

## Role of Platelet Rich Plasma in Healing of the Wound – A Comparative, Clinical and Radiographic Study.



### Medical Science

**KEYWORDS :** Platelet-Rich Plasma, Autologous bone graft, Bone healing, osseous defect.

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### ABSTRACT

**Purpose:** this study was done to assess the role of platelet rich plasma in healing of the wound.

**Materials and methods:** 30 patients with identical bilaterally impacted mandibular third molars were selected for the study. Bilateral third molar surgery was carried out in the same appointment. PRP gel was placed in one extraction socket and other was left to heal naturally. Both sockets were closed primarily. Periodic evaluation was done using measurement of Bone density on KODAK digital radiographic software and evaluation of probing depth using Michigan 'O' Probe with Williams marking.

**Result:** The results showed better soft tissue healing of extraction sockets with use of PRP in the early phase.

### Introduction:

The ultimate goal in oral surgical therapy after extraction of tooth is creation of an environment that is conducive to maintaining the patient's remaining dentition in health, comfort and function. The shift in the therapeutic concepts from resection to regeneration has significantly influenced the practice of oral and maxillofacial surgery in the last quarter of this century<sup>1</sup>.

Periodontal pocket formation on the distal of mandibular 2<sup>nd</sup> molar and subsequent cementum exposure following removal of partially erupted or impacted 3<sup>rd</sup> molars has been a problem in oral surgical practice.<sup>3, 4, 5, 6</sup> Management is usually directed at periodontal maintenance of the area and at osseous defects created by the surgical removal of 3<sup>rd</sup> molar.<sup>8</sup>

Several Autogenous and allogenic bone grafting materials are available for repairing osseous periodontal defects. Guided tissue regeneration has also been used to reconstruct 3<sup>rd</sup> molar defect.<sup>3, 4, 8</sup>

Autogenous bone is considered gold standard because of its osteoinductive and osteoconductive properties as it is a source of osteoprogenitor cells. In spite of the advantages sufficient autologous bone may not be available or harvesting would require additional surgical sites, patient morbidity and increase in clinician's chair time.<sup>9, 10</sup>

A new era of regenerative medicine /tissue engineering has emerged which offers alternatives to improve the traditional bone grafting procedures.

Platelet rich plasma (PRP), a biologically active sealant is derived from autologous blood collected in the immediate preoperative period containing high concentration of platelets is reported to enhance healing.

### Aims and Objectives of the study:

1. To evaluate the ability of platelet rich plasma to enhance the rate of wound healing & to reduce the organized clot vulnerability to environmental factors.
2. To ensure a bone superior in quantity as well as quality after tooth extraction
3. To assess Platelet rich plasma as a more predictable method of tissue regeneration in mandibular third molar extraction sockets.

4. To provide a method of platelet concentration, which require less specialized machinery.

### Material methods:

Thirty patients reporting to the Department of Oral and Maxillofacial Surgery, of our college presenting with identical bilaterally impacted mandibular third molars were selected for the study.

### Exclusion criteria

- 1) Patients with blood dyscrasias.
- 2) Pregnant women.
- 3) Patients on anticoagulant therapy.
- 4) Patients with history of recent myocardial infarction.
- 5) Patients suffering from any systemic disorders.

The surgical sites were divided into 2 groups:

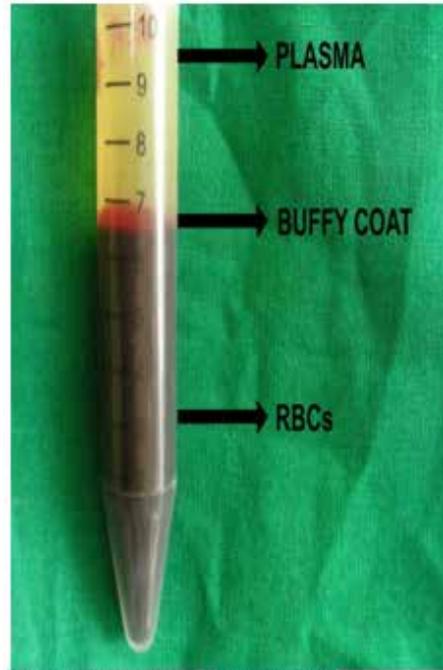
- 1) GROUP I – In this group the extraction socket was left to heal naturally after primary closure.
- 2) GROUP II – in which PRP was placed in the extraction socket.

