Original Article - Comparative Study

Autologous Platelet-rich Plasma after Third Molar Surgery

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Abstract

Aim and Objective: The aim of this study is to compare the efficacy of autologous platelet-rich plasma (PRP) in the third molar impactions, with respect to: pain, swelling, healing, and periodontal status distal to the second molar in patients who need surgical removal of bilateral impacted mandibular third molars. **Materials and Methods:** Twenty-five patients of both sexes aged between 16 and 60 years who required bilateral surgical removal of their impacted third molars and met the inclusion criteria were included in the study. After surgical extraction of the third molar, primary closure was performed in the control group, whereas PRP was placed in the socket followed by primary closure in the case group. The outcome variables were pain, swelling, wound healing, and periodontal probe depth that were follow-up period of 2 months. Quantitative data are presented as mean. Statistical significance was checked by *t*-test. **Results:** There was a difference in the pain (0.071) and facial swelling (0.184), reduction between test and control on day 3, but it was not found to be significant. Periodontal pocket depth (0.001) and wound healing (0.001) less in case group compared with the control group was found to be significant. **Conclusion:** The use of PRP lessens the severity of immediate postoperative sequelae and decreases preoperative pocket depth.

Keywords: Growth factor, Platelet-rich plasma, third molar

Introduction

Third molars are the teeth that are most commonly impacted. Third molars are present in 90% of the population with 33% having at least one impacted third molar, and these impactions are probably the result of both genetic and environmental factors.[1] An impacted tooth can cause the patient mild to serious problems if it remains in the unerupted state. However, surgical removal of impacted third molars is one of the most frequently performed surgical procedure to treat pathosis caused by impacted teeth. The procedure requires sound understanding of surgical principles along with patient management skills. Although it is a minor surgical procedure, its relation to adjacent soft tissues, vital teeth, and neurovascular bundle makes it a complex procedure. Periodontal pocket formation on the distal of mandibular second molar and subsequent cementum exposure following the removal of partially erupted or impacted 3rd molars has been a problem in oral and maxillofacial surgical practice.[2-5] Management is usually directed at periodontal maintenance distal to the second molar and at prevention of osseous defects created by the surgical removal of third molar.[6] Healing is a complex process which involves participation of many cell types and growth factors. The platelets, activated by coagulation cascade particularly thrombin and subendothelial collagen, release a number of growth factors from their alpha granules into the wound site.[7]

Platelet-rich plasma (PRP) is an autologous concentrate of platelets suspended in plasma.[8-10] It is a proven source of growth factors such as platelet-derived growth factors and transforming growth factor β 1 and 2, which is obtained by sequestering and concentrating platelets by gradient-density centrifugation.[11,12] By combining with calcium chloride and thrombin, PRP releases these growth factors. PRP gel also contains a native concentration of fibrinogen. As a result, it permits stabilized coagulation of blood, thereby favoring regeneration of osseous defects particularly in the early stages.

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Soft tissue healing is also substantially improved through the application of PRP, by increasing collagen content, promoting angiogenesis, and increasing early wound strength.[8] The growth factors found in PRP regulate key cellular processes, such as chemotaxis, cell differentiation, and metabolism.[11] It was Marx *et al.* popularized application of PRP in oral and maxillofacial surgery proving that PRP contains concentration of platelets up to 338% along with increased concentration of growth factors within them. When used along with bone grafts, PRP gives additional amount of growth factors shown by increased radiographic maturation rate by 1.6~ to 2.16 times.[10,11,13]

Materials and Methods

Patients of both sexes aged between 16 and 60, who had presented with bilateral mandibular impactions of similar clinical presentation and difficulty index (Pell and Gregory) were subjected to the study. Exclusion criteria were medical history such as diabetes, on anticoagulant therapy, any blood dyscrasias, pregnancy, HIV and immunocompromised, allergy to LA, and any systemic disease which have its effect in healing. Routine records for the purpose of diagnosis and treatment planning along with panaromic/intraoral periapical radiograph were obtained from all the patients. Informed written consent was taken from all the patients before treatment.

