ORIGINAL RESEARCH

Comparison of the Efficacy of Platelet-rich Fibrin with Platelet-rich Plasma in Third Molar Extraction Socket - A Prospective Clinical Study

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ABSTRACT

Objective: The objective is to compare the efficacy of platelet-rich fibrin (PRF) and platelet-rich plasma (PRP) in the third molar extraction socket and also comparative evaluation of pain, swelling, trismus, periodontal health, and quality of bone healing between PRF and PRP.

Study Design: A total of 15 individuals with the age group of 18–40 years with bilateral impacted lower third molars were the study subjects and divided into two groups - Group (A) where extraction socket was placed with PRF and Group (B) where extraction socket placed with PRP.

Results: The result of our study suggested that there is no significant difference between both PRF and PRP in over pain, swelling, trismus, periodontal health, and bone healing in the third molar extraction socket but when compared with the method of preparation, consistency, and cost-effectiveness, PRF is better than PRP.

Conclusion: Both PRF and PRP are excellent materials to induce healing and have great potential in healing of bony defects in the jaws. When we take the cost into consideration, PRF is cost-effective as it does not require anticoagulant and chelating agent for preparation.

Keywords: Pain, Periodontal health, Platelet-rich fibrin, Platelet-rich plasma

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INTRODUCTION

The third molar is one of the most commonly impacted teeth in the oral cavity. Sometimes, it remains asymptomatic, but most of the times it presents with pain, recurrent pericoronitis and if left untreated may lead to the formation of cyst, space infections, temporomandibular joint abnormalities, etc. Hence, its removal is one of the most commonly performed procedures which also provides a perfect study model to assess various aspects of surgery such as flap designs, socket healing, and role of biomaterials. The soft tissue healing as well as healing of bony defects in oral cavity is mediated by a wide range of intra- and extra-cellular events that are regulated by signaling proteins. Understanding the entire process is still incomplete.[1] Socket healing is a highly coordinated sequence of biochemical, physiologic, cellular, and molecular responses involving numerous cell types growth factors, hormones, cytokines, and other proteins, which is directed toward restoring tissue integrity and functional capacity after injury.[1,2] Platelets form an intracellular storage pool of proteins vital to wound healing and generate different growth factors such as platelet-derived growth factor (PDGF), transforming growth factor, and insulin-like growth factors which play a pivotal role in initiating and sustaining wound healing and tissue repair mechanism.[3,4] Various glass materials, autografts, and alloplastic materials have been tested to enhance socket healing and to minimize the post-operative sequelae such as bleeding, dry socket, wound infection, delayed healing, and swelling. Platelet-rich growth factors are very successful in stimulating bone regeneration and promote healing after the surgical removal of the third molar tooth.[4]

Platelet-rich plasma (PRP) is one of the platelet releasing growth factor that has been successfully used to accelerate soft tissue and hard tissue healing.[3,4] The growth factors present in PRP are well known including transforming growth factor, vascular endothelial growth factor, PDGF, and endothelial growth factor. These growth factors are considered to have the ability to accelerate chemotaxis, mitogenesis, angiogenesis, and synthesis of collagen matrix and favor tissue repair when applied on bone wounds.[1-4] Another entity called platelet-rich fibrin (PRF), as described by Choukroun *et al*., is the second-generation platelet

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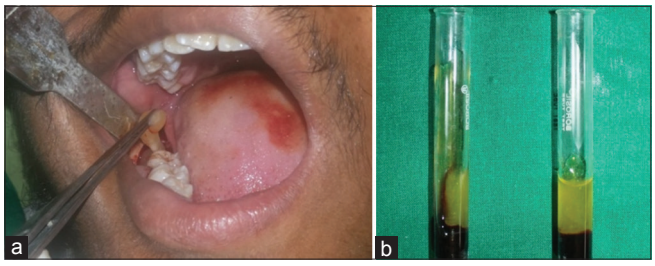

