IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 2 Ser.16 (February. 2023), PP 58-68
www.iosrjournals.org

Efficacy of Platelet Rich Plasma, Platelet Rich Fibrin and Bone Grafts in the Healing Of Oral and Maxillofacial Lesions and Extraction Sockets: A Comparative Study

Dr. Neel Kamal[1], Dr. Sumit Singh Lamba[2], Dr. Vaz Ashwin Alwyn[3], Dr. Amit Sharma[4], Dr. Saba P Khan[5]

[1](Professor, Department of Oral and Maxillofacial Surgery, Rajasthan Dental College and Hospital, Jaipur)
[2](Postgraduate, Department of Oral and Maxillofacial Surgery, Rajasthan Dental College and Hospital, Jaipur)
[3](Postgraduate, Department of Oral and Maxillofacial Surgery, Rajasthan Dental College and Hospital, Jaipur)
[4](Professor and Head, Department of Oral and Maxillofacial Surgery, Rajasthan Dental College and Hospital, Jaipur)
[5](Lecturer, Department of Oral and Maxillofacial Surgery, Rajasthan Dental College and Hospital, Jaipur)

Abstract:
Aim of the Study*: To compare the efficacy of platelet rich plasma, platelet rich fibrin and bone grafts in the healing of oral and maxillofacial lesion and extraction sockets.*
Objectives of the Study*: To assess and compare soft tissue healing with placement of PRP, PRF and bone graft in extraction socket and oral and maxillofacial lesion using standard parameters. To clinically observe the tissue color, response to palpation, bleeding, granulation tissue and suppuration postoperatively in patients with PRP, PRF and bone graft in extraction socket and lesion. To evaluate severity of pain after placement of PRP, PRF and bone graft in extraction socket and lesion using standard parameters. To evaluate and assess bone healing radiographically with respect to trabecular pattern, overall density and lamina dura after placement of PRP, PRF and bone graft in extraction socket and lesion using standard parameters.*
Materials and Method*: In this study, 90 patients of oral and maxillofacial lesion and extraction socket cases were randomly selected. These patients were divided into three groups having 30 patients each. Group A patients treated with PRP, Group B patients treated with PRF, Group C patients treated with bone graft. Parameters of this study included pain intensity by Visual Analogue Scale, soft tissue healing assessment using Landry and Turnbull index, radiographic bone healing assessment for extraction socket. Comparison of three study groups was done and results were obtained by statistical analysis.*
Results*: Pain and swelling were less on PRP and PRF site when compared to bone graft site at 1st, 3rd and 7th day. PRP and PRF site showed better soft tissue healing when compared to bone graft site at 3rd and 7th day. Radiographic assessment showed comparatively lesser bone density values in PRP and PRFsite at 1st and 3rdmonth than bone graft site.*
Conclusion:*This study clearly concluded that in cases treated with PRP and PRF there was obvious improvement in the pain, swelling, and healing of soft tissue. In regeneration of bone after third molar surgery and periapical surgery, bone graft group is much better as compared to the PRP and PRF-treated patients postoperatively.*
Key Word*:Platelet Rich Plasma; Platelet Rich Fibrin; Bone graft.*

Date of Submission: 14-02-2023 Date of Acceptance: 28-02-2023

I. Introduction

The development of bioactive surgical additives, which are being used to regulate the inflammation and increase the speed of healing process [1], is one of the greatest challenges in clinical research. In this sense, healing is a complex process, which involves cellular organization, chemical signals, and the extracellular matrix of tissue repair [2]. Platelets regenerative potential was introduced in the 70's [3], when it was observed that they contain growth factors that are responsible for increase collagen production, cell mitosis, blood vessels growth, recruitment of the other cells that migrate to the site of injury and cell differentiation induction among others [4]. One of the latest innovations in oral surgery is the use of platelet concentrates for in vivo tissue engineering applications: 1) platelet rich plasma (PRP) and 2) platelet rich fibrin (PRF). Platelet concentrates are concentrated suspension of growth factors found in platelets, which act as bioactive surgical additives that are applied locally to induce wound healing [4].

Platelet rich plasma (PRP) has been used and researched extensively for bone regeneration following a breakthrough study done by Marx*et al* [5]. PRP is an autologous concentration of human platelets in a small volume of plasma. Various growth factors are released by activated platelets which include angiopoietin-2, connective tissue activating peptide III, epidermal growth factor, factor V, factor IX, factor XIII, fibrinogen, basic fibroblast growth factor, fibronectin, insulin growth factor-1, osteocalcin, P-selectin, platelet derived endothelial cell growth factor, platelet derived growth factor, serotonin, transforming growth factor-b1 (TGF-b1),thrombospondin-1, vascular endothelial growth factor and von Willebrand factor. All these factors contribute to improve soft and hard tissue healing. PRP is a biological approach to promote the wound healing cascade by releasing therapeutic growth factor directly to the wound. These growth factors act on healing capable cells during cell division, matrix synthesis, and tissue differentiation and stimulate vascular bone ingrowths.