A detailed case history of the patient was obtained. An informed consent was obtained from the patients regarding the surgery as well as the use of PRP.

The surgical sites were divided into two groups:

- Group I (control) – In which PRP was not placed in the extraction socket
- Group II (test) – In which PRP was placed in the extraction socket.

Preparation of platelet-rich plasma

Ten milliliters blood was drawn from the patient by venipuncture at antecubital fossa in either of the arms. This blood was transferred to autoclaved centrifugation tubes containing 1 ml of citrate phosphate dextrose adenine (CPDA). Blood sample was centrifuged at 1300 rpm for 10 min to be separated into red blood cells (RBCs), buffy coat layer, and plasma [Figure 1]. Five milliliters syringe was used to aspirate straw-colored plasma and 1–2 mm of top part of RBC layer. It was then transferred to another tube and centrifuged at 2000 rpm for 10 min to separate serum and PRP. The PRP was aspirated by inserting the syringe as far as it can go. The contents of this syringe was emptied into a sterile container. 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.

Surgical procedure

Complete sterile and aseptic techniques were used before the surgery. Scrubbing of the surgical field was performed using savlon solution followed by intraoral irrigation with betadine and normal saline. Mandibular block was given to anesthetize the inferior alveolar, lingual, and long buccal nerve using 2% lignocaine hydrochloride with 1:200,000 adrenaline. Standard Ward's incision was used in all the cases. Full-thickness mucoperiosteal flap was raised to expose sufficient bone on the buccal and distal aspect of the impacted molar. The lingual flap was reflected to expose the distolingual aspect of the bone and the tooth.

The removal of bone was done with the help of stainless steel burs (number 8). A straight handpiece and micromotor were used. Buccal and distal bone was removed, and in some cases, a notch was made in bone near cementoenamel junction of impacted tooth for elevation. Constant irrigation with saline was used while removing bone to prevent thermal necrosis.

Tooth was luxated with the help of straight elevator and then extracted with the help of third molar forceps employing minimal forces. In some cases, sectioning of tooth was done. The surrounding bone was smoothened. The wound was gently irrigated using sterile saline solution. Wound was checked for any small detached fragments of bone or any tooth pieces.

In Group I, PRP gel was not placed in the extraction socket; closure of extraction socket was done.

In Group II, PRP gel was placed in the extraction socket, followed by closure of extraction socket [Figure 2].

The irregular margins of the wound were trimmed. Wound was closed with 3-0 black braided silk sutures. Interrupted sutures were placed. Pressure pack was given. Regular postextraction instructions were given.

Two observers (guide and pg student) involved in this research observed the patient in a standardized review protocol on the 1st, 3rd, 7th, and 60th day after surgery for Pain,swelling, Wound healing, periodontal Probing depth.

Pain was evaluated using visual analog scale (VAS) on the 1st, 3rd, and 7th day. Swelling was evaluated by measuring the horizontal distance from the corner of the mouth to the lobe of the ear and the vertical distance from the outer canthus of the eye to the angle of the mandible. The measurements were transferred onto a scale and recorded on a sheet [Figure 3]. The measurements were made on the day of surgery, 3rd and 7th day postoperatively.

Healing was evaluated by visual control and cautious exploration of a periodontal probe. It was used to evaluate any possible dehiscence or gaping of the wound margins. In this study, every gaping along the entire incision line was defined as a dehiscence. Healing was evaluated on the 7th day postoperatively. Periodontal pocket depth was evaluated pre- and post-operative using a Williams periodontal probe on the distobuccal, distolingual, and distal surfaces. The mean value was calculated. Periodontal pocket depth was measured on the 60th day postoperatively.