Figure 1: (a) Platelet-rich fibrin (PRF) in the test tube prepared by centrifugation method, (b) PRF is been carried to the third molar extraction socket

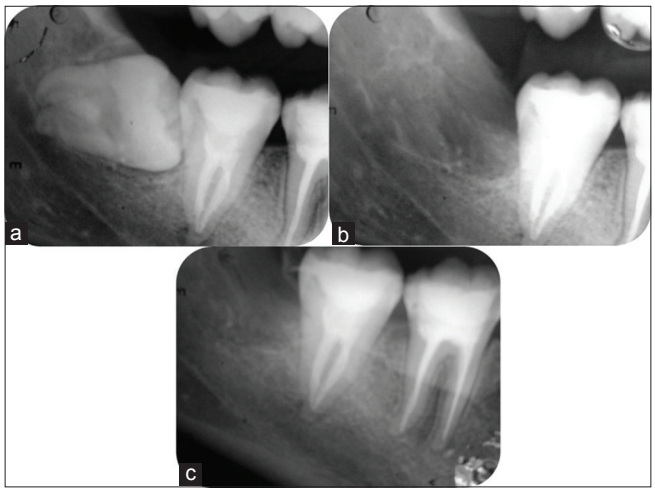

Figure 2: Bone healing in platelet-rich fibrin 2nd and 4th month postoperatively. (a) Pre-operative, (b) 2-month post-operative, (c) 4-month post-operative

concentrate which allows one to obtain fibrin membranes enriched with platelets and growth factors, after starting from an anticoagulant-free blood harvest without any artificial biochemical modification. The PRF clot forms a strong natural fibrin matrix, which concentrates almost all the platelets and growth factors of the blood harvest and shows a complex architecture as a healing matrix, including mechanical properties, no other platelet concentrate offers. It is an autologous biomaterial and not an improved fibrin glue.[5,6] The role of PRP in socket healing is well established through various scientific studies over the years.[7] However, studies of role of PRF in socket healing are very limited. Hence, we firmly believe that there is a need for study to compare the role of PRF with that of time-tested PRP in mandibular third molar socket healing.

Aims and Objectives of the Study

Aims

This study aims to compare the efficacy of PRF with PRP in lower third molar extraction socket.

Objectives

The objectives of this study were to compare between PRF and PRP for:

- To evaluate the efficacy of PRF in mandibular third molar extraction socket.
- To evaluate the efficacy of PRP in mandibular third molar extraction socket.
- Comparative evaluation of PRF and PRP.
- Comparative evaluation of pain, swelling, trismus, periodontal health, and quality of bone healing between PRF and PRP.

METHODOLOGY

A total of 15 patients who were found eligible and willing for the study were informed of the study protocol and written consent was obtained before sampling procedure was performed. The necessary written consent was taken from them. All necessary pre-operative, intraoperative and post-operative photographic records were maintained for these patients.

This was a split-mouth study where 25 impacted lower third molars on either side were divided into two groups:

Group (A): Extraction socket placed with PRF [Figure 1]

Group (B): Extraction socket placed with PRP.

In every patient, one side belonged to Group A and the other belonged to Group B.

In every odd patient, PRF was placed in the left socket and PRP was placed in the right socket. In every even patient, PRP was placed in the left socket and PRF was placed in the right socket.

Clinical Parameters

Various pre-operative, intraoperative, and post-operative parameters were used to evaluate the study subjects.

Pre-operative assessment

- Maximum mouth opening with Vernier caliper.
- Facial measurement with thread (From tragus to the soft tissue pogonion and from corner of mouth to tragus).
- Periodontal health by measuring pocket depth distal to mandibular second molar using William's periodontal probe.
- Intraoral periapical (IOPA).

Intraoperative assessment

Immediately after the procedure, details of the procedure were documented including the duration of the

surgery in minutes, volume of local anesthetic solution, and intraoperative complications if any.