### PREPARATION OF PLATELET RICH PLASMA

- 1) 10 ml blood was drawn from the patient by venepuncture at the antecubital fossa.
- 2) This blood was transferred to an autoclaved centrifugation tubes containing 1 ml of anticoagulant ACD (acid citrate dextrose).
- 3) This blood sample was then centrifuged at 1000 rpm for 13 minutes to be separated into RBCs, buffy coat layer and plasma.
- 4) 5 ml syringe was used to aspirate the straw coloured plasma and 1 to 2 mm of the top portion of the RBC layer.
- 5) It was then transferred to another autoclaved centrifugation tube and centrifuged at 2000 rpm for 10 minutes to separate serum and PRP.
- 6) The PRP was aspirated by inserting the syringe into the centrifugation tube.
- 7) The contents of the syringe were then expressed into a sterile container.
- 8) 0.5 ml of 10% calcium gluconate was added to the PRP to get a gel like consistency.

In our technique calcium gluconate alone was mixed with PRP to form an autologous platelet gel. This platelet gel was free of eliciting any antigen-antibody reaction as it was prepared from patients own blood.

STEPS IN PREPARATION OF PLATELET RICH PLASMA



3 LAYERS OBTAINED AFTER ASPIRATED SUPERNATANT

1<sup>ST</sup> CENTRIFUGATION

DRAWING OF BLOOD AT THE PLACING THE BLOOD IN THE ANTECUBITAL FOSSA. CENTRIFUGE.



PLATELET RICH PLASMA (at the bottom of the tube) OBTAINED AFTER 2ND CENTRIFUGATION



PRP ASPIRATED AFTER 2<sup>ND</sup> PLATELET RICH PLASMA GEL CENTRIFUGATION



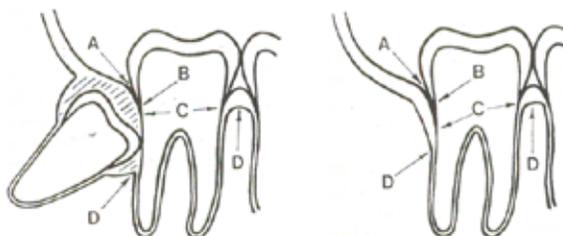
**PLATELET RICH PLASMA GEL READY**

Bilateral third molar surgery was carried out at the same appointment. The PRP gel was placed in one extraction socket (GROUP II) and another extraction socket (GROUP I) was left to heal naturally and both the sockets were closed primarily thereafter.

Follow-up Probing Depth was measured and Intraoral digital radiographs of both the surgical sites were taken at 2 month, 4 months and 6 months interval.

**Measurement of Various Parameters**

**For clinical & radiographic evaluation certain landmarks were used<sup>1</sup>:**



- A = Free gingival margin (fgm)
- B = Cementoenamel junction. (CEJ)
- C = Bottom of the pocket.
- D = Alveolar crest.

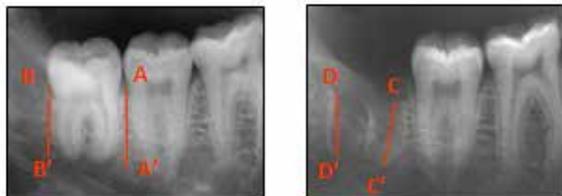
**1. Probing depth (PD).** Probing depth was measured using Michigan 'O' Probe with William's markings. Measurements were made in 3 different positions of the second molar {Distobuccal (DB), Distal (D) and Distolingual (DL)}; PD was measured from free gingival margin to the bottom of the pocket in mm. The average of PD at the three different positions i.e. DB, D, DL was taken pre-operatively, 2<sup>nd</sup>, 4<sup>th</sup>, and 6<sup>th</sup> month post operatively.

**MEASUREMENT OF BONE DENSITY**

Radiovisiographic images were taken pre-operatively and at the end of 2<sup>nd</sup> month, 4<sup>th</sup> month and 6<sup>th</sup> month post-operatively, using KODAK RVG and the densitometric analysis was done on KODAK digital radiography software.

The preoperative RVG image of mandibular third molar was taken and the average density of the surrounding bone just mesial (A to A') and just distal to the third molar (B to B') was measured using KODAK digital radiography software. The Mean of the above averages was taken as preoperative density.