However, the drawback of PRP included biochemical blood handling with addition of anticoagulants. The development of technologies to obtain platelet concentrates lead to formation of new kind of fibrin adhesive – Platelet Rich Fibrin.

Choukroun's platelet rich fibrin (PRF) was described by Choukroun*et al*. in France in 2001[1]. 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. PRF releases (through degranulation) at least six different growth factors, as well as cytokines, that stimulate bone and soft tissue healing.

PRF is strictly autologous in nature containing large quantity of platelet and leukocyte cytokines. This technique neither requires anticoagulant nor bovine thrombin. Platelets and leukocyte cytokines play an important part in the biology of this biomaterial, the fibrin matrix supporting them certainly constitutes the determining element responsible for the real therapeutic potential of PRF.

PRF stimulates many different kinds of cells, particularly the proliferation and differentiation of osteoblast. PRF in the form of a platelet gel can be used in conjunction with bone grafts, which has several advantages, such as promoting wound healing, bone growth and maturation, wound sealing and hemostasis, and imparting better handling properties to graft materials.

Bone is often subjected to various damages leading to regeneration or repair [6]. Repair restores the bone to its original form and function. In the case of extraction socket healing, there is resorption of alveolar bone leading to decrease in ridge volume and alteration of ridge contour that consequently impair prosthetic rehabilitation. Several biocompatible graft materials have been used to combat above healing defects, which include allografts, alloplast, autografts and xenografts [7]. All these materials are being researched to know their capability of improving clinical outcomes.

Synthetic graft materials mainly comprise of calcium phosphate ceramics, which have a composition similar to bone mineral [8]. Hydroxyapatites were considered most useful until [9]; Larry Hench developed a material using silica (glass) incorporated with calcium and phosphorus to fuse broken bones that came to be known as "Bioactive Glass". Both synthetic hydroxyapatite and bioactive glass are now combined to be known as "bioactive ceramics" [8]. Both these materials have osteoconductive properties.

The major advantages of bone grafts are their biocompatibility and potential to offer an unlimited supply of bone substitutes, the absence of donor site infection and decreased operative time as compared to platelet rich plasma and fibrin as these additives own to the complexities involved – such as the lengthy and tedious production protocols and 'risk of cross infection'.

Bone graft and bone regeneration material are used with varying degree of success. All these approaches are known as regenerative therapies [8]. The key to tissue regeneration is to stimulate a cascade of healing events that, if coordinated, can result in the completion of integrated tissue formation.

II. Materialsand Method

In the present study 90 patients were randomly selected from the outpatient Department of Oral & Maxillofacial Surgery, Rajasthan Dental College & Hospital, Jaipur. These patients were divided into three groups having 30 patients each. Group A-PRP group, Group B-PRF group, Group C-Bone graft group. Each patient was selected randomly irrespective of their caste, color, creed, religion and socioeconomic status and were explained about the surgical procedure.

Inclusion Criteria

1. Patient willing to give informed consent.
2. Patients in the age group between 18-50 years.
3. Patient having periapical lesion with respect to mandibular or maxillary teeth.

4. Patients with mandibular and maxillary teeth indicated for extractions.

Exclusion Criteria

1. Patients with medical history that could influence the outcome of the therapy.
2. Patients who were smokers & not willing to quit smoking/tobacco chewing even after therapy.
3. Pregnant or lactating patients.
4. Uncontrolled periodontal disease.
5. Presence of any acute local infection.
6. Patient on aspirin therapy.
7. Patient unwilling to participate in study.
8. Patient with systemic illness.

A custom-made case sheet was designed for the study to record the case history. All patients were explained individually about the procedure for the treatment, its complications and the follow-up period involved in the study and willing patients were enrolled for the study after getting their written consent.

