

## Effect of Platelet Rich Plasma on Alveolar Osteitis and Bone Healing Following Surgical Extraction of Teeth

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### Abstract

**Objective:** To determine the efficacy of platelet rich plasma on bone healing of alveolar socket and alveolar osteitis prevention following surgical extraction of teeth compared to normal healing.

**Setting:** This Comparative cross sectional study was conducted at Department of Oral and Maxillofacial Surgery LUMHS Jamshoro from June 2018 to December 2019.

**Methodology:** A complete history of the patient with personal details, presenting complains, past medical and dental history, health status was noted. After examination the clinical findings were recorded along with history of any habits that can interfere with healing so as to control the confounding factors. Presence or absence of alveolar osteitis was noted and bone healing was assessed radiographically.

**Results:** Total 96 patients were studied. 48 of platelet rich plasma group (PRP) and 48 of platelet sans rich plasma group (control). Mean age of PRP group was  $34.81 \pm 9.09$  years and control  $32.70 \pm 9.54$  years. There was no significant difference among both groups according to age, p-value 0.638. Patient's distribution according to criteria for dry socket, on 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> day assessment post-operative pain, partially or totally disintegrated blood clot, denuded socket and pus in the socket were significantly lower among patients of PRP group as compared to control group. On patient's distribution according to mean radiographic score for assessment of bone healing on 3<sup>rd</sup> week most of the cases were with (+1 Lamina dura substantially thinned, missing in some areas) in both groups and 2<sup>nd</sup> month assessment most of the patients with (0 Within normal limits) in both groups, result were statistically non-significant on 2<sup>nd</sup> month and 4<sup>th</sup> month p-values 0.344 and 0.959 respectively.

**Conclusion:** Platelet rich plasma showed better outcomes of alveolar socket healing and encountered decrease occurrence of dry socket as compare to control group.

**Keywords:** Platelet Rich Plasma; Surgical Extraction; Bone Healing; Alveolar Osteitis

## Introduction

There has been application of platelet rich plasma in variety following surgical procedures from diabetic foot infection [1], to corneal ulcers and corneal surgeries [2], and have reported significant improvement in the time consumed and the quality of repaired tissues in the presence of platelet concentrates compared to normal healing, keeping various factors such as health status and age of subjects to the closest limits. A study in 2016, reports significant benefits of treating female pattern hair loss by the use of autologous platelet rich plasma injected as intra-perifollicular [3].

Platelet concentrates under practice and research are surgical innovative tools of regenerative medicine that are being widely tested in oral and maxillofacial surgery yet unfortunately the literature on the topic is contradictory and limited [4]. Tooth extraction is a very common procedure in dentistry for teeth that cannot be restored, the following sequel involve vertical and horizontal alveolar ridge resorption. Following most tooth extractions, patient's form (aesthetics) and function (mastication) is affected immediately post procedure and in the healing phase which requires restoration and rehabilitation. Ridge resorption makes prosthesis placement difficult and in some cases impossible. It is well established that post-extraction ridge preservation can be beneficial [5]. Following the extraction of teeth, the use of platelet rich plasma may enhance and accelerate the complete healing process by 1. Better hemostasis 2. Reduction of post-operative inflammation. Enhance the soft tissue healing 4. Enhance the bone healing and 5. Prevent post-surgical complications such as alveolar osteitis (dry socket). This would significantly reduce post-operative pain and infection and greatly reduces the morbidity of patient and even limit the use of anti-biotic and analgesics. The factors that may influence the healing process are inflammatory cytokines, bone morphogenetic proteins (BMPs) such as BMP-2, BMP-7, vascular endothelial growth factor (VEGF), transforming growth factor- $\beta$  (TGF- $\beta$ ), platelet-derived growth factor (PDGF), fibroblast growth factor (FGF) and insulin-like growth factor (IGF) which are essential during the bone healing [6]. The use of autologous platelet rich plasma and other platelet concentrates is not only limited to wound care of soft and hard tissue but also has an application in joint derangements such as Temporomandibular joint disorders and has even been documented in internal knee derangements [7], in restorative dentistry, periodontology for Guided Tissue Regeneration (GTR) and Guided Bone Regeneration (GBR) and oral and maxillofacial surgery, especially following third molar surgeries [8]. The available literature suggests that vast benefits of autologous platelet rich plasma include low cost, ease of preparation and handling, no reported adverse effects or reactions when used as an adjunctive to bone graft although the results of benefit over bone

graft are contradictory [9] which warrants more research such as split mouth studies and controlling the confounding factors along with longer follow-up and larger sample size [10].

