinically for pain, number of analgesics consumed for relief, soft tissue healing and incidence of infection at 3rd, 7th and 15th day post-operatively. No patients had infection. Incidence of pain was less in study group and patients showed significantly less consumption of analgesics compared to those in control group (p=0.003). Healing of soft tissues was also seen to be significantly better both at 3rd day (p=0.017) and 7th day (p=0.014) post-operatively. Radiographically, the mean percentage reduction of volumetric quantity of bone defect at 3rd month post-operatively compared to pre-operatively measured quantity was ~40.8% in study group compared to ~23.5% in control group (p=0.002).

6. Discussion

Healthy bone regeneration after periapical surgery is influenced by four critical factors - primary wound closure, angiogenesis as in blood supply and source of undifferentiated mesenchymal cells, space maintenance, and stability of the wound (PASS principle). [11]

All the surgeons aim to remove the pathology, prevent recurrence and take care of the residual bony defect. The cyst is enucleated, intact or piecemeal, and the underlying bone is curetted as an adjunctive method to remove superficial surrounding bone, ensuring removal of residual lining / satellite cysts or epithelial islands. [2]

Post enucleation, the most important aspect of follow-up period is not only to check for recurrence of the pathology but also to confirm that the residual bony defect is filled with new bone. Stable bone healing is achieved when there is an adequate blood supply and immobilization at the site of the defect. For the first 4 weeks, angiogenic and osteogenic cells originate from the surrounding bone walls and periosteum, while woven bone forms around the defect. These processes are governed by various cytokines and growth factors. [12]

One of the recent achievements in dentistry is the use of PRF as during platelet degranulation, many biologically active substances are released, which participate in the primary hemostasis and help the following reparation and regeneration of the soft and hard tissues. [13] Choukroun et al. (2001) developed a protocol aimed at collection of platelet and release of cytokines in a fibrin clot. Here, the fibrin matrix is the key, as it supports cell during the initial healing phase. [3] The proteins derived from platelets include platelet derived growth factor (PDGF), TGF-β, vascular endothelial growth factor (VEGF), and epidermal growth factor (EGF). Plasma also contains growth factors like insulin-like growth factor (IGF) and hepatocyte growth factor (HGF). [14]

The mean VAS score in study group on 3rd day was 2.2 ± 3.03 and on 7th day was reduced to 1.0 ± 1.41. However, in control group, the mean VAS score on 3rd day was 4.60 ± 4.22 reducing to 3.20 ± 2.95. This correlates to more pain experienced by control group which is also seen in literature by Al-Hamed et al. (2017), Canellas et al. (2017), and Dar et al. (2018). [15]

The mean number of analgesics consumed by both the groups when subjected to student's unpaired 't' test revealed a significant difference between the scores (p=0.003), suggesting that the control group patients perceived significantly more pain. In a study by Gupta et al., patients treated with PRF after removal of mandibular third molar showed similar reduced pain, swelling and number of analgesics taken as compared to the control group. This can be correlated to release kinetics of growth factors and mediator of inflammation by PRF which starts from day 1 continues till day 8–10. [16] Fernando et al., showed similar results and they concluded that the use of PRF decreases postoperative pain and discomfort. [15]

The healing index (Landry et al, 1998) [9] scores the tissues 1 indicating "very poor" healing and 5 indicating "excellent" healing of tissues. Mean score of healing index was calculated for both the groups separately for 3rd and 7th day and then were subjected to statistical analysis using Mann-Whitney test. The mean score of study group on 3rd day was 3.2 ± 0.84 and for control group was 1.6 ± 0.55 which was highly significant (p=0.017).

Subsequently the mean score of study group on 7th day was 4.4 ± 0.55 and for control group was 3.2 ± 0.45 which also indicated significance (p=0.014). These values of intergroup comparison at 2 different days post-operatively, both significantly higher for study group suggested better healing outcomes in our study, generally attributed to the fibrin matrix, which acts as a 3-dimensional scaffold for the leukocytes and platelets and delayed release of their products. The beneficial wound-healing effects are present for a longer time period and it traps more leukocytes within its network [17]; therefore, it can simultaneously support the epithelial coverage, immunity, and act as a natural guide for development of angiogenesis. Thus, the requirement of an extracellular matrix scaffold which permits the migration, division, and phenotypic change of endothelial cells has been demonstrated to cause faster angiogenesis. [18]

Dohan et al. [19] concluded that PRF has many advantages as follows: it decreases the frequency of intra-operative and post-operative 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. [20]

Lack of post-operative infection can be correlated with our stringent aseptic protocols and strict medical regimen as well as to perform regular mouth rinses with 0.12% chlorhexidine digluconate by patients of both the groups.

Evaluation of radiographic CBCT scans was done and the maximal size of the cystic lesion was measured in 3 dimensions and data was collected as pre-operative, immediate post-operative and 3rd month measurements for each patient, taking care, that same scan slice is chosen for measurement, to avoid measuring error. Comparison of the reduction of volume of bony cavities at the end of 3 months to that of pre-operative record for both groups was done. Mean percentage reduction was calculated from to result in a mean reduction of 40.8% ± 6.64% in study group and 23.5% ± 5.37% in control group. Finally, intergroup comparison of mean percentage reduction was done showing highly significant reduction of defect (p=0.002).