ARMAMENTARIUM FOR PRP, PRF AND BONE GRAFT PLACEMENT

Fig. 1: 10ml glass test tubes

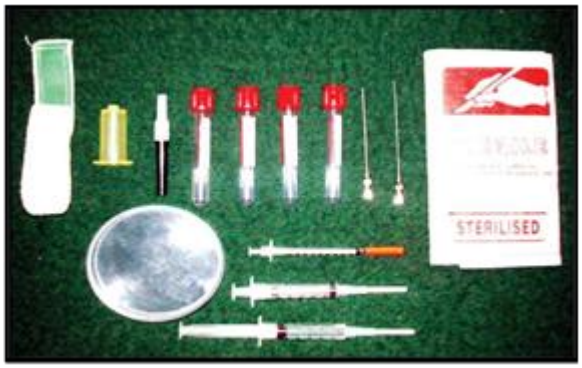

Fig. 2: Armamentarium for PRPand PRF formation

Fig. 3: Centrifuge machine

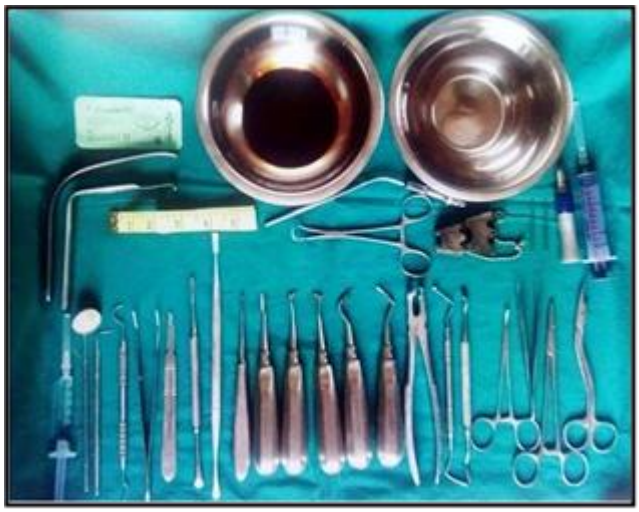

Fig. 4: Armamentarium for surgicalprocedures

PROCEDURE

Platelet Rich Plasma

Tourniquet was placed on the hand from which blood was to be drawn. In all patients under all aseptic techniques, 10 ml of blood was drawn intravenously using 18-gauge needle from the antecubital region of patients forearm and was placed in 2 test tubes of 5 ml each. Anti-coagulant (Citrate Phosphate Dextrose 1.5ml) was placed in test tubes and the withdrawn blood was added to it. Each test tube contained 6.5ml blood with

anticoagulant. The first centrifugation cycle consisted of 2000 rpm for 15 min. This resulted in the separation of the whole blood into a lower red blood cell region and upper straw-colored plasma. This plasma contained relatively low concentration of platelet-poor plasma (PPP) in the uppermost region and higher concentration of platelet and white blood cell in the boundary layer known as "buffy coat". With a micropipette, the PPP and the buffy coat layer including 1 mm below the boundary layer was collected in a sterile vacutainer and centrifuged at 3000 rpm for 10 min. After the second centrifuge, the upper half was discarded and the lower half was used as PRP. The PRP that was obtained after centrifugation was activated using 10% calcium chloride and 2.5 ml of PRP was thoroughly mixed with 1.8ml of 10% $CaCl_2$. This resulted in a clot formation. A standing time of 5–8 min was given if required. The clot was then placed in the extraction socket and the bony defects.

Platelet Rich Fibrin

Tourniquet was placed on the hand from which blood was to be drawn. In all patient under all aseptic techniques, 10 ml of blood was drawn using 18-gauge needle intravenously from the antecubital region of patients forearm in vacutainers without anticoagulant. The collected blood was centrifuged immediately at the rate of 3000 rpm for 10 min. This leads to formation of three compartments with the formation of a strong fibrin clot in the middle of the tube. The clot thus formed is a leukocyte-rich PRF clot. This clot thus formed was then placed in the extraction socket and bony defect.

Bone Graft

The graft material used was G-Bone a bioceramic composite material which contains 90% HA and 10% beta-tricalcium phosphate. These grafts are white and granular measuring 1–2 mm in size and with porosity of 500–1200/mm. The material is dispensed in a sterile disposable 2 cc syringe in a blister pack.

Fig. 5: G-Bone

SURGICAL PROCEDURE FOR GRAFT PLACEMENT
(Extraction patients)

In all cases grafts were placed under local anesthesia (2% Lignocaine Hydrochloride with 1:80,000 adrenaline). Before the placement of grafts all patients were advised to rinse with chlorhexidine mouthwash, thus disinfecting the mucous membrane. Skin preparation and isolation of surgical field with barrier draping was accomplished. Inferior alveolar nerve block, lingual nerve block, and long buccal nerve block were administered. Standard Ward's incision was used in all the cases. Full thickness mucoperiosteal flap was raised. Removal of bone was done with stainless steel burs (No. 8). Constant irrigation with saline was used while removing bone to prevent thermal necrosis. Graft material was packed in the extraction socket. Using 3-0 black braided silk, interrupted sutures were placed and pressure pack was given.

SURGICAL PROCEDURE FOR ORAL AND MAXILLOFACIAL LESION
(Apicoectomy case)

In all cases grafts were placed under local anesthesia (2% Lignocaine Hydrochloride with 1:80,000 adrenaline). Before the placement of graft all patients were advised to rinse with chlorhexidine mouthwash, thus disinfecting the mucous membrane. Skin preparation and isolation of surgical field with barrier draping was accomplished. A scalloped horizontal incision in attached gingiva and two vertical releasing incision given. Mucoperiosteal flap was raised with periosteal elevator. Flap was retracted away with langenbeck retractor.

Apex in the intact buccal plate is identified and a bony window is created with surgical bur over the root apex area. Bony window is completed to expose the root apex area. Root tip is sectioned horizontally and root tip is removed following periapical curettage. The PRF clot was then packed into the defect to completely fill the bony crypt. Wound closure was then obtained with 3-0 silk suture.