Similarly, the post operative RVG image was taken on 2<sup>nd</sup>, 4<sup>th</sup> and 6<sup>th</sup> month postoperatively and the bone density calculated.



**Preoperative and post operative RVG Images showing method to evaluate bone density**

**Pre operative density** = Average density from A to A'+Average density from B to B'

2

Where, Point A = Point at alveolar crest just mesial to 3<sup>rd</sup> molar.

Point A' = Point just mesial to 3<sup>rd</sup> molar at the level of apical third.

Point B and B' = Points in similar fashion but distal to mandibular third molar.

**Post operative density**=Average density from C to C'+Average density from D to D'

2

Where, Point C = Mesial Point in the 3<sup>rd</sup> molar socket at the alveolar crest level.

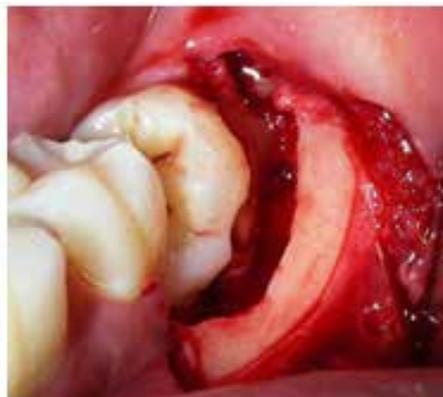
Point C' - Mesial Point in the 3<sup>rd</sup> molar socket at the level of apical third.

Point D and D'- Points in similar fashion but at the distal aspect of the 3<sup>rd</sup> molar extraction site.

