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EFFECT OF PLATELET-RICH FIBRIN WITH BONE SUBSTITUTE ON THE HEALING OF IMPACTED MANDIBULAR THIRD MOLAR EXTRACTION SOCKETS

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ABSTRACT

Objectives: Assessment of post-operative pain, swelling and trismus at various time intervals; measurement of the periodontal health distal to mandibular second molar at various time intervals; measurement of bone density at the site of extraction. **Subjects and Methods:** 60 patients were divided into two groups; each group contains 30 patients. Group A: the extraction socket received fresh autologous PRF with plaster of paris (POP) immediately after removal of the impacted mandibular third molar tooth and before suturing of the mucoperiosteal flap. Group B: the extraction socket received the fresh autologous PRF alone immediately after removal of the impacted mandibular third molar and before suturing of the mucoperiosteal flap. Follow up and evaluation were done in both groups for pain, swelling, healing, trismus and bone density. **Results:** our results showed that Group A had a significant decrease in the post-operative complications pian, swelling and trismus compared to group B. It also showed that group A had a significant increase in both periodontal health and bone density compared to group B. **Conclusion:** The use of PRF with POP within sockets of extraction impacted third molars proved to be effective for patients in decreasing the post-operative complications pain, swelling and trismus as well as increasing the periodontal health and bone density after removal of impacted lower third molar tooth.

KEYWORDS: Mandibular third molar extraction sockets, platelet-rich fibrin, plaster of paris and bone fill.

INTRODUCTION

Extraction of mandibular third molars is the most common procedure performed by oral-maxillofacial surgeons [(1)]. Complications of postoperative which involved pain, edema, trismus, infection, and dry sockets may be associated surgical procedure [(2-6)].

Platelet-rich fibrin (PRF) is the second generation of the platelet concentrates. It is prepared with a simplified, inexpensive process and without biochemical blood handling[(7)]. It is an autologous soluble biologic material that does not introduce foreign material into the surgical site and prevents consequent foreign-body inflammatory responses[(8,9)].

Similar to natural healing, slow polymerization during PRF preparation generates a fibrin network that enhances cell migration and proliferation. Being a reservoir of platelets, leukocytes, cytokines,

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and immune cells, PRF was reported to allow slow release of cytokines transforming growth factor, platelet derived growth factor, vascular endothelial growth factor, and epidermal growth factor which play a critical role in angiogenesis, tissue healing, and cicatrization [7, 9-11].

Moreover, PRF has multiple applications in implant and dento-alveolar surgery. PRF may be used alone or combined with bone grafts as a socket preservation material and for treatment of periodontal bony defects [12-15]. PRF is used to enhance tissue healing and to minimize postoperative inflammatory complications after mandibular third molar extractions [8, 16-17].

Autogenous bone grafts is the gold standard for any bone regeneration procedure. However, it has its disadvantages of needing a second surgical site and its attendant morbidity. Allogenic and xenogenic bone grafts have a risk of disease transmission and hypersensitivity reaction in addition to disadvantage of the higher costs. Several alloplasts are available today for bone regeneration. They include hydroxyapatite, calcium phosphate, calcium sulphate, bioglass and polymers. They are easily available in large quantities and are biocompatible. However, they are costly and needs proper soft tissue closure with advancement of flaps. Plaster of Paris is promising as a bone substitute because of its long history of safe use, low cost, easily sterilized, simple technique and complete replacement by bone in 4 weeks' time.

Also calcium sulphate hemihydrate of medical grade type can be used to bind the bone graft with any type of particle-based bone graft material in order to enhance the handling characteristics, graft particle containment and increase bone formation; significantly, more bone formed in defects grafted with a combination of allograft and calcium sulphate vs. allograft alone [18, 19].

Plaster of Paris (POP), (SALVIN Regenerative, Salvin Dental Specialties Inc , Charlotte, USA) is osteoconductive. It is not osteogenic in itself, but in the presence of bone and/or periosteum [20]. The temporary local drop in pH due to the degradation of calcium sulphate results in the demineralization of the surface layer of existing bone leading to expression of bioactive molecules and the release of growth factors such as fibroblast growth factors, transforming growth factors and bone morphogenetic proteins [21, 22].

So the present study was conducted to evaluate the effect of intraoperative incorporation of autologous PRF with plaster of Paris (POP) as bone substitute in impacted third molar extraction sockets.