Post-operative assessment

Post-operatively patient was evaluated for:

- Pain - 1st, 3rd, 7th, and 14th post-operative day. It was evaluated using 10-point visual analog scale (VAS), with a score of "0" equals "no pain" and "10" equals "very severe pain."
- Trismus - 1st, 3rd, 7th, and 14th post-operative day.
- Swelling - 1st, 3rd, 7th, and 14th post-operative day.
- Periodontal health - on the 8th and 16th week. It was checked with William's periodontal probe, with millimeter marking by measuring pocket depth.
- Bone healing - The bone healing of the third molar socket is assessed using IOPA radiographs using a standard periapical X-ray. The criteria of bone healing and scoring system are based on modification of method used by Kelly *et al*. Three parameters, namely: Lamina dura score, density score, trabecular pattern score will be assessed. Radiographs were taken immediately after the procedure and on the 8th and 16th week postoperatively.

Procedure

1. Written informed consent was obtained from all the patients who are willing for the study.
2. The area of the antecubital region was prepared with the cotton and spirit.
3. Withdrawal of blood: 10 ml of intravenous blood was drawn through 10 ml sterile syringe which was transferred to centrifugal test tubes containing 1 ml of citrate phosphate dextrose for the preparation of PRP and for the preparation of PRF.
4. After standard painting and draping incision for envelope flap or triangular flap is given.
5. Bone removal and removal of tooth
6. .Placement of PRP or PRF: Immediately, after toileting of the wound PRP and PRF was placed according to the study and closure of the socket done with 3–0 silk.
7. Immediate post-operative X-ray of the extraction socket was taken.
8. Post-extraction instructions were given and patients were recalled for follow-up on the 1st, 3rd, 7th, and 14th post-operative day and also after the 8th and 16th week.

RESULTS

Evaluation after Data Acquisition

Table 1: Comparison of mean pain scores in PRF and PRP at different post-operative days

Time	Groups	*n*	Mean	SD	Mean difference	*t*	*P*
1st	Group A	25	6.33	1.113	0.4	1.468	0.164
	Group B	25	5.93	1.280			
3rd	Group A	25	4.07	1.710	0.333	0.77	0.454
	Group B	25	3.73	1.438			
7th	Group A	25	1.73	1.280	0.267	1.169	0.262
	Group B	25	1.47	1.505			
14th	Group A	25	0	0	0	0	0
	Group B	25	0	0			

Paired *t*-test was used to compare the mean pain scores between PRF and PRP. The post-operative pain values in all the four post-operative visits were almost same in both PRF and PRP. There was no statistically significant difference present between pain scores at different tpost-operative days. SD: Standard deviation, PRF: Platelet-rich fibrin, PRP: Platelet-rich plasma

Table 2: Comparison of mean swelling scores (in mm) in PRF and PRP at different post-operative days

Time	Groups	*n*	Mean	SD	Mean difference	*t*	*P*
1st	Group A	25	97.27	1.710	0	0	1
	Group B	25	97.27	1.870			
3rd	Group A	25	94.3	1.952	−0.414	−0.77	0.187
	Group B	25	94.2	2.366			
7th	Group A	25	90.67	1.718	−0.733	−1.181	0.257
	Group B	25	91.4	2.473			
14th	Group A	25	90.07	1.751	−0.067	−1	0.334
	Group B	25	90.13	1.727			

Paired *t*-test was used to compare the swelling between PRF and PRP after their placement in the third molar extraction socket. The values obtained were evaluated statistically and they were not statistically significant. SD: Standard deviation, PRF: Platelet-rich fibrin, PRP: Platelet-rich plasma

Table 3: Comparison of mean trismus scores (in mm) in PRF and PRP at different post-operative days