**STEPS SHOWING SURGICAL REMOVAL OF THIRD MOLAR AND PLACEMENT OF PRP.**



**PRE-OP INCISION AND REFLECTION OF FLAP**



**BONE REMOVAL EXTRACTION SOCKET FOLLOWING TOOTH REMOVAL**

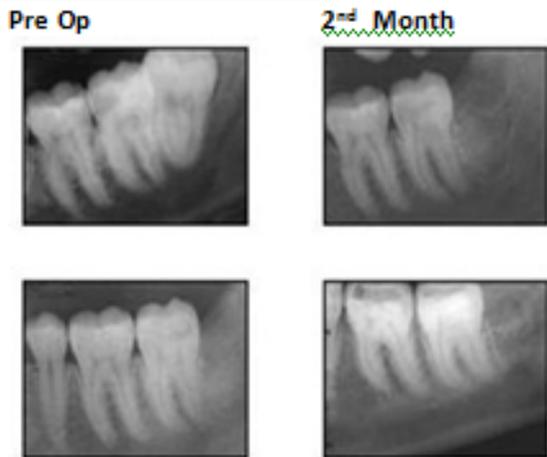


**PLACEMENT OF PRP**

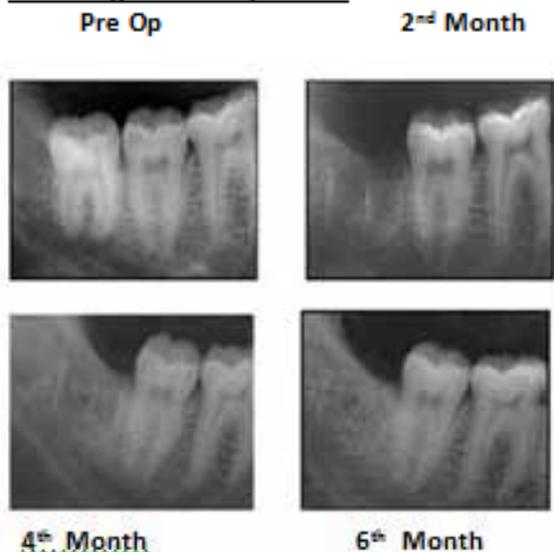


**CLOSURE OF THE SURGICAL SITE**

**RVG Images of Group I Case**



**RVG Images of Group II Case**



|    |      |      |      |      |      |      |      |      |
|----|------|------|------|------|------|------|------|------|
| 5  | 4.00 | 3.00 | 2.00 | 1.33 | 4.00 | 2.00 | 2.00 | 1.00 |
| 6  | 4.66 | 3.66 | 2.66 | 1.66 | 4.33 | 2.33 | 4.00 | 1.00 |
| 7  | 5.00 | 3.66 | 2.00 | 1.66 | 5.00 | 3.00 | 1.66 | 1.00 |
| 8  | 4.00 | 3.00 | 2.00 | 1.00 | 3.33 | 2.33 | 1.33 | 1.00 |
| 9  | 4.00 | 3.00 | 2.00 | 1.00 | 4.66 | 3.66 | 2.00 | 1.66 |
| 10 | 5.00 | 3.66 | 2.00 | 1.66 | 5.00 | 3.00 | 1.66 | 1.00 |
| 11 | 4.66 | 3.00 | 2.00 | 1.00 | 4.00 | 2.33 | 2.00 | 1.00 |
| 12 | 5.00 | 3.66 | 2.00 | 1.00 | 3.33 | 2.66 | 1.33 | 1.00 |
| 13 | 4.00 | 3.00 | 2.00 | 1.66 | 4.00 | 2.33 | 2.00 | 1.66 |
| 14 | 5.33 | 4.00 | 2.00 | 1.33 | 5.00 | 3.00 | 1.66 | 1.33 |
| 15 | 3.66 | 2.00 | 2.00 | 1.33 | 3.66 | 2.00 | 2.00 | 1.00 |

**Table 2 : BONE DENSITY ON RVG (In Pixels) I**

| Case No. | Group I (Control Group) |          |          |          | Group II (PRP Group) |          |          |          |
|----------|-------------------------|----------|----------|----------|----------------------|----------|----------|----------|
|          | Pre op                  | 2 Months | 4 Months | 6 Months | Pre op               | 2 Months | 4 Months | 6 Months |
| 1        | 136                     | 108      | 120      | 126      | 134                  | 110      | 113      | 127      |
| 2        | 142                     | 116      | 125      | 136      | 148                  | 109      | 122      | 138      |
| 3        | 117                     | 90       | 101      | 109      | 121                  | 105      | 109      | 113      |
| 4        | 128                     | 98       | 108      | 118      | 136                  | 121      | 110      | 101      |
| 5        | 137                     | 109      | 116      | 121      | 140                  | 89       | 115      | 127      |
| 6        | 130                     | 109      | 116      | 124      | 135                  | 126      | 109      | 119      |
| 7        | 140                     | 97       | 119      | 128      | 143                  | 109      | 125      | 132      |
| 8        | 127                     | 91       | 104      | 115      | 124                  | 97       | 102      | 120      |
| 9        | 132                     | 96       | 109      | 121      | 140                  | 99       | 115      | 127      |
| 10       | 118                     | 78       | 90       | 106      | 139                  | 119      | 123      | 133      |
| 11       | 141                     | 99       | 114      | 128      | 144                  | 92       | 108      | 128      |
| 12       | 116                     | 74       | 93       | 107      | 122                  | 90       | 103      | 117      |
| 13       | 128                     | 94       | 112      | 122      | 141                  | 108      | 121      | 130      |
| 14       | 136                     | 108      | 117      | 125      | 139                  | 102      | 112      | 120      |
| 15       | 120                     | 78       | 89       | 106      | 127                  | 98       | 109      | 114      |

**Table 3: PROBING DEPTH (fgm to bottom of the pocket, in mm)**

| S. No.      | GROUP I (Control Group) |               |               |               | GROUP II (PRP Group) |               |               |               |
|-------------|-------------------------|---------------|---------------|---------------|----------------------|---------------|---------------|---------------|
|             | Pre op                  | 2 Mo. Post-op | 4 Mo. Post-op | 6 Mo. Post-op | Pre op               | 2 Mo. Post-op | 4 Mo. Post-op | 6 Mo. Post-op |
| <b>MEAN</b> | 4.5313                  | 3.2640        | 2.0440        | 1.308         | 4.3313               | 2.7087        | 1.9533        | 1.1540        |
| <b>SD.</b>  | 0.5316                  | 0.50485       | 0.17041       | 0.29163       | 0.6179               | 0.5317        | 0.6168        | 0.27516       |