POSTOPERATIVE PROCEDURE

Antibiotics (Tab. amoxicillin 500 mg every 8 hrs + clavulanic acid 125 mg every 8 hrs for 5 days), anti-inflammatory drugs (Tab. Diclofenac sodium 50 mg + Paracetamol 500 mg, every 8 hrs for 5 days) and multivitamin supplements for 5 days was prescribed to all patients. Patients were given oral hygiene maintenance instructions. Patients were specifically instructed not to take any other drug without informing the investigator.

METHODOLOGY

The patients were divided into three groups of 30 patients each.

- Group A - PRP Group
- Group B - PRF Group
- Group C -Bone Graft Group

All the patients were evaluated according to following parameters:

1) Assessment of pain intensity by Visual Analogue Scale [10] on 1st, 3rd and on 7th postoperative day.
2) Soft tissue healing assessment was done on 3rd and 7th post- operative day using the Landry and Turnbull index [11].
3) Bone healing assessment for extraction socket was done radiographically using standard IOPA's. Three radiographic parameters, namely, lamina dura (LD), overall density, and trabecular pattern was used for the assessment of bone healing.
4) Assessment of bone healing in periapical defect was done with two radiographic parameters overall density and trabecular pattern.

Pain: Pain intensity was assessed with Visual Analogue Scale [10]. A scale of 0-10 was used to assess the intensity of pain 0 means no pain and 10 being the most pain possible. The patient was asked to place a mark on the location of line that best describes his or her pain pre-operatively or post-operatively.

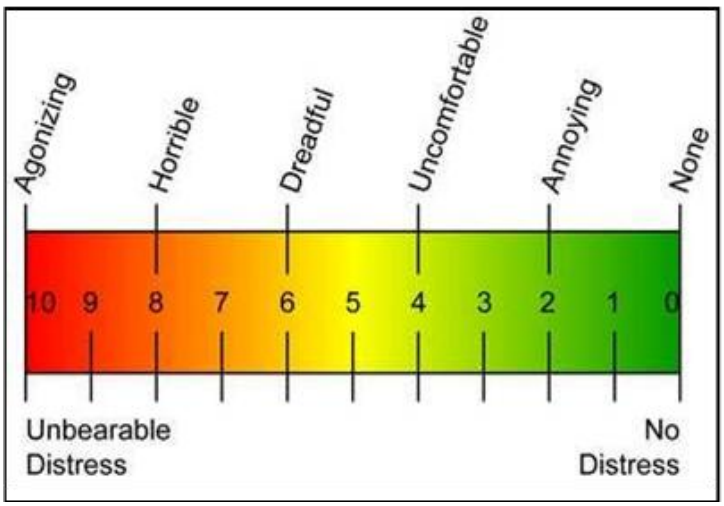

Fig. 6: Visual Analogue Scale

MEASUREMENT OF VARIOUS PARAMETERS

Soft tissue healing

The soft tissuewas assessed and scored as per the Landry and Turnbull index [11].

Table 1: Landry and Turnbull index

Score	Clinical Signs
Healing index 1: Very poor	Tissue color: ≥ 50% of gingiva red Response to palpation: Bleeding Granulation tissue: Present Incision margin: Not epithelialized with loss of epithelium beyond incision margin Suppuration: Present
Healing index 2: Poor	Tissue color: ≥50% of gingiva red Response to palpation: Bleeding Granulation tissue: Present Incision margin: Not epithelialized with connective tissue exposed.
Healing index 3: Good	Tissue color: ≥25% and < 50% of gingiva red Response to palpation: No bleeding Granulation tissue: None Incision margin: No connective tissue exposed
Healing index 4	Tissue color:<25% of gingiva red Response to palpation: No bleeding Granulation tissue: None
Healing index 5	Tissue color: All tissue pink Response to palpation: No bleeding Granulation tissue: None Incision margin: No connective tissue exposed

Scoring Criteria for Bone Healing

The radiographic evaluation of lamina dura and trabecular pattern are used for assessment of bone healing in oral and maxillofacial lesion and extraction socket cases [12]. A score of +2 to -2 represented gross variance from base line radiograph score and a score of +1 to -1 represented significant variation from normal.

Lamina Dura

+2 : LD essentially absent, may be present in isolated areas.
+1 : LD substantially thinned, missing in some areas.
0 : Within normal limits.
−1 : Portions of LD thickened, milder degrees.
−2 : Entire LD substantially thickened.

Trabecular Pattern

+2 : All trabeculae substantially coarser.
+1 : Some coarser trabeculae; minor degrees.
0 : Within normal limits.
−1 : Delicate finely meshed trabeculations.
−2 : Granular, nearly homogenous patterns, individual trabeculations essentially absent.

Overall Density

Periapical radiographs were taken pre-operatively and on 1st and 3rd month post-operatively to access radiograph at the site of graft placement. Bone density was measured with the help of gray scale histogram study of extraction sockets and lesions.