SUBJECTS AND METHODS

Study design:

- Intervention randomized, Controlled, Clinical trial.
- The study included 60 patients requiring extraction of impacted mandibular third molars. The patients were selected from the Outpatient Clinics of Oral and Maxillofacial Surgery Department at Faculty of Dental Medicine, Al-Azhar University, Cairo, Boys.

a. Inclusion criteria:

Include Patients who have impacted mandibular third molars teeth indicated for extraction, skeletally matured adult patients with an age 18-35 years.

b. Exclusion criteria

Include Patients on chemotherapy, radiotherapy or finished the therapy from less than six months, Patients with very poor oral hygiene and/or generalized chronic destructive periodontitis, medically compromised patients systemically contraindicated for surgery and Pregnant female.

Patient grouping:

Patients were divided into two equal groups: Group A: Consisted of patients in whom the

extraction socket received fresh autologous PRF with POP immediately after removal of the impacted mandibular third molar tooth and before suturing of the mucoperiosteal flap. Group B: Include those patients in whom the extraction socket received the fresh autologous PRF alone immediately after removal of the impacted mandibular third molar and before suturing of the mucoperiosteal flap.

The procedure was done with local anesthesia. Preparation of PRF by 10 ml of venous blood collected in vacuolated plain tube and centrifuged at 3000 rpm for 10 minutes. A full thickness mucoperiosteal two-sided flap was reflected, removal of resistant bone, impacted tooth removed and the socket receive PRF with POP in group A and PRF only in group B. Suturing the flap without tension. Routine postoperative instructions were given to all patients: Bite firmly on gauze for at least 20 minutes, take soft and cold diet and avoid hard, hot and spicy food. Post-surgical medication includes antibiotic, analgesic and cold fomentation over the cheek at the first 24 hrs. Replaced by hot fomentation the second day. Follow up: 3, 7 days, 8weaks and 3 months post-operative for evaluating the incidence of pain, facial swelling, mouth opening, wound healing, periodontal health and Bone healing (figure 1).