**Table 4: BONE DENSITY ON RVG IMAGE (in Pixels)**

| S. No.      | GROUP I (Control Group) |               |               |               | GROUP II (PRP Group) |               |               |               |
|-------------|-------------------------|---------------|---------------|---------------|----------------------|---------------|---------------|---------------|
|             | Pre op                  | 2 Mo. Post-op | 4 Mo. Post-op | 6 Mo. Post-op | Pre op               | 2 Mo. Post-op | 4 Mo. Post-op | 6 Mo. Post-op |
| <b>MEAN</b> | 129.86                  | 96.33         | 108.86        | 119.466       | 135.53               | 104.93        | 113.066       | 123.066       |
| <b>SD.</b>  | 8.927                   | 12.635        | 11.274        | 9.1563        | 8.365                | 11.234        | 7.075         | 9.497         |

**Results and observation**

- All the subjects completed the study.
- The results were evaluated based on clinical observation and densitometric analysis of the RVG image.
- All results were calculated using the mean value and standard deviation for each of the Paired t Test.
- The differences in the results of PD and Bone density at 2, 4, and 6 months were compared between each group using.
- Results of all the parameters have been shown from table 1 to table 8.

**Table 1: Probing Depth (fgm to bottom of the pocket, in mm)**

| Case No. | Group I (Control Group) |          |          |          | Group II (PRP Group) |          |          |          |
|----------|-------------------------|----------|----------|----------|----------------------|----------|----------|----------|
|          | Pre op                  | 2 Months | 4 Months | 6 Months | Pre op               | 2 Months | 4 Months | 6 Months |
| 1        | 4.00                    | 3.00     | 2.00     | 1.00     | 4.00                 | 2.33     | 2.00     | 1.00     |
| 2        | 5.00                    | 3.66     | 2.00     | 1.00     | 5.00                 | 3.00     | 1.66     | 1.00     |
| 3        | 4.66                    | 3.00     | 2.00     | 1.33     | 4.66                 | 3.66     | 2.00     | 1.00     |
| 4        | 5.00                    | 3.66     | 2.00     | 1.66     | 5.00                 | 3.00     | 2.00     | 1.66     |

**Table 5: PROBING DEPTH(PD)**

**Difference between Group I & Group II**

|                    | GROUP I          | GROUP II        | p-value |
|--------------------|------------------|-----------------|---------|
| Pre-operative      | 4.5313 ± 0.53161 | 4.3313 ± 0.6179 | 0.35    |
| <b>At 2 Months</b> | 3.2640 ± 0.50485 | 2.7087 ± 0.5317 | *0.0007 |
| <b>At 4 Months</b> | 2.0440 ± 0.1704  | 1.9533 ± 0.6168 | 0.588   |
| <b>At 6 Months</b> | 1.308 ± 0.2916   | 1.1540 ± 0.2751 | 0.148   |

**Table 6: BONE DENSITY ON RVG IMAGE (in Pixels)**

**Difference between Group I & Group II**

|                    | GROUP I          | GROUP IIa       | p-value |
|--------------------|------------------|-----------------|---------|
| Initial            | 129.86 ± 8.927   | 135.53 ± 8.365  | 0.84    |
| <b>At 2 Months</b> | 96.33 ± 12.635   | 104.93 ± 11.234 | 0.59    |
| <b>At 4 Months</b> | 108.86 ± 11.274  | 113.066 ± 7.075 | 0.232   |
| <b>At 6 Months</b> | 119.466 ± 9.1563 | 123.066 ± 9.497 | 0.300   |

Significant \*p<0.05

**Table 7 : Difference between Probing Depth at Intervals**

| Difference between      | GROUP I (Mean/Sd) | GROUP II (Mean/Sd) | p-value |
|-------------------------|-------------------|--------------------|---------|
| <b>Pre Op -2 months</b> | 1.26733 ± 0.2565  | 1.622 ± 0.4687     | *0.016  |
| Preop - 4 months        | 2.4873 ± 0.5472   | 2.378 ± 0.837      | 0.675   |
| <b>Pre op -6months</b>  | 3.223 ± 0.5435    | 3.177 ± 0.602      | 0.828   |
| <b>2 months-4months</b> | 1.2200 ± 0.4965   | 0.755 ± 0.8872     | 0.088   |
| <b>2 months-6months</b> | 1.956 ± 0.5150    | 1.554 ± 0.5130     | *0.041  |
| <b>4 months-6months</b> | 0.7360 ± 0.2844   | 0.7993 ± 0.6759    | 0.741   |