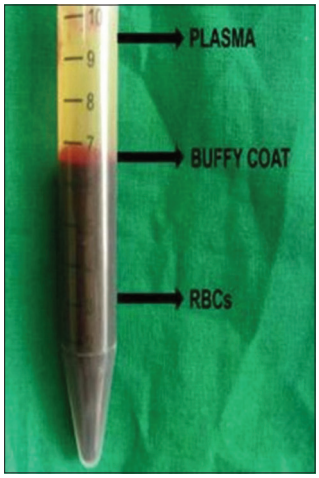

Figure 1: Three layer obtained after first transfusion

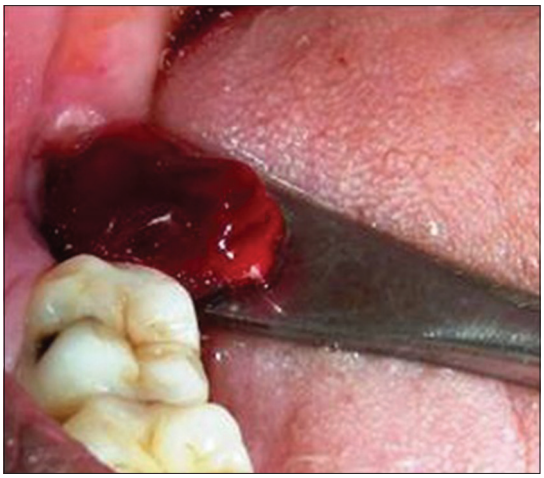

Figure 2: Gel form of platelet-rich plasma and its placement as grafting

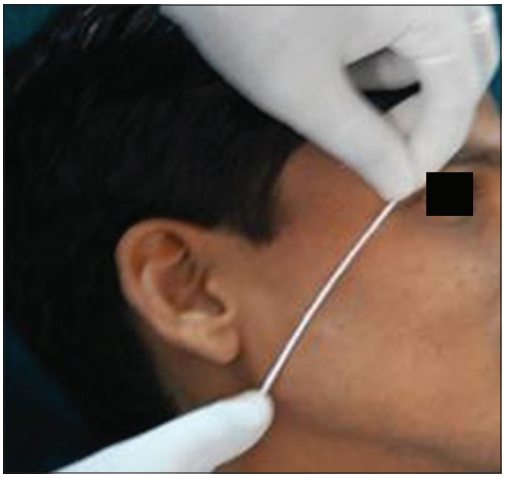

Figure 3: Facial swelling measurement as vertically

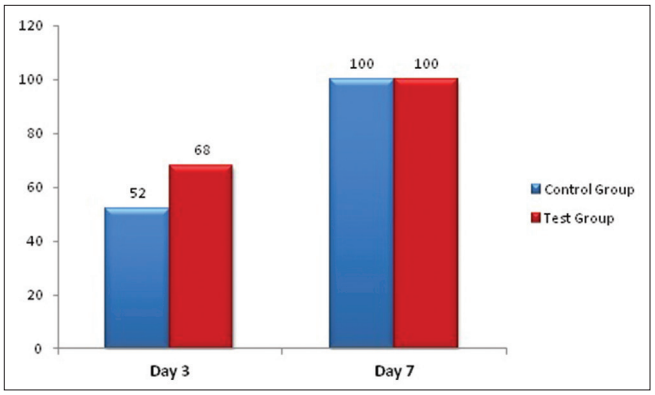

Figure 4: Result of pain between the groups at different time intervals

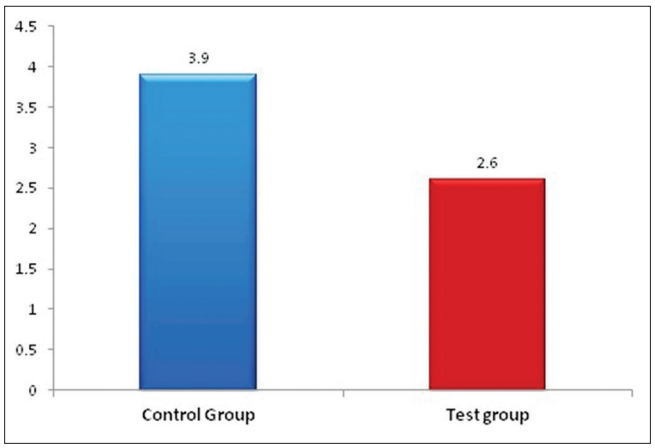

Figure 5: Result of periodontal probe depth between the cases and control group

Results

The results were evaluated based on clinical observations and measurements. All results were calculated using the mean value and standard deviation. Each of the parameters considered and checked for statistical significance using *t*-test.