Time	Groups	*n*	Mean	SD	Mean difference	*t*	*P*
1st	PRF	25	36.53	1.885	−0.667	−1.784	0.089
	PRP	25	37.2	1.265			
3rd	PRF	25	38.60	1.454	−0.867	−1.923	0.099
	PRP	25	39.47	1.407			
7th	PRF	25	41.53	1.642	−0.774	−1.832	0.091
	PRP	25	41.53	1.642			
14th	PRF	25	41.53	1.642	−0.774	−1.832	0.091
	PRP	25	41.53	1.642			

A paired *t*-test was used to compare the mean trismus scores between PRF and PRP. It was observed that there was no significant difference present between two on the 1st, 3rd, 7th, and 14th post-operative day. Hence, the effect of both PRF and PRP on trismus is the same. SD: Standard deviation, PRF: Platelet-rich fibrin, PRP: Platelet-rich plasma

Table 4: Comparison of periodontal pocket depth scores (in mm) in PRF and PRP at different post-operative days

Time	Groups	*n*	Mean	SD	Mean difference	*t*	*P*
Pre-operative	PRF	25	0.933	0.07988	0.0133333	−1	0.334
	PRP	25	1.00	0.10327			
1st	PRF	25	5.747	0.4998	0.0067	−1	0.334
	PRP	25	5.740	0.5054			
3rd	PRF	25	5.02666	0.53112	0	0	1
	PRP	25	5.02666	0.53112			
7th	PRF	25	4.33333	0.63658	0	0	1
	PRP	25	4.33333	0.63658			
14th	PRF	25	3.44667	0.59144	0	0	1
	PRP	25	3.44667	0.59144			
2nd month	PRF	25	0.95333	0.06399	−0.0066667	−0.435	0.670
	PRP	25	0.9600	0.09856			
4th month	PRF	25	0.95333	0.06399	−0.0066667	−0.435	0.670
	PRP	25	0.9600	0.09856			

A paired *t*-test was used to compare the mean pocket depth scores between PRF and PRP. It was observed that there was no significant difference present between two at the 1st, 3rd, 7th, 14th, 2-month, and 4-months post- operative day. SD: Standard deviation, PRF: Platelet-rich fibrin, PRP: Platelet-rich plasma

DISCUSSION

The third molars are present in 90% of the population with 33% having at least one impacted third molar. In most of the situations, it results in recurrent pericoronitis, caries to adjacent tooth, cyst, etc.[6-10]

The third molar surgery provides a very good opportunity for the researchers to study various aspects such as pain management, flap design, and wound healing as it provides a perfect platform to study healing of bony defects and results can be applied to clinical use in other areas in the mandible.[11-13] There are various augmentation procedures and grafts used after the tooth extraction to maintain or enhance ridge form for prosthetic reconstruction, periodontal health, or implant placement.[14-16] One of the most recent and innovative techniques which have come up is the use of PRF.

The response of living tissues to all forms of injury is inflammation, which involves humoral and cellular reactions at the site of injury and prepares the site for healing. The biological events are mainly controlled by autologous platelets.[6,17] The biologic properties of autologous platelet concentrates exploit the potential of several platelet growth factors (platelet-derived growth factor, transforming growth factor beta-beta, epidermal growth factor, vascular endothelial growth factor, insulin-like growth factor I, b-fibroblast growth factor, and hepatocyte growth factor) obtained with a simple centrifugation procedure, for example, PRF and PRP, to stimulate several biological functions such as chemotaxis, angiogenesis, proliferation, differentiation, and modulation, thereby representing a possible therapeutic device for a more rapid and effective regeneration of hard and soft tissues.[18-20] Platelets also play an important role in host defense mechanisms at the wound site by delivering signaling peptides which attract macrophage cells.[21,22]

The use of PRF and PRP has shown to be a valid technique for promoting soft tissue healing, hard tissue healing following extraction of impacted third molars.[23,24] The present study compares the clinical effectiveness of PRF along with time-tested PRP, where both show significant improvement in clinical as well as radiographic parameters. Different parameters such as pain, swelling, trismus, periodontal pocket depth, and bone formation were considered.[25-27]

A study was done by Ogundipe *et al*.[1] where pain was evaluated using a 10-point VAS with a score of "0" equal to no pain and "10" equal to "very severe pain." They found significant decrease in pain when PRP was placed in one socket and other was kept empty. Same scale was used to assess pain in the present study.