III. Result

Ninety patients were randomly selected from the Department of Oral & Maxillofacial Surgery, Rajasthan Dental College & Hospital, Jaipur, irrespective of age, sex, religion & socio-economic status to study the efficacy of PRP, PRF and bone grafts in the healing of oral and maxillofacial lesion and extraction sockets clinically and radiographically.

Among the 90 cases, there were 52 males and 38 females. The age group for study was taken between 18 to 50 years, among which 54(60%) patients were in the age group less than 35 years and 36(40%) patients were in the age group more than 35 years (**Table2**).

Among 90 patients, 70(77.8%) patients have grafts placed in mandible and 20(22.2%) patients had grafts placed in maxilla (**Table2**).

Among 90 cases, 18(20%) patients below age of 35 years and 12(13.3%) above 35 years had PRP placed at the healing site. In 20(22.2%) patients below age of 35 years and 10(11.1%) patients above 35 years had PRF place at healing site and in 16(17.7%) patients below 35 years age and 14(15.6%) patients above 35 years had bone graft placed at healing site (**Table3**).

The intensity of pain in these different groups was scored on 1st, 3rd and 7th post-operative day. The result represented on (**Table 4**) shows reduction in intensity of pain in all the groups from day 1. Maximum reduction

in pain in accordance to mean value was recorded with PRF group (0.2) and PRP group (0.3) than bone graft group (0.5) on the 7th postoperative day.

Bone healing was assessed in terms of the appearance of LD, the overall density, and the trabecular pattern that were observed on the Intraoral Periapical Radiographs.

Comparison of three study groups (A, B, C) with respect to LD, overall density, and trabecular pattern scores for extraction cases and overall density and trabecular pattern scores for lesion cases at 1st day, 1st month, and 3rd post-operative month was done by Kruskal-Wallis ANOVA test, whereas pairwise comparison was done by Mann-Whitney U-test.

Lamina Dura

The mean LD score of group C was higher as compared to that of group A and group B. At the end of 1 month, the mean LD score of group C was 0.9 whereas that of group A and B was 0.5 and 0.7 respectively. At the end of 3 months, the mean LD score of group C was 1.8 whereas that of A and B was 1.5 and 1.6respectively. In terms of duration, there was a significant difference in the LD scores of all the three groups at the end of 3 months (**Table5**).

Overall Density

The score for overall density for group C was higher as compared to that of other two groups both at the end of 1st month as well as 3rd month. At the end of 1st month, the mean score of group C was 0.7, whereas the other two groups had a mean score of0.5 and 0.2 respectively. At the end of 3 months, the mean score of group C was 1.6, whereas that of group A and B was 1.2 and 1.5 respectively. In terms of duration, a significant difference was noted in all three groups at the end of 1st month and 3rd month as compared to 1st postoperative day. As compared to the 1st month, the change in the overall density was more at the end of 3rd month (**Table6**).

For the lesion cases overall density score was higher for group C as compared to other groups both at the end of 1st month and third month. At first month the mean score of group C was 0.8 which was comparatively higher than group A and group B which was 0.3 and 0.7. At the end of 3rd month mean score for group C was 1.9 which was significantly higher as compared to group A and group B with mean score1.2 and 1.6 respectively (**Table8**).

Trabecular Pattern

In terms of trabecular pattern, there was a statistically significant difference in the scores of groups A and B as compared to group C at the end of 3 months. The mean scores of group C, B, A being 1.9>1.7>1.3, respectively. Furthermore, there was a significant difference in the 3rd month and 1st month scores of all three groups (**Table7**).

For lesion, trabecular pattern for group C was higher at the end of 1st month with a mean score of 0.9 as compared to other two groups. At the end of third month mean score of group C was 1.7 as compared to group A and group B with a mean score of 1.5 and 1.3 respectively (**Table9**).

Soft Tissue Healing

The soft tissue was assessed clinically and scores were assigned as per the Landry and Turnbull index. Comparison of three study groups (A, B, C) with respect to soft tissue scores at 3rd day, 7th day, was done using Kruskal–Wallis ANOVA test. On the 7th day, the mean score of group B was 3.7 and that of group A was 3.3. Both these scores were higher as compared to the mean score of group C which was 3.0 (**Table10**).

Table2: Distribution of age according to graft sites of subjects

Age (Years)	**Mandible**		**Maxilla**	
	No.	%	**No.**	%
<35	44	48.9	10	11.1
35-50	26	28.9	10	11.1
Grand Total	70	77.8	20	22.2

Table3: Distribution of age according to placement of PRP, PRF and bone graft at healing sites

Age (Years)	**PRP**		**PRF**		**Bone Graft**	
	No.	%	**No.**	%	**No.**	%
<35	18	20	20	22.2	16	17.7
35-50	12	13.3	10	11.1	14	15.6

Table4: Distribution of pain at various intervals of the subjects

Postoperative Day	PRP(Mean Value)	PRF(Mean Value)	Bone Graft (Mean Value)
1st Day	3.4	3.3	3.6
3rd Day	1.2	1.0	1.4
7th Day	0.3	0.2	0.5

