

COMPARISON BETWEEN THE EFFECTS OF THE PLATELET RICH FIBRIN (PRF) VERSUS XENOGRAFT ON PRIMARY STABILITY IN MANDIBULAR PREMOLARS IMMEDIATE IMPLANTS

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ABSTRACT

Aim of the study: The aim of this study was to compare the regenerative potential of deproteinized bovine bone (xenograft) and platelet rich fibrin on implant primary stability in immediately placed mandibular premolar implants.

Material and Methods: Twelve patients were selected from twenty five patients examined in the outpatient clinic of the implant clinic in Faculty Dentistry Cairo University

The patients fulfilled the following criteria: Presence of non-restorable mandibular premolar tooth due to trauma, caries, root resorption, root fracture, endodontic or periodontal failure, Male or female patients between the ages of 30 to 50. and Patient with Sufficient bone volume, good oral hygiene and nonsmokers.

Results: The results showed that the measurements of primary stability for immediately extracted sockets with PRF and implant placement were greater than that with the xenograft; there was a statistically significant difference between the PRF group and the control group regarding measurements of primary stability.

The higher mean value was found in (PRF) group, while the lowest mean value was found in (Xenograft) group.

Conclusion: From the results of the current study we can conclude that:

PRF provides better primary implant stability than xenograft as space filling material.

PRF is an effective material for management of jumping gap after immediately placed dental implants.

Further studies are recommended for long term evaluation of PRF as space filling material.

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INTRODUCTION

One of the main problems of tooth extraction is that the alveolar ridge undergoes resorption both vertically and horizontally after 6 months, which leads to loss of bone volume and difficult implant positioning. Immediate implant placement is the insertion of the implant immediately into the fresh extraction socket site right after tooth extraction and is considered to be a predictable and acceptable procedure, the immediate implant placement is often preferred because of preservation of the bone and prevention of resorption of the alveolar ridge, and it also shortens the surgical and treatment time. The decreased surgical trauma of immediate placement decreases the risk of bone necrosis and permits the bone remodeling process to occur, i.e. the healing period is rapid and allows the woven bone to be transformed into lamellar bone.^[1,2]

In addition, the natural socket is rich in periodontal cells which make the healing faster and more predictable.^[3]

Many cases of the immediate dental implant installation have partial wall defects around the dental implant. If the horizontal defect size is 1.5 mm, this means that the bone to implant contact size is approximately 50% without a barrier membrane. In the case of wide defects, a bone graft or guided bone regeneration (GBR) technique can be considered.^[4]

Guided bone regeneration accompanying immediate implant placement, has been used as an adjunctive treatment option to reduce the subsequent bone resorption process. Autografts, allograft, xenografts or a mixture of all of these materials have been used as grafting and space filling materials in the space between the implant body and the socket walls.^[5]

Platelet-rich fibrin (PRF) belongs to a new generation of platelet concentrates, with simplified processing and without biochemical blood handling.

Here, blood is collected without any anticoagulants and immediately centrifuged. A natural coagulation process then occurs and allows for the easy collection of a leucocyte and platelet- rich fibrin (L- PRF) clot, without the need for any biochemical modification of the blood, there is no anticoagulants, thrombin or calcium chloride required for preparation.^[6]

Nevertheless fibrin is a recognized support matrix for bone morphogenetic protein (BMP) transplants. Therefore, the fibrin matrix associated with BMPs has angiogenic, haemostatic and osseous conductive properties^[7].

The need for comparison between platelet rich fibrin as growth factor and xenograft to determine which is more beneficial to close the space around immediate implant and help in rapid and more bone regeneration.

Aim of the study: The aim of this study was to compare the regenerative potential of deproteinized bovine bone (xenograft) and platelet rich fibrin on implant primary stability in immediately placed mandibular premolar implants.

MATERIAL AND METHODS

Patient selection

Twelve patients were selected from twenty five patients examined in the outpatient clinic of the implant clinic in Faculty Dentistry Cairo University

The patients fulfilled the following criteria:

- Presence of non-restorable mandibular premolar tooth due to trauma, caries, root resorption, root fracture, endodontic or periodontal failure.
- Male or female patients between the ages of 30 to 50.
- Patient with Sufficient bone volume, good oral hygiene and nonsmokers.
- **Exclusion criteria:**
- Extreme bone atrophy in mandibular premolar area.

- Patients who have systemic disorders.
- Patients with bone diseases, presence of periapical pathology affecting the neighboring teeth and Bad oral hygiene.

Patient examination

In this stage the patients were checked if they matched the patient selection criteria of this research or not.

A) Medical history:

Past and present medical history was recorded in the patient's chart.

B) Dental history:

Each patient was asked about the cause of extractions, date of the last extraction and any previous prosthetic experience.

C) Lab investigations:

Glycosylated Hemoglobin test was performed for each patient to confirm the absence of uncontrolled diabetes.