In our study, the values of pain assessed at specific time interval. There was no statistically significant difference present between pain scores in PRF and PRP at different post-operative days. However, we noticed more pain on the 1st, 3rd, and 7th post-operative day in PRF group when compared to PRP group, but the difference is not statistically significant. This beneficial effect was thought to be related to high growth factors content in both PRF and PRP and its ability to stabilize blood clot in the extraction socket.

The study done by Ogundipe *et al*., reduced swelling was noted after the use of PRP gel in the third molar extraction socket. After the assessment of the values, the data obtained were not statistically significant. However, there was 0.8% less swelling noticed in PRP group than PRF group on the 7th post- operative day. In the remaining post-operative days, the swelling is almost the same. The reduction of swelling can be attributed to

the growth factors released by platelets which increases angiogenesis, vessel permeability and acts as chemoattractant for neutrophils and fibroblasts.[28,29]

The third parameter is trismus which was evaluated with the Vernier caliper between the incisal edges of the incisors. The mean value of trismus on the 1st, 3rd, 7th, and 15th post-operative day for PRF and PRP is compared. Even though the values obtained were not statistically significant, the interincisal opening on the 7th and 14th post-operative day was almost the same, but there was 1.8% less trismus on the 1st post-operative day and 2.2% less on the 3rd post-operative day in PRP group when compared to PRF group. However, both the entities were efficient in reducing trismus which can attributed to the growth factors released by platelets which increases angiogenesis, vessel permeability and acts as chemoattractant for neutrophils and fibroblasts.[30,31]

The fourth parameter is periodontal health. Probing depth was measured at specific time intervals, and after evaluating the values, the data obtained were not statistically significant. These results did not show a significant periodontal breakdown in both the sockets where PRF and PRP are used. This can be attributed to significant slow-sustained release of key growth factors for at least 7 days to 28 days and growth factors play a key role in increasing angiogenesis, vessel permeability and act as chemoattractant for neutrophils and fibroblasts.[32]

The last parameter of the present study is the bone healing which is evaluated at 2 months and 4 months postoperatively using the radiographic method described by Ogundipe *et al*. The scores were tabulated and later evaluated statistically. The results obtained were not apparently significant when compared between PRF and PRP. However, their lamina dura score was 26% more in PRP group on the 2nd month post-operative when compared to PRF group. On considering the trabecular pattern, there was 33% more improvement after 2 months and 11% more improvement after 4 months than PRF. Moreover, finally comparing the overall density, for PRP group, there was 8% more improvement on the 2nd month post- operative and 3.9% more improvement after 4 months postoperatively when compared to PRF [Figure 2].

Oyama *et al*.,[26] Nazaroglou *et al*.,[25] and Albanese *et al*.[29] did a similar study to compare the efficacy of PRP in bone formation and hence concluded the same thing.

Zhao *et al*. did a study where they used PRF and active bioglass after operating the periapical pathosis, and there was satisfactory healing in that region.

CONCLUSION

Reconstruction of bone defects represents a challenging problem for the surgical community. Various bone graft materials such as autograft, allograft, and alloplastic materials have been tried for the reconstruction of hard tissues and accelerate its healing. PRF used in our study which is readily prepared by the patient's own blood and can be used in similar conditions with full ease.