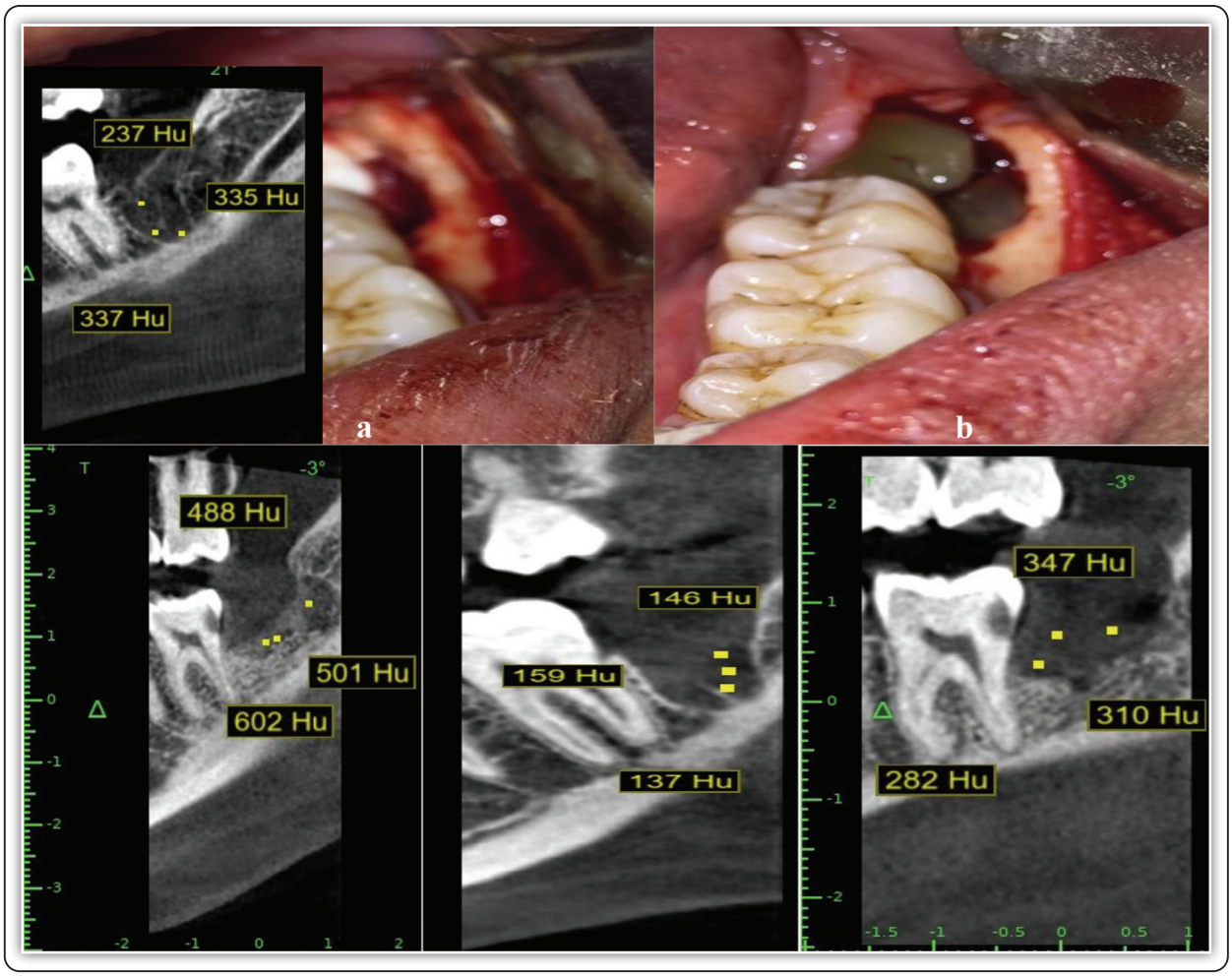

FIG (1) (a) clinical photograph showing application of POP; (b) clinical photograph showing application PRF; (c) CBCT radiograph (sagittal view) showing bone density in group A immediate after extraction; (d) CBCT radiograph (sagittal view) showing bone density in group A 3 months after extraction; (e) CBCT radiograph (sagittal view) showing bone density in group B immediate after extraction; (f) CBCT radiograph (sagittal view) showing bone density in group B 3 months after extraction.

Sample size calculation:

Statistical analysis of the data: Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. The following tests were done: A one-way analysis of variance (ANOVA) when comparing between more than two means. Post Hoc test. To assesses individual differences after a significant ANONA. Chi-square (x2) test of significance was used in order to compare proportions between qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%.

RESULTS

The two groups were comparable in age with the mean±SD in each of Group, there was no statistically significant difference between the Group A and Group B with p-value (p=0.634), as shown in table (1). This table showed also sex was comparable in the two Groups. In term of Sex, there was no statistically significant difference between the Group A and Group B with p-value (p=1.000), as shown in table (1).

Regarding pain, facial swelling and maximum mouth opening, there was no statistically significant difference between the Groups.

Regarding Periodontal Probing Depth (mm), There was a statistically significant difference between two groups according to Periodontal Probing Depth (mm) at 8th weeks with p-value (p<0.05). Group A showed a statistically significant lower Periodontal Probing Depth than group B.

Regarding bone density, There was a highly statistically significant difference between immediate postoperative and at 3 months according to bone density "HU" in each group with p-value (p<0.001). The higher mean value it was found at 3-months (449.47±111.18) compared to immediate postoperative (287.27±64.96) in Group A, as for the Group B there was higher mean value at 3-months (270.50±23.81) compared to preoperative (143.27±19.38). This table indicates a bone density in the two groups, but the Group A was better than the Group Bas shown in table (1).

TABLE (1) Comparison between groups according to age, sex, Pain, Swelling, Trismus, Periodontal Probing Depth (mm) and Bone density (HU)

	Group A (n=30)	**Group B (n=30)**	**p-value**
	Mean ± SD	**Mean ± SD**	
Age (years)	28.89±4.73	29.43±3.97	0.634
Sex			
Male	18 (60%)	18 (60%)	
Female	12 (40%)	12 (40%)	1.000
Pain			
3rd day	2.07±0.94	2.55±1.13	0.079
7th day	0.60±0.72	0.91±0.61	0.077
Swelling (Facial measurement A-B) "cm"			
Preoperative	10.59±.32	10.53±.29	0.426
3rd day	11.27±0.44	11.43±0.31	0.109
7th day	10.61 ±.28	10.7333±.27	0.098
Swelling (Facial measurement C-D) "cm"			
Preoperative	10.59±.32	10.74±.36	0.014
3rd day	11.63±0.44	11.72±0.32	0.369
7th day	10.75±0.33	10.86±0.35	0.242
Trismus [Inter incisal distance (cm)]			
Preoperative	4.25±.45	4.32±.48	0.543
3rd day	2.86±.62	2.55±.61	0.061
7th day	4.31±.49	4.11±.39	0.086
Periodontal Probing Depth (mm)			
Preoperative	2.18±.22	2.14±.25	0.795
8th weeks	2.61±0.17	2.85±0.38	0.003*
Bone density (HU)			
Immediate	287.27±64.96	143.27±19.38	<0.001**
3-months	449.47±111.18	270.50±23.81	<0.001**

Using: Independent Sample t-test

*Using: Paired Sample t-test; **p-value <0.001*

**p-value <0.05 S; **p-value <0.001 HS*

DISCUSSION

Socket healing is a process that contains a sequence of cellular, biochemical, physiological and molecular responses including cytokines, proteins and growth factors which is aimed to restore tissue integrity and functional capacity after extraction[23,24].