## Aim of the Study

The aim to conduct this study is to clinically evaluate the effect of application of autologous platelet rich plasma in reducing the patient morbidity by reducing post-operative complications such as dry socket and significantly improve the quality of socket healing.

## Materials and Methods

This is Comparative cross sectional study with Non-Probability Consecutive Sampling. Data was analyzed by statistical software package SPSS version 20.0.

### Inclusion criteria

- Age 2<sup>nd</sup> to 5<sup>th</sup> decade of life.
- Patients giving consent for the study and follow-up.
- All patients indicated for surgical (open) extractions of mandibular molar teeth.
- Patients with hypercementosed (bulbous roots).
- Patients with curved roots or widely divergent roots liable to break or cause tissue tear.
- Patients with impacted mandibular 3<sup>rd</sup> molars indicated for extraction.
- A state of good general body and oral health.

### Exclusion criteria

- Patients with any systemic disease.
- Patients with extensive surgical defects.
- Presence of opposing traumatic occlusion.
- Patients with habits such as betel nut, smoking, alcohol etc.

### Clinical evaluation

- The presence or absence of dry socket was diagnosed based on Blum's criteria [12].
- Bone healing was assessed radio-graphically. The criteria for bone healing and the scoring system was based on modification of the Kelley's method [13].
- Intra Oral Peri Apical radiographs (IOPA) were advised to the patients and Orthopentograms (OPG) were advised for mandibular 3<sup>rd</sup> Molar teeth.

### Preparation of platelet rich plasma

Patients giving consent for the study were asked to accompany to the nearby Liaquat University Diagnostic and Research Labora-

tory for the preparation of platelet rich plasma for which approximately 5cc blood was drawn intravenously from the anticubital region of patient’s forearm under sterile protocols, aseptic technique using vacutainer needle and BD® vacutainers containing 3.8% trisodium citrate (0.8 ml each). Centrifugal machine was used for preparation of PRP. The vacutainers were thoroughly shaken to ensure mixture of anti-coagulant with the drawn blood. The whole blood was then immediately centrifuged at 2,400 rpm for 10 minutes. The supernatant formed was platelet poor plasma (PPP) and buffy coat. PPP and buffy coat [upper 1 mm red blood corpuscles (RBC)] layer was collected in a fresh vacutainer and again centrifuged at 3,600 rpm for 10 minutes. The upper half of the supernatant was discarded and destroyed according to the Human Biological Material guidelines of National Bioethics Committee Pakistan (15) code 3.1 and 3.2 and the lower half was mixed thoroughly to yield PRP. Activation of the PRP was done with addition of 10% calcium gluconate to form PRP gel.

Note: All the remaining blood/blood products were discarded and destroyed in the hospital human waste collection in front of the patient immediately after use and were not stored or used for any other purpose than mentioned above to ensure complete privacy of the patient according to the National Bioethics Committee code 3.

**Results**

Total 96 patients were studied followed by 48 of platelet rich plasma group (PRP) and 48 of platelet sans rich plasma group (control), mean age of PRP group was 34.81 ± 9.09 years and control 32.70 ± 9.54 years, mean age was statistically insignificant p-value 0.272 (Table 1).

			N = 96
Study group	N. of cases	Age	p-value
		Mean ± Std	
PRP	48	34.81 ± 9.09 years	0.272
Control	48	32.70 ± 9.54 years	

**Table 1:** Patient’s distribution according to age statistic.

Among patients of PRP group, 24 were male and 24 were female, and in patients of control group 26 were male and 22 were females, there was no significant difference among both groups according to age, p-value 0.638 (Table 2).

According to patient’s distribution according to criteria for dry socket, on 3<sup>rd</sup> day assessment post-operative pain, partially or totally disintegrated blood clot, denuded socket and pus in the socket were significantly lower among patients of PRP group as

				n = 96
Gender	Study groups		Total	p-value
	PRP	Control		
Male	24	26	50	0.638
Female	24	22	46	
Total	48	48	96	

**Table 2:** Patient’s distribution according to gender.

compared to control group p-value 0.001. On 7<sup>th</sup> day assessment only 2 cases were found with necrotic debris in PRP group, while in control group 5 cases showed partially disintegrated blood clot, necrotic debris in 6 cases and denuded socket was in 3 cases, findings were statistically significant p-value 0.018. On 14<sup>th</sup> day assessment only 2 cases were found with halitosis in PRP group and 5 cases in control group, results were statistically insignificant, p-value 0.239 (Table 3).