- On evaluation of pain, trismus, swelling, periodontal pocket depth, and bone formation in the third molar extraction socket region after the placement of PRF and PRP were not statistically significant.
- The major differences between the two are method of preparation, consistency, and the handling properties. Considering the method of preparation as described earlier, PRF is better than PRP since there is no necessary of anticoagulant and chelating agent for its preparation as latter requires it. Second, considering the consistency, PRF which is fibrous consistency can be easily carried to the extraction socket. PRP which is in gel consistency is difficult to carry to the required surgical site. Finally, the handling properties, PRF is better since it directly converts into the usable form, whereas PRP will be in liquid form and converting it into gel form is time consuming. In the nutshell, both PRF and PRP are excellent materials to induce healing and have great potential in healing of bony defects in the jaws. When we take the cost into consideration, PRF is cost-effective as it does not require anticoagulant and chelating agent for preparation.

REFERENCES

1. Ogundipe OK, Ugboko VI, Owotade FJ. Can autologous platelet-rich plasma gel enhance healing after surgical extraction of mandibular third molars. J Oral Maxillofac Surg 2011;69:2305-10.
2. Célio-Mariano R, de Melo WM, Carneiro-Avelino C. Comparative radiographic evaluation of alveolar bone healing associated with autologous platelet-rich plasma after impacted mandibular third molar surgery. J Oral Maxillofac Surg 2011;69:229-32.
3. Antonio M, Martins T. Platelet rich fibrin: Evolution of platelet rich concentrate. Indian J Dent Res 2008;19:42-7.
4. Choukroun J, Diss A, Simonpieri A, Girard MO, Schoeffler C, Dohand SL, *et al*. Platelet-rich fibrin (PRF): A second-generation platelet concentrate. Part IV: Clinical effects on tissue healing. Oral Maxillofac Surg 2006;101:e56-60.
5. Pryor SG, Sykes J, Tollefson TT. Efficacy of fibrin sealant (Human) (Evicel) in rhinoplasty a prospective, randomized, single-blind trial of the use of fibrin sealant in lateral osteotomy. Arch Facial Plast Surg 2008;10:339-44.
6. Toffler M, Toscano N, Holtzclaw D. Osteotome-mediated sinus floor elevation using only platelet-rich fibrin: An early report on 110 patients. Implant Dentistry 2010;19:447-57.
7. Gaßling VL, Açil Y, Springer IN, Hubert N, Wiltfang J. Platelet-rich plasma and platelet-rich fibrin in human cell culture. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;108:48-55.