D) Clinical examination

Extra-oral examination

Extra-oral examination included assessing the patient's general facial proportions and symmetry. The patient's facial profile was used to primary determining the maxilla-mandibular skeletal classification. Temporo-mandibular functions and lymph nodes were examined.

Intra oral examination:

Thorough intraoral examinations were done for soft tissue and amount of present keratinized mucosa.

E) First Radiographic examination:

Digital Panoramic radiographs were made for the patients to evaluate the bone and exclude any bony lesions (figure.1)

Radiographic examination included preoperative panoramic radiograph with 1:1 magnification (figure1) was taken for each candidate as a primary survey to obtain an approximation of the available bone height and the presence of periapical pathosis. (figure.1)

Preoperative cone-beam CT (CBCT) were made to accurately measure the dimensions of the residual alveolar bone height between the apices and the coronal part of the mental nerve, sufficient buccal bone, and absence of any pathological lesion related to remaining root and selection of implant diameter and length.

The method of randomization in this trial was using sealed opaque envelopes. The grafting methods were placed in twenty envelopes. The envelopes were randomly opened on the day of the surgery by the operator.

Surgical procedures:

Pre-operative antibiotics were administered orally 1 hour before procedure.

All procedures were performed under local anesthesia using lidocaine.

A periosteal elevator was carefully used to sever surrounding periodontal ligament attachments of the premolar to be extracted then the roots were finally delivered using extraction forceps, with extreme care to preserve integrity of buccal and lingual plates

Osteotomy site preparation

The osteotomy was prepared through the socket opening with copious sterile saline irrigation where the implant bed at the apical portion of the socket was prepared by drilling 2-3mm beyond the apex and at least 3mm apical engagement of the body of the implant into the residual alveolar bone between the socket and the superior border of the mental nerve.

A parallel pin was placed in the osteotomy site to confirm the position and the angulations of the osteotomy, the osteotomy was then widened using an intermediate (twist) drill and the final drill according to the diameter of the implant then the implant was threaded into the bone using a ratchet with insertion torque between 30 and 50 Ncm

In the control group

In the control group, the gap around the implant in the extraction socket was completely packed using deproteinized bovine bone (tutogenbone) (figure 1)



Fig. (1) Xenogenic bone graft packed into the extraction socket after implant placement

In the study group

In the study group a blood sample was withdrawn in plain 10-mL tubes (without anti-coagulant) which was immediately centrifuged at 3000 rpm for 10 minutes as Choukroun indicated in a 2011 study. Then PRF was removed from the tube and compressed by sterile gauze to be shaped in a form of membrane followed by packing into the socket till

Implant osteotomy site.(figure 2)

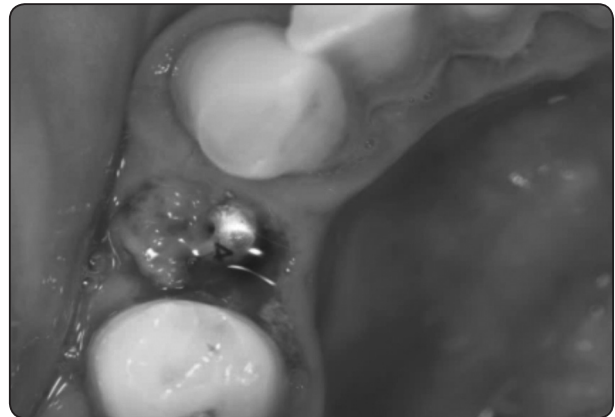


Fig. (2) Platelet rich fibrin packed into the socket

Measurement of the implant primary stability

The Smart Peg was connected to the smart peg mount then it was screwed onto the implant, using approximately 4-6 Ncm of torque.

The measurement probe of the osstell was held close to the top of the Smart Peg without touching it. When the instrument senses the Smart Peg, the ISQ value was displayed on the screen of the portable instrument.

Measurement in all direction of smart peg buccal, lingual, mesial and distal, 4 readings were taken for each side and an average was taking (figure 3)

Implant stability

Resonance frequency analysis was performed to determine implant stability at the time of implant placement and after 2, 4,6,10 and 12weeks. Finally, the healing collar was then placed in place with the screw driver.

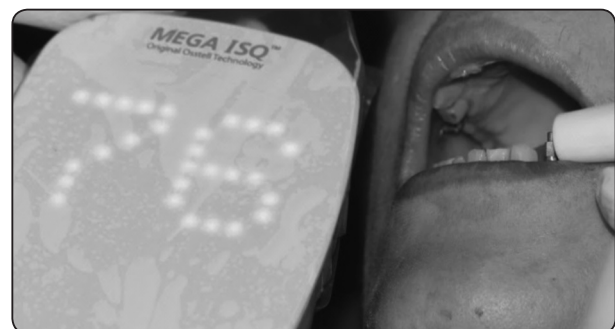


Fig. (3) Showing primary stability measurement by osstell

Post-operative care:

Post-operative medications were prescribed as follows:

Amoxicillin/clavulanic acid tablets 1mg every 12 hours for 5 days, diclofenac potassium 50mg every 12 hours for 5 days and chlorhexidine 0.1% mouthwash 3 times daily for 5 days

RESULTS**1- Stability results****A) Effect of time****a) PRF:**

There was a statistically significant difference was found between (0w) and each of (2w), (4w), (6w), (10w) and (12w) where ($p=0.010$), ($p<0.001$), ($p<0.001$), ($p<0.001$) and ($p<0.001$).