				n = 96
Criteria for dry socket day 3	Study group		Total	p-value
	PRP	Control		
Post-operative pain	8	17	25	0.001
Partially or totally disintegrated blood clot	0	5	5	
Necrotic debris	10	2	12	
Denuded socket	0	7	7	
Exudates or pus in the socket	0	5	5	
Nil	30	12	42	
Total	48	48	96	
Criteria for dry socket day 7				0.018
Partially or totally disintegrated blood clot	0	5	5	
Necrotic debris	2	6	8	
Denuded socket	0	3	3	
Exudates or pus in the socket	0	1	3	
Nil	46	33	77	
Total	48	48	96	
Criteria for dry socket day 14				0.239
Halitosis	2	5	7	
Nil	46	43	89	
Total	48	48	96	

**Table 3:** Patient’s distribution according to criteria for dry socket.

On patient’s distribution according to mean radiographic score for assessment of bone healing on 3<sup>rd</sup> week most of the cases were with (+1 Lamina dura substantially thinned, missing in some areas) in both groups and 2<sup>nd</sup> month assessment most of the patients with (0 Within normal limits) in both groups, result were statistically non-significant on 2<sup>nd</sup> and 4<sup>th</sup> month p-values 0.344 and 0.959 respectively. While on 4<sup>th</sup> month assessment majority of PRP group patients found with (+2 Lamina dura essentially absent, may be present in isolated areas) and (0 within normal limits) as compared to control group, p-value 0.001, results showed in (Table 4).

Mean radiographic score for assessment of bone healing on 3 <sup>rd</sup> week	Study group		Total	p-value
	PRP	Control		
	+1 Lumina	2		
o within	7	10	17	
-1 portions	37	34	71	
-2 entire	2	4	6	
Total	48	48	96	
Mean radiographic score for assessment of bone healing on 2 months				0.959
+1 Lumina	7	8	15	
o within	31	30	61	
-1 portions	10	10	20	
Total	48	48	96	
Mean radiographic score for assessment of bone healing on 4 <sup>th</sup> month				0.001
+2 Lumina	13	3	16	
+1 Lumina	7	18	25	
o within	28	23	51	
-1 portions	0	4	4	
Total	48	48	96	

**Table 4:** Patient’s distribution according to mean radiographic score for assessment of bone healing at different time.

- +2 Lamina dura essentially absent, may be present in isolated areas.
- +1 Lamina dura substantially thinned, missing in some areas.
- 0 Within normal limits.
- 1 Portions of lamina dura thickened, milder degrees.
- 2 Entire lamina dura substantially thickened.

On overall density assessment of bone healing at 3<sup>rd</sup> week most of the patients of PRP group (-1 Mild to moderate decrease in radiographic density), among both group without significant difference p-value 0.074.while on 2<sup>nd</sup> month and 4<sup>th</sup> month assessment almost patients of PRP group noted with (+1 Mild to moderate increase in radiographic density and 0 Within normal limits) as compared to control group, results were statistically significant p-values quite significant, results showed in (Table 5).

Overall density on 3 <sup>rd</sup> week	Study group		Total	p-value
	PRP	Control		
0	02	02	04	0.074
-1	46	36	82	
-2	0	10	10	
Total	48	48	96	
Overall density on 2 months				0.009
+1	08	02	10	
0	32	24	56	
-1	08	22	30	
Total	48	48	96	
Overall density 4 <sup>th</sup> month				0.001
+2	01	00	01	
+1	27	9	36	
0	20	35	55	
-1	00	04	04	
Total	48	48	96	

**Table 5:** Patient’s distribution according to overall density assessment of bone healing at different time.

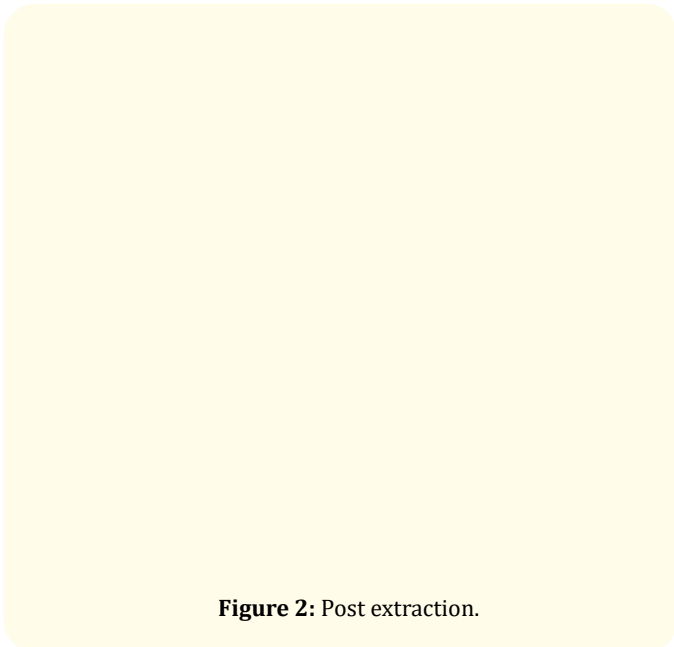
- +2 Severe increase in radiographic density.
- +1 Mild to moderate increase in radiographic density.
- 0 Within normal limits.
- 1 Mild to moderate decrease in radiographic density.
- 2 Severe decrease in radiographic density.