Pain was significantly reduced to 1.1 ± 0.6 on day 3 and on day 7 as compared to 2.1 ± 0.7 on day 1 in the control group as shown in Table 1, $P = 0.001$. Pain had significantly reduced to 0.6 ± 0.6 on day 3 and to 0 on day 7 as compared to 1.8 ± 0.8 on day 1 in the test group as shown Figure 4.

Comparison of facial swelling within the group and between the groups was done. Facial swelling significantly reduced at day 7 compared to day 3 in both test and control group as shown in Table 1. In the control group, percentage facial swelling on day 3 was 4.3 ± 2.9 and day 7 was 0.1 ± 0.08. *P* value calculated when day 3 was compared to day 7 was found to be 0.001, which was found to be statistically significant. In test group, percentage facial swelling on day 3 was 2.9 ± 1.7 and day 7 was 0.04 ± 0.2, *P* value calculated when day 3 was compared with day 7 was found to be 0.001, which was found to be statistically significant. Percentage reduction in facial swelling at day 3 is significantly lesser in test group compared to the control group.

Wound healing was judged by the absence of dehiscence. Comparison between the test and control group was done. Significantly higher proportion of patients from control group had more dehiscence compared to test group. In all, 44% of patients had dehiscence in the control group. One patient or

Table 1: The within group comparison of pain and percent facial swelling in each study group

Parameters	Control group ($n=25$)			*P*			Test group ($n=25$)			*P*		
	Day 1	Day 3	Day 7	Day 1 vs. Day 3	Day 1 vs. Day 7	Day 3 vs. Day 7	Day 1	Day 3	Day 7	Day 1 vs. Day 3	Day 1 vs. Day 7	Day 3 vs. Day 7
Pain	2.1±0.7	1.1±0.6	0.0±0.0	0.001 (Significant)	0.001 (Significant)	0.001 (Significant)	1.8±0.8	0.6±0.6	0.0±0.0	0.001 (Significant)	0.001 (Significant)	0.001 (Significant)
Facial swelling	-	4.3±2.9	0.1±0.08	-	-	0.001 (Significant)	-	2.9±1.7	0.04±0.2	-	-	0.001 (Significant)

Values are mean±standard deviation. *P* values by paired *t*-test (within group significance of difference). $P<0.05$ is considered to be statistically significant

4% of the patients had dehiscence. *P* value was found to be 0.001, which was statistically significant as shown in Table 2.

Periodontal probing depth was measured 2 months postoperatively, and the mean periodontal probing depth is significantly higher in control group compared to the test group as shown in Figure 5. The mean value of periodontal probing depth was 3.9 ± 0.2 in control group compared to 2.6 ± 0.4 in the test group. *P* value was found to be 0.001, which was statistically significant as shown in Table 3.

Discussion

The optimal management of impacted mandibular third molars continues to challenge clinicians. There are various materials used at the time of tooth extraction to maintain or enhance ridge form for prosthetic rehabilitation and periodontal health. After the extraction of mandibular third molar, a reported complication is the development of periodontal osseous and soft tissue defects on the distal of second molar.