8. Del Fabbro M, Bortolin M, Taschieri S. Is autologous platelet concentrate beneficial for post-extraction socket healing? A systematic review. Int J Oral Maxillofac Surg 2011;40:891-900.
9. Zumstein MA, Bielecki TZ, Ehrenfest DM. The future of platelet concentrates in sports medicine: Platelet-rich plasma, platelet-rich fibrin, and the impact of scaffolds and cells on the long-term delivery of growth factors. Oper Tech Sports Med 2011;19:190-7.
10. Keyhan SO, Hemmat S, Badri DA, Abdeshahzadeh A, Khiabani K. Use of platelet-rich fibrin and platelet rich plasma in combination with fat graft: Which is more effective during facial lipostructure? J Oral Maxillofac Surg 2013;71:610-21.
11. Ozdemir H, Ezirganli S, Kara MI, Mihmanli A, Baris E. Effects of platelet rich fibrin alone used with rigid titanium barrier. Arch Oral Biol 2013;58:537-44.
12. Kobayashi M, Kawase T, Horimizu M, Okuda K, Wolff LF, Yoshie H. A proposed protocol for the standardized preparation of PRF membranes for clinical use. Biologicals 2012;40:323-9.
13. Chang YC, Wu KC, Zhao JH. Clinical application of platelet-rich fibrin as the sole grafting material in periodontal intrabony defects. J Dent Sci 2011;6:181-8.
14. Uraz A, Sezgin Y, Yalim M, Taner IL, Cetiner D. Comparative evaluation of platelet-rich fibrin membrane and connective tissue graft in the treatment of multiple adjacent recession defects: A clinical study. J Dent Sci 2013;2013:1-10.
15. Zhao JH, Tsai CH, Chang YC. Management of radicular cysts using platelet-rich fibrin and bioactive glass: A report of two cases. J Formosan Med Assoc 2012;2:1-7.
16. Lee HJ, Choi BH, Jung JH, Zhu SJ, Lee SH, Huh JY. Maxillary sinus floor augmentation using autogenous bone grafts and platelet-enriched fibrin glue with simultaneous implant placement. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;2:6-11.
17. Pripatnanont P, Nuntanaranont T, Vongvatcharanon S, Phurisat K. The primacy of platelet-rich fibrin on bone regeneration of various grafts in rabbit's calvarial defects. J Cranio-Maxillo Fac Surg 2013;2013:1-10.
18. Jankovic S, Aleksic Z, Milinkovic I, Dimitrijevic B. The coronally advanced flap in combination with platelet rich fibrin(PRF) and enamel matrix derivative in the treatment of gingival recession: A comparative study. Eur J Esthet Dent 2010;5:260-73.
19. Gürbüzer B, Pikdöken L, Tunalı M, Urhan M, Küçükodaci Z, Ercan F. Scintigraphic evaluation of osteoblastic activity in extraction sockets treated with platelet-rich fibrin. J Oral Maxillofac Surg 2010;68:980-9.
20. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J. Platelet-rich fibrin (PRF): A second-generation platelet concentrate. Part I: Technological concepts and evolution. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;101:E37-44.
21. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J. 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 Radiol Endod 2006;101:E51-5.
22. Gürbüzer B, Pikdöken L, Urhan M, Süer BT, Narin Y. Scintigraphic evaluation of early osteoblastic activity in extraction sockets treated with platelet-rich plasma. J Oral Maxillofac Surg 2008;66:2454-60.
23. Kazakos K, Lyras DN, Verettas D, Tilkeridis K, Tryfonidis M. The use of autologous PRP gel as an aid in the management of acute trauma wounds. Injury. Int J Care Injure 2009;40:801-5.
24. Sammartino G, Tia M, Marenzi G, di Lauro AE, D'Agostin E, Claudio PP. Use of autologous platelet-rich plasma (PRP) in periodontal defect treatment after extraction of impacted mandibular third molars. J Oral Maxillofac Surg 2005;63:766-70.
25. Nazaroglou I, Stavrianos C, Kafas P, Matoulas E, Upile T, Barlas I, *et al*. Radiographic evaluation of bone regeneration after the application of plasma rich in growth factors in a lower third molar socket: A case report. Case J 2009;2:9134.
26. Oyama T, Nishimoto S, Tsugawa T, Shimizu F. Efficacy of platelet-rich plasma in alveolar bone grafting. J Oral Maxillofac Surg 2004;62:555-8.
27. Kugelberg CF. Periodontal healing two and four years after impacted lower third molar surgery a comparative retrospective study. Int J Oral Maxillofac Surg 1990;19:341-5.
28. Schlegel KA, Zimmermann R, Thorwarth M, Neukam FW, Klongnoi B, Nkenke E. Sinus floor elevation using autogenous bone or bone substitute combined with platelet-rich plasma. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;104: e15-25.
29. Albanese A, Licata ME, Polizzi B, Campisi G. Platelet-rich plasma (PRP) in dental and oral surgery: From the wound healing to bone regeneration. Immun Age 2013;10:23.
30. Martin G, Ricucci D, Gibbs JL, Louis M. Histological findings of revascularized/revitalized immature permanent molar with apical periodontitis using platelet-rich plasma. JOE 2013;39:13.
31. Lekholm U, Grondahl HG. Influence of mandibular third molars on related supporting tissues. Int J Oral Surg 1973;2:137-42.
32. de Marco Antonello G, do Couto RT, Giongo CC, Corrêa MB, Chagas OL Jr, Lemes CF. Evaluation of the effects of the use of platelet-rich plasma (PRP) on alveolar bone repair following extraction of impacted third molars: Prospective study. J Cranio-maxillofacl Surg 2013;41:e70-5.