Marx and colleagues (1998) showed that PRP is an osteoinductive force retaining a high concentration of PDGF and TGF-β, acting to promote mitogenesis of stem cells nearby and chemotaxis incoming inflammatory cells. These actions produced almost 2-fold increase in bone density in their surgeries. [21] Choukroun et al. (2006), reviewed that, after a cystic ablation surgery, the residual bony defect is filled with blood clot which is a more "lighter" version of PRF itself. Instead, when PRF is placed within the cavity, it acts as an organized trap for circulating stem cells that act by osseoinducition. They presented case of a cavity filled with PRF that totally healed in 2 months instead of 6-12 months taken for physiologic healing.[22] Dar et al. (2016), carried out a clinical study on 20 cystic lesions concluding that rapid, progressive, predictable and significant radiographic osseous regeneration can be seen using PRF after enucleation procedure.[5] Similarly Meshram et al. (2015), also treated 10 cysts with enucleation followed by PRF. Regular follow-up radiographic evaluation showcased faster bony regeneration of bone within 6 months post-operatively.[11]

7.Conclusion

Our experience of using PRF, is based on the outcomes observed in this study based on which we conclude that – PRF is an efficacious and reliable therapy with negligible complications and very high patient compliance proving it to be an invaluable treatment option for accelerated osseous regeneration as well as clinical outcomes following surgical enucleation of cystic lesions of jaws.

8. References

1. Kramer IR. Changing views on oral disease. Proceedings of the Royal Society of Medicine 1974;67(4):271-6.
2. Speight PM. Shear's cysts of the oral and maxillofacial regions. 5th ed. USA: Wiley-Blackwell; 2022:ch7:136-7.
3. Miron RJ, Choukroun J. Platelet rich fibrin in regenerative dentistry. 1st ed. UK: Wiley-Blackwell; 2017:ch1:1-3.
4. Eldibany M, Shokry MM. The effect of Nanobone® in combination with platelet rich fibrin on bone regeneration following enucleation of large mandibular cysts. Tanta Dental Journal 2014;11(2):100-8.
5. Dar M et al. Use of autologous platelet-rich fibrin in osseous regeneration after cystic enucleation: A clinical study. J Oral Biol Craniofac Res 2016;6(1):29-32.
6. Singh A, Kohli M, Gupta N. Platelet rich fibrin: a novel approach for osseous regeneration. J Maxillofac Oral Surg 2012;11(4):430-4.
7. Silva IM, Freitas DQ, Ambrosano GM, Bóscolo FN, Almeida SM. Bone density: comparative evaluation of hounsfield units in multislice and cone-beam computed tomography. Braz Oral Res 2012;26(6):550-6.
8. He L, Lin Y, Hu X, Zhang Y, Wu H. A comparative study of platelet-rich fibrin (PRF) and platelet-rich plasma (PRP) on the effect of proliferation and differentiation of rat osteoblasts in vitro. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;108(5):707-13.
9. Hayes MHS, Patterson DG. Experimental development of the graphic rating method. Psychological Bulletin 1921;18(1):98-9.
10. Landry RG, Turnbull RS, Howley T. Effectiveness of benzydamine HCl in the treatment of periodontal post-surgical patients. Res Clin Forum 1988;10(1):105-18.
11. Meshram VS, Lambade PN, Meshram PV, Kadu A, Tiwari MS. The autologous platelet rich fibrin: A novel approach in osseous regeneration after cystic enucleation: A pilot study. Indian J Dent Res 2015;26(6):560-4.
12. Hwang DY, On SW, Song SI. Bone regenerative effect of recombinant human bone morphogenetic protein-2 after cyst enucleation. Maxillofac Plast Reconstr Surg 2016;38(1):22.
13. Chenchev I, Drangov M. The use of platlet rich plasma in the oral surgery. J of IMAB 2005;11(2):30-1.
14. Pal US, Mohammad S, Singh RK, Das S, Singh N, Singh M. Platelet-rich growth factor in oral and maxillofacial surgery. Natl J Maxillofac Surg 2012;3(2):118-23.

15. Almeida CF, Mello-Machado RC, Javid K, Moraschini V. The use of leukocyte- and platelet-rich fibrin in the management of soft tissue healing and pain in post-extraction sockets: a randomized clinical trial. J Craniomaxillofac Surg 2020;48(4):452-7.
16. Gupta N, Agarwal S. Advanced-PRF: clinical evaluation in impacted mandibular third molar sockets. J Stomatol Oral Maxillofac Surg 2021;122(1):43-9.
17. Fan Y, Perez K, Dym H. Clinical uses of platelet-rich fibrin in oral and maxillofacial surgery. Dent Clin North Am 2020;64(2):291-303.
18. Bilginaylar K. Comparison of the clinical outcomes of buccal advancement flap versus platelet-rich fibrin application for the immediate closure of acute oroantral communications. J Craniofac Surg 2019;30(1): e45-e9.
19. Dohan DM et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part I: technological concepts and evolution. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006 Mar;101(3): e37-44.
20. Freymiller EG, Aghaloo TL. Platelet-rich plasma: ready or not? J Oral Maxillofac Surg 2004;62(4):484-8.
21. Marx RE, Carlson ER, Eichstaedt RM, Schimmele SR, Strauss JE, Georgeff KR. Platelet-rich plasma: Growth factor enhancement for bone grafts. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998;85(6):638-46.
22. Choukroun J et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrates. Part IV: clinical effects on tissue healing. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;101(3): e56-60.

CITATION
Deval M., Sonal M., Shrey C., & Harsh B. (2025). Role of Platelet – Rich Fibrin (PRF) In Accelerated Osseous Regeneration Post Cystic Enucleation in Maxillo-Mandibular Complex – A Prospective in-Vivo Case Series. In Global Journal of Research in Dental Sciences (Vol. 5, Number 1, pp. 38–44).
https://doi.org/10.5281/zenodo.14770246