On patient’s distribution according to mean radiographic score for assessment of bone healing on 3<sup>rd</sup>week majority of control group patients found with (-2 Granular, nearly homogenous patterns; individual trabeculations essentially absent) as compared to PRP group p-value 0.006. While on 2<sup>nd</sup> month and 4<sup>th</sup> month assessment almost patients achieved (+1 Some coarser trabeculae; milder degrees and 0 Within normal limits) among both groups without significant difference, p-value quite insignificant, results showed in table 6.

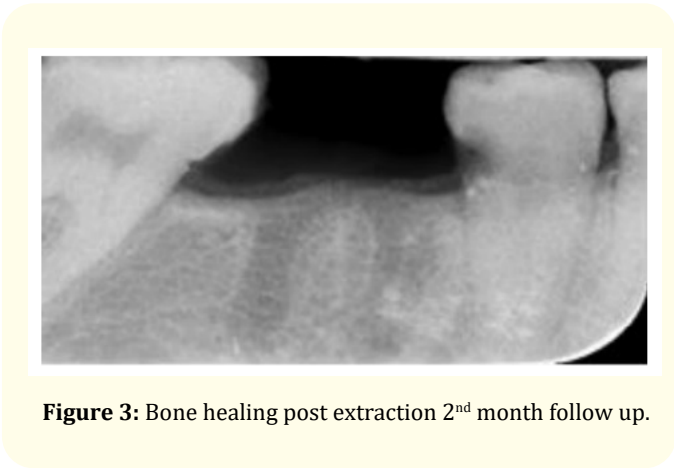
Trabecular pattern on 3 <sup>rd</sup> week	Study group		Total	p-value
	PRP	Control		
	o within	6		
-1 delicate	41	28	69	
-2 granular	1	9	10	
Total	48	48	96	
Trabecular pattern on 2 <sup>nd</sup> months				0.107
+1 some coarser	12	5	17	
o within	25	28	53	
-1 delicate	11	12	23	
-2 granular	0	3	3	
Total	48	48	96	
Trabecular pattern on 4 <sup>th</sup> month				0.428
+2 all trabeculae	4	2	6	
+1 some coarser	26	23	49	
o within	14	14	28	
-1 delicate	4	9	13	
Total	48	48	96	

**Table 6:** Patient’s distribution according to mean radiographic score for assessment of bone healing at different time as tubercular pattern.

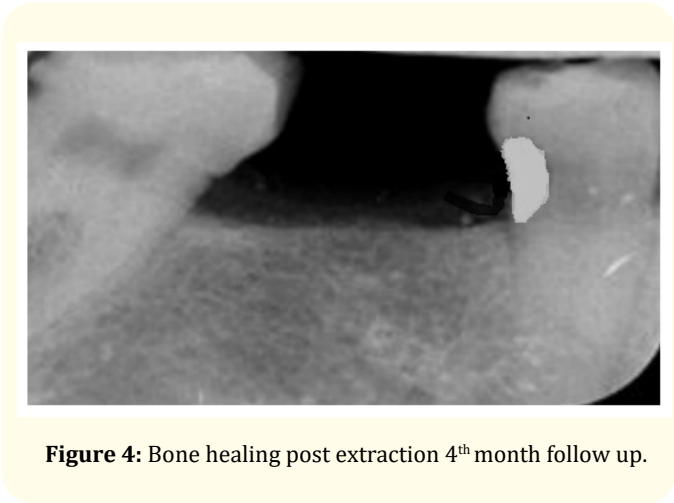
Picture 1 to 4 shows bone healing after 2<sup>nd</sup> and 4<sup>th</sup> month in a grossly carious mandibular first molar extraction.