It was Whitman *et al*. who introduced the PRP to oral and maxillofacial surgery community, used it as fibrin glue for faster soft tissue healing. The author thought that through activation of the platelets within the gel and the resultant release of the growth factors, enhanced wound healing should be expected.[14]

The PRP gel is a product of PRP with thrombin and calcium and was used initially as a soft tissue sealing agent.[14,15] However, it was Marx *et al*. in 1998, who popularized PRP in oral and maxillofacial surgery after the publication of their landmark article, which showed that combining PRP with autogenous bone in mandibular continuity defects resulted in significantly faster radiographic maturation and histomorphometrically denser bone regenerate.[10]

Landesberg *et al.*[9] and Marx *et al.*[10] stated that the use of ethylenediaminetetraacetic acid (EDTA) is potentially more harmful than citrate. Although EDTA gave greater yields of platelets, they appeared damaged by the presence of EDTA. Hence, we used CPDA anticoagulant solution in our study as it maintains or preserves platelet membrane integrity.[16]

The positive effects of PRP as reported in literature are:[7,10,17,18]

- "Jump starts" the cascade of osteogenesis in bone graft
- Improves trabecular bone density
- Provides earlier availability of growth factors and bone morphogenetic proteins
- Promotes early consolidation of the graft
- Hastens the mineralization of the graft.

Pain was also assessed with VAS for pain and it was found that the severity of pain was equal both in study and control side, and the results were not significant at all the time recorded from day 1 to day 7.

We assessed the percentage of facial swelling in both the study and the control side according to the formula given by Amin and Laskin[19] The percentage of facial swelling was greater on the control side as compared to the study side at the third postoperative day and at the seventh postoperative day.

On evaluating wound dehiscence, we found that Group II (test) showed dehiscence in 1 (4%) case out of 25 and Group I showed dehiscence in 11 (44%) of cases on the seventh postoperative day. This signifies a better soft tissue healing of extraction sockets treated with autologous PRP. The difference is significant. Our finding is supported by Fennis *et al*[20] in which comparison group showing Statically superior healing with PRP.

A comparison of the probing depth between both the groups at 2 months was done. The value of the periodontal pocket depth in the control group was significantly larger when compared to the test group. This result is supported by a study conducted by Sammartino *et al.*[21] where notable reduction in probing depth was observed at 12 and 18 weeks in those extraction cases treated with PRP compared to controls where PRP was not used.

In the present study, PRP was placed in the third molar extraction sockets. We found that there was good soft tissue healing response in PRP-treated sites as compared to the other site.

In our study, results showed clinical significant in reduced facial swelling, good wound healing, reduction periodontal probe, and clinical insignificant for pain between both study groups. The limitation of this study was that 2-month postoperative follow-up is of short duration to comment on the efficacy of PRP in complete soft tissue healing process but adequate enough to evaluate the effects of PRP in initiating and enhancing both hard and soft tissue healing. Long-term follow-up is required along with histological study of the bone for assessment of the efficacy of PRP.

Table 2: The comparison of dehiscence at day 7 between two study groups

Dehiscence	Number of patients (%)		*P*
	Control group (*n*=25)	Test group (*n*=25)	
Present	11 (44.0)	1 (4.0)	0.001 (significant)
Absent	14 (56.0)	24 (96.0)	

Values are *n* (%). *P* values are obtained by Chi-square test for independence if cell frequency is larger than 5, else Fisher's exact probability test is used. $P<0.05$ is considered to be statistically significant

Table 3: The comparison of PPD between two study groups

Parameter	Control group (*n*=25)	Test group (*n*=25)	*P*
PPD (2 months)	3.9±0.2	2.6±0.4	0.001 (significant)

Values are mean±SD. *P* values by independent sample *t*-test (between group significance of difference). $P<0.05$ is considered to be statistically significant. SD=Standard deviation; PPD=Periodontal probing depth

Conclusion

In our study, results showed clinically significant reduced facial swelling, good wound healing, reduction periodontal probe, and clinical insignificant for pain between both study groups. The limitation of this study was that 2-month postoperative follow-up is of short duration to comment on the efficacy of PRP in complete soft tissue healing process but adequate enough to evaluate the effects of PRP in initiating and enhancing both hard and soft tissue healing. Long-term follow-up is required along with histological study of the bone for assessment of the efficacy of PRP

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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