Significant \*p<0.05

**Table 8 : Difference between Bone Density at intervals**

| Difference between      | GROUP I          | GROUP II         | p-value |
|-------------------------|------------------|------------------|---------|
| Pre Op -2 months        | 33.533 ± 7.17004 | 30.600 ± 12.557  | 0.439   |
| <b>Preop - 4 months</b> | 21.000 ± 4.9425  | 22.466 ± 5.7677  | 0.461   |
| <b>Pre op -6months</b>  | 10.4000 ± 2.9952 | 12.466 ± 7.5863  | 0.335   |
| <b>2 months-4months</b> | -12.533 ± 4.356  | -8.133 ± 10.87   | 0.157   |
| <b>2 months-6months</b> | -23.133 ± 6.3230 | -18.133 ± 15.310 | 0.257   |
| <b>4 months-6months</b> | -10.600 ± 3.5010 | -10.000 ± 6.9487 | 0.767   |

Significant

\* p<0.05

The mean initial probing depth in both groups was 4.5313 +/- 0.50485 at 2 months, 2.0440 +/- 0.17041 at 4 months and 1.308 +/- 0.29163 at 6 months.

Similarly, the decrease in Probing Depth in Group II was 2.7087 +/- 0.5317 at 2 months, 1.9533 +/- 0.6168 at 4 months, 1.1540 +/- 0.27516 at 6 months.

The statistical analysis showed a highly significant reduction in probing depth from the initial period to 2 months in Group

I and II. Concerning the probing depth, the difference between both the groups are presented in table 5, favoring Group II at 2, 4 and 6 months. Statistically highly significant difference was seen at 2<sup>nd</sup> month.

The Results of Bone Density are presented in table 6. The mean initial density of the bone adjacent to the extraction socket in Group I and Group II was 129.86 +/- 8.927 and 135.53 +/- 8.365 respectively.

The mean Bone density of Group I was 96.33 +/- 12.635 at 2 months, 108.86 +/- 11.274 at 4 months and 119.466 +/- 9.1563 at 6 months.

The mean BD of Group II was 104.93 +/- 11.234 at 2 months, 113.066 +/- 7.075 at 4 months and 119.466 +/- 9.1563 at 6 months.

Table 6 shows that the difference in BD between Groups I and II at 2, 4, 6 months was not statistically significant.

Table 7 shows the difference between the mean probing depth from preoperative- 2 months, Preoperative -4 months, Preoperative -6 months, 2 months-4 months, 2months - 6 months and 4 months-6 months in both the groups. It was observed that the difference between Group I and Group II from preoperative to 2 months was statistically significant, favoring Group II.

Table 8 shows the difference between the mean bone density from preoperative- 2 months, Preoperative -4 months, Preoperative -6 months, 2 months-4 months, 2months - 6 months and 4 months-6 months in both the groups. The difference between both the groups was not statistically significant.

**DISCUSSION AND CONCLUSION:**

Surgeons are continuously searching for ways to improve bone healing and success of bone grafting with either autogenous bone or other bone substitutes. One of the most recent and innovative technique which has come up is the use of PRP. The theory behind PRP is compelling. It is now known that platelets have many functions beyond that of simple haemostasis. Platelets contain important growth factors, that are secreted, are responsible for increasing cell mitosis, increasing collagen production, recruiting other cells to the site of injury, initiating vascular ingrowth, and, inducing cell differentiation. These are crucial steps in early wound healing. Using the concept that increasing the concentration of platelets at a wound site may promote more rapid and better healing, it seems very logical that increasing the concentration of platelets in the bone graft and therefore increasing the concentration of growth factor may lead to more rapid and denser bone regeneration. There are various methods of PRP preparation from autologous blood. Techniques vary from using 10cc of blood in a clinical laboratory centrifuge to using a unit(250-450cc) of whole blood that is put in the cell separator; they sequester and concentrate the platelets . At a minimum, any procedure developed to concentrate platelets should be able to show a sufficiently high concentrate of platelets to affect a clinical outcome and demonstrate high percentage of growth factor in the resulting concentrate, as well as a variable platelet population.

The present study was an attempt to evaluate the role of platelet rich plasma in healing of the wound compared to the natural healing that takes place without using PRP in third molar sockets.

The study comprised of 15 patients in the age group of 16-30 yrs, presenting with identical bilaterally impacted third molars were selected for the study. These patients were divided into 2 groups.