**Figure 2:** Post extraction.



**Figure 3:** Bone healing post extraction 2<sup>nd</sup> month follow up.



**Figure 4:** Bone healing post extraction 4<sup>th</sup> month follow up.



**Figure 1:** Extraction of grossly carious left 1<sup>st</sup> mandibular molar was planned.



## Discussion

In this study total 96 patients were studied, 48 of platelet rich plasma group (PRP) and 48 of control group. In this study mean age of PRP group was (34.81 ± 9.09) years and control (32.70 ± 9.54) years with insignificant difference. This mean age was near to the study of Bhujbal R., *et al.* [11] as 5.20 ± 7.19 years.

Alveolar osteitis is the most common postoperative complication following the extraction of permanent teeth [12]. In the present study, all the sockets filled with PRP healed uneventfully. Among patient's distribution according to criteria for dry socket, on 3<sup>rd</sup> day assessment post-operative pain, partially or totally disintegrated blood clot, denuded socket and pus in the socket were significantly lower among patients of PRP group as compared to control group p-value 0.001. On 7<sup>th</sup> day assessment only 2 cases were found with necrotic debris in PRP group, while in control group 5 cases showed partially disintegrated blood clot, necrotic debris in 6 cases and denuded socket was in 3 cases, findings were statistically significant p-value 0.018. On 14<sup>th</sup> day assessment only 2 cases were found with halitosis in PRP group and 5 cases in control group, results were statistically insignificant, p-value 0.239. This finding is in agreement with the study carried out by Allisa R [13] and Rutkowski JL [14] in which a significant reduction in the incidence of alveolar osteitis was associated with PRP application when compared with controls. Similar findings were reported by Supriya GB., *et al.* [15]. Larger randomised controlled trials are required to validate these preliminary findings.

On patient's distribution according to mean radiographic score for assessment of bone healing on 3<sup>rd</sup> week, most of the cases were with (+1 Lamina dura substantially thinned, missing in some areas) in both groups, and 2<sup>nd</sup> month assessment most of the patients were with (0 Within normal limits) in both groups, results were statistically non-significant on 2<sup>nd</sup> month and 4<sup>th</sup> month. While on 4<sup>th</sup> month assessment majority of PRP group patients found with (+2 Lamina dura essentially absent, may be present in isolated areas) and (0 within normal limits) as compared to control group. On overall density assessment of bone healing at 3<sup>rd</sup> week most of the patients of PRP group (-1 Mild to moderate decrease in radiographic density), while on 2<sup>nd</sup> month and 4<sup>th</sup> month assessment almost patients of PRP group noted with (+1 Mild to moderate increase in radiographic density and 0 Within normal limits) as compared to control group, results were statistically significant p-values quite significant. On patient's distribution according to mean radiographic score for assessment of bone healing on 3<sup>rd</sup> week majority of control group patients found with (-2 Granular, nearly homogenous patterns; individual trabeculations essentially absent) as compared to PRP group. While on 2<sup>nd</sup> month and 4<sup>th</sup>

month assessment almost patients achieved (+1 Some coarser trabeculae; milder degrees and 0 Within normal limits) among both groups without significant difference, p-value quite insignificant. Bhujbal R., *et al.* [11] reported that the bone healing was more favorable in the PRP site compared to the control site. A significant increase in bone density was seen on the PRP site 3 and 6 months postoperatively. Alissa., *et al.* [13], Ogundipe., *et al.* [16], Del., *et al.* [17] and Antonello., *et al.* [18] reported better epithelialization, more mature bone and better organized trabeculae than controls, and accelerated bone formation postoperatively in the PRP group compared to the control group. However, Earl., *et al.* [19] did not report substantial bone formation when PRP was applied.

Performance of autologous platelet-rich plasma (PRP) applied in tooth sockets were evaluated by Célio Mariano., *et al.* [20]. They carried out extraction of bilateral impacted third molars among 30 patients. After extraction, among each patient 1 socket was filled with autologous PRP (PRP group) and the other was filled with blood clot (control group). Periapical radiographs were taken post-operatively after 7 days, 1 month, 2 month, 3 month and 6 month. Sockets treated with PRP showed more rapid bone formation in 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> month as compare to control group in their study. No statistical dissimilarity was seen on the seventh day and sixth month of analysis, but there was superior means of radiographic bone density in sockets managed with PRP.

## Conclusion

It was concluded that PRP showed better efficacy on bone healing in alveolar socket following surgical extraction of teeth compared to normal healing. PRP was able to prevent the occurrence of dry socket in contrast to normally healed patients. Further research should be conducted on this comparison.

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