COMPARISON OF BONE HEALING INDEX OF PATIENTS

Table5: Comparison of the three study groups with respect to lamina dura scores

Months	PRP(Mean Value)	PRF(Mean Value)	BoneGraft(Mean Value)
1st Month	0.5	0.7	0.9
3rd Month	1.5	1.6	1.8

Table6: Comparison of the three study groups with respect to overall density scores

Months	PRP(Mean Value)	PRF(Mean Value)	BoneGraft(Mean Value)
1st Month	41.43	55.085	65.17
3rd Month	73.44	76.23	84.2

Table7: Comparison of the three study groups with respect to trabecular pattern scores

Months	PRP(Mean Value)	PRF(Mean Value)	BoneGraft(Mean Value)
1st Month	0.2	0.6	0.9
3rd Month	1.3	1.7	1.9

COMPARISON OF BONE HEALING INDEX OF PATIENTS (LESION GROUP)

Table8: Comparison of the three study groups with respect to overall density scores

Months	PRP(Mean Value)	PRF(Mean Value)	Bone Graft (Mean Value)
1st Month	44.5	56.15	65.44
3rd Month	72.1	76.5	84.3

Table9: Comparison of the three study groups with respect to trabecular pattern scores

Months	PRP(Mean Value)	PRF(Mean Value)	Bone Graft (Mean Value)
1st Month	0.3	0.6	0.9
3rd Month	1.3	1.5	1.7

Table10: Comparison of soft tissue healing index of patient

Day	PRP(Mean Value)	PRF(Mean Value)	Bone Graft (Mean Value)
3rd day	2.4	2.6	2.2
7th day	3.3	3.7	3.0

IV. Discussion

As this saying goes, the limitation of surgery is that it neither guarantees nor even promote bone healing. Bone is a specialized form of connective tissue that provides support and protection for vital structures. Bone is a unique tissue; it can be injured and then can repair itself and return to its full function without scarring or undergoing deformity. The replacement of osseous defects has been attempted for centuries and still, Surgeons are continuously searching for ways to improve the success of bone grafting with either autogenous bone, bone substitutes or substance which can enhance healing.

Several studies including *in vivo* animal studies suggest that biological mediators such as growth factors can be used to accelerate the healing of soft tissue and bone.

He et al. [13] conducted a study to evaluate and compare the effect of biologic features of PRP and PRF on proliferation and differentiation of rat osteoblasts. It was observed that PRF demonstrated controlled and long- term release of the growth factors as compared to PRP. Furthermore, PRF showed better effects on the proliferation and differentiation of rat osteoblasts as compared to PRP.

A study conducted by **Hatakeyamaet al**. [14] comparing the effect PPP, PRP, and PRF on healing of extraction sockets with buccal dehiscence in dogs and it was found that bone maturation in both the PRP and PRF groups was more than that in PPP. Furthermore, a better condensed fibrin network that was more compactly arranged was found in the PRF group when compared with the PPP and PRP groups.

However, the growth factors released from platelets in PRP indicated higher concentrations than that in PRF.

Gotzet al. [15] assessed the immunohistochemical properties of hydroxyapatite nanocrystalline silica gel on biopsies obtained from human jaw bones. Based on the results of the study, they concluded that NanoBone®

had osteoconductive and biomimetic properties and was integrated into the host's physiological bone turnover at a very early stage.

PRP, PRF contain growth factors in concentrated form. PRP or PRF when placed in the extraction sockets release PDGF, transforming growth factor‑ beta, fibroblast growth factor, vascular endothelial factor, and numerous other proteins that facilitate soft and hard tissue healing, collagen production, improve wound strength, and kick start callus formation.

Bone regeneration after surgical intervention takes place in a very slow manner. Hence, to enhance these processes a number of bone substitutes are being tried out. The objective of using a bone graft is to achieve successful and complete healing of the bone. Bone grafting is the most common form of regeneration therapy. A variety of materials are available for bone regeneration, which are highly osteoconductive or osteoinductive like Hydroxyapatite, freeze dried bone graft, bioactive glass, emdogain, PTR polymer, MTA, tricalcium phosphate, and octacalcium phosphate.

In our study the intensity of pain was recorded on 1st, 3rd and 7th post-operative day using Visual Analogue Scale.

On 7th post-operative day,a significant difference in mean value of pain intensity was seen with a mean value of (0.3) for group A, (0.2) for group B and (0.5) for group C. Maximum reduction in pain in accordance to mean value was recorded with PRF group (0.2) and PRP group (0.3) than bone graft group (0.5) on the 7^{th}postoperative day.

The results were similar to **Balse et al.** [16]which also stated maximum reduction in pain with PRF group when compared to PRP and bone graft site on the 7^{th} post-operative day. In 2016 similar study done by **Dutta et al.**[17]showed same result. PRF closed site gave better result as compared to other groups with significant difference in reduction in pain intensity on 7^{th} post-operative day as compared to 1^{st} and 3^{rd} postoperative day.