- 1) **Group I:** In this group the extraction socket was left to heal naturally after primary closure.
  - 2) **Group II:** In this group the extraction socket was filled with autologous platelet rich plasma and primary closure was done
- The wound status and the bone density of the extraction sockets, Probing depth, distal to 2<sup>nd</sup> molar were evaluated in post operative follow up visits at 2<sup>nd</sup>, 4<sup>th</sup>, and 6<sup>th</sup> month.
  - Concerning the Probing Depth, there was a highly significant reduction in the probing depth from the initial period to 2 months, 4 months and 6 months in both the groups, but a greater decrease was seen in Group II at the end of 2 months.
  - There was a significant difference between the preoperative density of the adjacent bone and the bone formed in the extraction socket at 2<sup>nd</sup>, 4<sup>th</sup> and 6<sup>th</sup> month postoperatively in both the groups. But this difference of bone density, between Group I and Group II, at 2<sup>nd</sup>, 4<sup>th</sup> and 6<sup>th</sup> month was not significant.
  - The results of above mentioned parameters definitely signify a better soft tissue healing of extraction sockets with use of PRP in the early phase.
  - The results of the bone density doubts the comparative efficacy of PRP as the results clearly indicated a non significant difference between both the groups.

#### We found the following advantages of PRP :

1. It provides adhesiveness and tensile strength for clot stabilization.
2. It contains a dense fibrin network that is highly osteoconductive
3. It has hemostatic properties
4. It improves wound healing
5. It is an affordable treatment modality.

## REFERENCE

1. Mumtaz B Habal and Hari A Reddi. Chapter 1- Introduction to bone grafting. Bone grafts and substitutes. Page 3-5. | 2. Carl F. Kugelburg, Ulf Ahlstrom, Sune Ericson and Anders Hugoson. Periodontal healing after impacted lower third molar surgery. A retrospective study. *Int. J. Oral Surgery* 1985; 14:29-405 | 3. Thomas B. Dodson. Reconstruction of alveolar bone defects after extraction of mandibular third molars. A pilot study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1996; 82: 241-7 | 4. Oxford G E, Quintero G, Stuller CB, and Gher ME: Treatment of 3rd molar induced periodontal defects with guided tissue regeneration. *J Clin Periodontol* 1997; 24:464-469. | 5. Hisham F. Nasar, Mary Elizabeth. Bone and Bone Substitutes. *Periodontology* 2000, 1999; Vol 19: 74-86 | 6. Yao Peng, Yuen-Chin Tseng, E-Chin, Shian-Chun Chiu, Earl Fu, and Yu-Wen Huang. Mandibular second molar periodontal status after third molar extraction. *J Periodontol* 2001; 72:1647-1651 | 7. Peter K. Moy. Clinical experience with osseous site development using autogenous bone, bone graft substitutes, and membrane barriers. *Oral and Maxillofacial Clinics of North America* Vol 13 no.3 Aug 2001, 493-509. | 8. Roger R. Thronsdon & S.Barret. Grafting mandibular third molar extraction sites: A comparison of bioactive glass to a non grafted site. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2002; 94(41) : 3-9 | 9. Carl E. Misch. Chapter 29- Bone augmentation for implant placement: Keys to Bone Grafting Contemporary Implantology. Mosby 2002; 451-467 | 10. Carl Misch. Chapter 31- Intraoral Autogenous Donor Bone Grafts for Implant Dentistry. Contemporary Implantology. Mosby 2002; 497-508. | 11. Dean H. Whitman, Ronald L. Berry and David M Green. Platelet Gel: An autologous alternative to fibrin glue with applications in oral and maxillofacial surgery. *J. Oral & Maxillofacial Surg* 1997; 55(11):1294-1299 | 12. Robert. E. Marx et al. "Platelet rich plasma: Growth factor enhancement for bone Grafts". *Oral surgery, Oral medicine, Oral pathology*. 1998; 85: 638-646. | 13. Freymiller EG, Aghaloo T.L (2004) Platelet Rich Plasma: Ready or Not? *J Oral maxillofac Surg* 62(4): 484-488 | 14. Marx RE, Carlson ER, Eichstaedt RM, Schimmele SR, Strauss JE, Georgeff KR(1998) Platelet Rich Plasma: Growth factor enhancement for bone grafts. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 85(6): 638-646