Reconstruction of bony defects is a challenging problem in the surgical field. Many defects in facial skeleton may significantly impair proper prosthetic and functional rehabilitation of the stomatognathic system [25].

The two groups were comparable in age with the mean ± SD in each of Group A and Group B was 28.89±4.73 compared to 29.43±3.97 respectively, there was no statistically significant difference between the Group A and Group B with p-value (p=0.634).

There was no significant reduction of pain in group A compared to group B at 3rd day and 7th day. The application of intra-alveolar either PRF alone or combined with POP could explain the reduction of pain.

All of clinical studies on PRF applications high lightened the improvement of tissue cicatrization due to the development of effective neovascularization, accelerated wound closing with fast cicatricial tissue remodeling, and nearly total absence of infectious events [10].

Studies have also shown that PRF, unlike the other platelet concentrates, would be able to progressively release cytokines during fibrin matrix remodeling; such a mechanism might explain the clinically observed healing properties of PRF [26].

In dental implantolgy a less number of studies have been made, examining the possible use of PRF as a grafting material in the augmentation procedures of maxillary sinus. PRF mixed with freeze-dried bone allograft has been shown to reduce healing time before implant placement [27, 28].

In the present study, facial measurement and maximum mouth opening have no significant difference at 3rd and 7thday after surgery. Yuasa H et al [29] studied the postoperative facial swelling and pain after extraction of impacted mandibular third molar and concluded that: facial swelling and pain differ depending on patients' characteristics (age and sex) and preoperative index of difficulty.

In the present study there was a statistically significant difference between two groups according to Periodontal Probing Depth (mm) at 8th weeks with p-value (p<0.05). The higher mean value was found in Group B (2.85±0.38) compared to Group A (2.61±0.17), while preoperatively there was no statistically significant difference between the two groups, with p-value (0.795).

Shaffer CD [30] and Andreana S [31] reported good Clinical and radiographic results using CS in periodontal infrabony defects.

Orsini M et al [32]. Claimed that the addition of CS to autologous bone graft in the treatment of intra bony periodontal defect has been found to show similar clinical outcomes when compared to autologous graft alone which is considered the gold standard graft.

Kim CK et al. [33] the placement of CS in a surgically created three-walled defects in dogs showed significant improved regeneration of both alveolar bone and cementum.

Dahiya et al [34]. studied the use of cone-beam computed tomography in evaluating bone density at posterior mandible, it was observed that the mean bone density of males was 690.5 ± 104.12 HU and that in females, it was 580.20 ± 120.2 HU.

There was a statistically significant difference between the two groups according to bone density immediate and 3-months postoperatively with p-value (p<0.001). The higher mean value was found in Group A (287.27±64.96) compared to Group B (143.27±19.38) immediately postoperative, also for the bone density at 3-months there was higher

mean value in Group A (449.47±111.18) compared to Group B (270.50±23.81).

The histological reports of eight different materials that compeered it's of one clinical study to grafting of autologous bone in 144 patients sinuses appeared that the CS has same results with less remnant graft than others.

Scarano et al [36].reported the application of CS in peri-implant defects in the time of implant placement lead to formation of trabecular bone with the absence of any residual CS through light microscopy while 40% of new bone formation appeared in the histomorphometry.

Murashima et al [37]. surgically created different defects after root canal treatment in the beagle dog model and reported that osseous defects had extremely higher values of bone volume and mineral apposition rates on the experimental CS-filled side while the control side had lower outcomes.

Guarnieri R et al [38]. Have used POP as a bone substitute for socket preservation and reported that it completely resorbed in 4 weeks and replaced by the host bone and showed better ridge preservation and post-operative comfort.

CONCLUSIONS

Under the limitation of the present study it could be concluded that:

1. Medical grade Plaster of Paris combined with PRF, decreases the Periodontal Probing Depth following removal of impacted mandibular third molars.
2. Medical grade Plaster of Paris combined with PRF promotes bone healing which in turn enhances bone density.
3. There is no statistically significant difference between two groups according to pain, facial swelling and maximum mouth opening.

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