We evaluated the soft tissue clinically using healing index by Landry et al. in accordance with the study by **Y Tejesh et al**. [18]in which they found a significant difference in the healing potentials of PRP, PRF and bone graft and they found PRF to be better. In our study, the mean score for soft tissue healing was 3.7 for the PRF group and 3.3 for PRP group, whereas it was 3.0 for the bone graft group. Thus, both group A and group B showed a better soft tissue healing as compared to the group C and the healing score of PRF was greater than that of PRP, the result being similar to the study conducted by **Y Tejesh et al.** [18]and also in accordance with the study conducted by **Hatakeyama et al**. [14]However, only the difference between the healing potentials of PRF and the bone graft group was statistically significant. These results were also similar to **Dutta et al.** [17]which stated that soft tissue healing with PRF closed site was better than PRP and bone graft site. However, there was a significant less difference between the mean value of PRF and PRP group on the postoperative day.

Our study demonstrated that the use of PRP and PRF in extraction socket and lesions was more beneficial in accelerating the healing of soft tissue than HA. PDGF and epidermal growth factor are mainly involved in the migration of fibroblast, their proliferation, and collagen synthesis, thereby accelerating soft tissue wound healing. Thus, the use of platelets in bone defects to improve, fasten healing, and stimulate new bone formation is quite justifiable.

Bone healing in extraction socket was assessed in terms of three parameters LD, overall density and trabecular pattern and bone healing in lesion was assessed in terms of overall density and trabecular pattern.

In our study, it was found that at the end of 1st month and 3rd month, the mean LD score of group C was higher than that of group A and group B. At the end of 1 month, the mean LD score of group C was 0.9 whereas that of group A and B was 0.5 and 0.7 respectively. At the end of 3 months, the mean LD score of group C was 1.8 whereas that of A and B was 1.5 and 1.6 respectively. In terms of duration, there was a significant difference in the LD scores of all the three groups at the end of 3 months. The results were similar to study conducted by **Balse et al.** [16]as the mean LD score with the bone graft closed sites was better than PRP and PRF closed sites on 3^{rd} month postoperatively. **Dutta et al.**[17]studied comparing the efficacy of PRP, PRF and bone graft in third molar extraction socket showed similar result and the mean value of bone graft for lamina dura was significantly high as compared to PRP and PRF sites at the end of third month postoperatively. The results were also similar to the study done by **Balse et al.** [16]where lamina dura score third month postoperatively were significantly higher for bone graft as compared to PRP and PRF in extraction sockets.

There was significant difference in the overall density between the three groups postoperatively in both extraction socket and lesion cases. The group C showed better density as compared to group B and group A both at the end of 1st month and 3rd month. This result is partly in accordance with that of the study conducted by **Y. Tejesh et al.** [18]in which they compared the densities using Adobe Photoshop CS software. In a similar study by **Dutta et al.** [17]same result with increased overall density with bone graft site were found as compared to PRP and PRF group. There was significant difference in mean value of bone graft cases and compared to PRP and PRF cases at the end of 3^{rd} month. **Balse et al.** [16]used the same bone healing index used in our study to assess the efficacy of PRP in extraction sockets. Although they got better scores of the study group suggesting better

healing, they suggest interpreting the results obtained based on this bone healing index with caution as the difference was not statistically significant in their study.

The last parameter used to assess bone healing in our study was trabecular pattern. There was a statistically significant difference in the scores of group C as compared to group A and group B at the end of 3 months. The studies by **Balse et al.,**[16]**Dutta et al.,**[17]**Y. Tejesh et al.** [18]showed similar results with significantly increase in trabecular pattern mean value in bone graft group as compared to PRP and PRF group at the end of third month postoperatively.

All the materials used in this study were found to be biocompatible with no detectable evidence of foreign body reaction or rejection of the material. One of the disadvantages of PRP and PRF over HA is that former preparation is cumbersome procedure. Both preparations need patient's blood collection and taking to laboratory which requires some time while HA is readily available and can be placed immediately. The use of HA granules (G Bone) is cost-effective for the patients compared to other bone graft materials. The limitation of this study was that three months postoperative follow‐ up period was short to comment on the efficacy of various graft materials in complete bone regeneration process but adequate to evaluate the effects of initiating and enhancing the role in pain, swelling, also in soft tissue healing. However, long-term follow-up along with histological study of the bone is required for assessment of the efficacy of various graft materials.

V. Conclusion

In the study conducted in the department of oral and maxillofacial surgery, Rajasthan Dental College and Hospital, we have made an attempt to identify the efficacy of platelet rich plasma, platelet rich fibrin and bone graft in the healing of extraction sockets and oral and maxillofacial lesion.The results obtained from the study clearly indicate that in cases treated with PRP and PRF there was obvious improvement in the pain, swelling, and healing of soft tissue. In regeneration of bone after third molar surgery and periapical surgery, bone graft group is much better as compared to the PRP and PRF-treated patients postoperatively. The use of bone substitutes helps in rapid and qualitative bone regeneration when compared to natural healing. In addition, the procedure for the preparation of PRP and PRF in this study is simple, economical, and exhibited fruitful results.

In conclusion "Primitively established in 1965, the field of growth factor technology made stellar advances for many years despite a total lack of clinical application. Begning in 1998, the clinical science of growth factors grew exponentially which is proven to be boon in treatment of osseous defects and in soft tissue healing".

The study consisted fair number of patients but with a limited follow up period. Hence a more extensive study with a longer period of follow up is required to come to a definitive conclusion.

References

[1]. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part III: leucocyte activation: a new feature for platelet concentrates? Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 2006 Mar;101(3):e51-5

[2]. Singer AJ, Clark RA. Cutaneous wound healing. N Engl J Mea. 1999; 341(10):738-46.

[3]. Ross R, Glomset J, Kariya B, Harker L Proc. A platelet-dependent serum factor that stimulates the proliferation of arterial smooth muscle cells in vitro. NatnAcad Sci USA. 1974;71:1207–10.

[4]. Kiran NK, Mukunda KS, Tilak Raj TN. Platelet concentrates: A promisinginnovationindentistry.J DentSciRes.2011;2:50-61.

[5]. Robert E Marx, Eric R Carlson. Platelet-rich plasma. Growth factor enhancement for bone grafts. Oral Surgery, Oral medicine, Oral pathology and Oral radiology and endodontics. 1998;85:638-46.

[6]. Intini G. The use of platelet-rich plasma in bone reconstruction therapy. Biomaterials. 2009;30(28):4956–66.

[7]. Oltramari PV, Navarro Rde L, Henriques JF, Taga R, Cestari TM, Janson G,et al. Evaluation of bone height and bone density after tooth extraction: anexperimental study in minipigs. Oral Surg Oral Med Oral Pathol Oral RadiolEndod.2007;104:e9-16.

[8]. Constantine PD, Friedman CD. Synthetic bone graft substitute. Otolaryngolclin North Am. 1994;1037-74.

[9]. Maté-Sánchez de Val JE, Mazón P, Guirado JLC, Ruiz RA, Ramírez Fernández MP, Negri B, et al. Comparison of three hydroxyapatite / β- tricalcium phosphate/collagen ceramic scaffolds: an in vivo study. J Biomed Mater Res A. 2014 Apr;102(4):1037-46.

[10]. Kumar P, Tripathi L. Challenges in pain assessment: Pain intensity scales. Indian J Pain. 2014 May 1;28(2):61-70.

[11]. Vivek GK, Sripathi Rao BH. Potential for osseous regeneration of platelet rich plasma: a comparative study in mandibular third molar sockets. J Maxillofac Oral Surg. 2009 Dec;8(4):308-11.

[12]. Dar M, Hakim T, Shah A, Najar L, Yaqoob G, Lanker F. Use of autologous platelet-rich fibrin in osseous regeneration after cystic enucleation: a clinical study. J Oral Biol Craniofac Res. 2016 Nov;6:S29-32.

[13]. 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 RadiolEndod. 2009 Nov;108(5):707-13.

[14]. Hatakeyama I, Marukawa E, Takahashi Y, Omura K. Effects of platelet-poor plasma, platelet-rich plasma, and platelet-rich fibrin on healing of extraction sockets with buccal dehiscence in dogs. Tissue Eng Part A. 2014 Feb;20(3-4):874-82.

[15]. Götz W, Gerber T, Michel B, Lossdörfer S, Henkel KO, Heinemann F. Immunohistochemical characterization of nanocrystalline hydroxyapatite silica gel (NanoBone(r)) osteogenesis: a study on biopsies from human jaws. Clin Oral Implants Res. 2008 Oct;19(10):1016-26.

[16]. Balse N, Baliga S. Evaluation of wound healing and bone regeneration using autologous platelet-rich plasma and platelet-rich fibrin postextractions: A comparative study. Indian J Health Sci Biomed Res. 2017 May 1;10(2): 167-72.
[17]. Dutta SR, Passi D, Singh P, Sharma S, Singh M, Srivastava D. A randomized comparative prospective study of platelet-rich plasma, platelet-rich fibrin, and hydroxyapatite as a graft material for mandibular third molar extraction socket healing. Natl J Maxillofac Surg 2016;7:45-51
[18]. Yelamali T, Saikrishna D. Role of platelet rich fibrin and platelet rich plasma in wound healing of extracted third molar sockets: a comparative study. J Maxillofac Oral Surg. 2015 Jun;14(2):410-6.

Dr. Neel Kamal, et. al. "Efficacy of Platelet Rich Plasma, Platelet Rich Fibrin and Bone Grafts in the Healing Of Oral and Maxillofacial Lesions and Extraction Sockets: A Comparative Study." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 22(2), 2023, pp. 58-68.