Also, a statistically significant difference was found between (2w) and each of (4w), (6w) and (10w) where ($p<0.001$), ($p<0.001$) and ($p=0.017$) respectively. While no statistically significant difference was found between (2w) and (12w) where ($p=0.182$).

A statistically significant difference was found between (4w) and each of (10w) and (12w) groups where ($p=0.020$) and ($p=0.002$). While no statistically significant difference was found between (4w) and (6w) where ($p=0.235$).

Also, a statistically significant difference was found between (6w) and each of (10w) and (12w) groups where ($p=0.002$) and ($p<0.001$).

A statistically significant difference was found between (10w) and (12w) groups where ($p<0.001$).

b) Xenograft:

There was a statistically significant difference between (0w), (2w), (4w), (6w), (10w) and (12w) groups where ($p<0.001$).

A statistically significant difference was found between (0w) and each of (2w), (4w), (6w), (10w) and (12w) where ($p<0.001$).

Also, a statistically significant difference was found between (2w) and each of (4w), (6w) and (12w) where ($p<0.001$), ($p<0.001$) and ($p=0.044$) respectively. While no statistically significant difference was found between (2w) and (10w) where ($p=0.111$).

A statistically significant difference was found between (4w) and each of (10w) and (12w) groups where ($p<0.001$). While no statistically significant difference was found between (4w) and (6w) where ($p=0.308$).

Also, a statistically significant difference was found between (6w) and each of (10w) and (12w) groups where ($p<0.001$).

A statistically significant difference was found between (10w) and (12w) groups where ($p=0.001$).

B) Effect of groups:**a- 0w:**

There was no statistically significant difference between (PRF) and (Xenograft) groups where ($p=0.555$).

b- 2w:

There was a statistically significant difference between (PRF) and (Xenograft) groups where ($p<0.001$).

c- 4w:

There was a statistically significant difference between (PRF) and (Xenograft) groups where ($p=0.001$).

d- 6w:

There was a statistically significant difference between (PRF) and (Xenograft) groups where ($p<0.001$).

e- 10w:

There was a statistically significant difference between (PRF) and (Xenograft) groups where ($p < 0.001$).

f- 12w:

There was a statistically significant difference between (PRF) and (Xenograft) groups where ($p = 0.002$).

TABLE (1) The mean, standard deviation (SD) values of stability of different groups.

Variables	Stability				p-value
	PRF		Xenograft		
	Mean	SD	Mean	SD	
0w	72.17	3.74	71.42	2.19	0.555ns
2w	68.25	2.60	62.75	2.26	<0.001*
4w	62.33	3.08	58.50	1.68	0.001*
6w	63.50	1.45	57.58	2.11	<0.001*
10w	65.08	1.68	61.83	1.64	<0.001*
12w	66.58	2.07	63.58	2.23	0.002*
p-value	<0.001*		<0.001*		

*; significant ($p < 0.05$) ns; non-significant ($p > 0.05$)

Two-way ANOVA:

Data in table (2) shows the results of Two-way ANOVA analysis for the effect of different variables on stability. The results showed that groups had a statistically significant effect. Also, time had a statistically significant effect. The interaction between the two variables had a statistically significant effect.

C) Effect of groups regardless of time:

There was a statistically significant difference between (PRF) and (Xenograft) groups where ($p < 0.001$).

The higher mean value was found in (PRF) group, while the lowest mean value was found in (Xenograft) group.

TABLE (3) The mean, standard deviation (SD) values of stability of different groups regardless of time.

Variables	Stability	
	Mean	SD
PRF	66.32	4.10
Xenograft	62.61	4.93
p-value	<0.001*	

*; significant ($p < 0.05$) ns; non-significant ($p > 0.05$)

TABLE (2) Results of Two-way ANOVA for the effect of different variables on mean Stability.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2710.743 ^a	11	246.431	46.004	.000
Intercept	598431.174	1	598431.174	111716.556	.000
Mode of curing	495.063	1	495.063	92.419	.000
Thickness	2110.285	5	422.057	78.791	.000
Mode of curing * Thickness	105.396	5	21.079	3.935	.002
Error	707.083	132	5.357		
Total	601849.000	144			
Corrected Total	3417.826	143			

df: degrees of freedom = (n-1),

* Significant at $P \leq 0.05$

D) Effect of time regardless of groups:

There was a statistically significant difference between (0w), (2w), (4w), (6w), (10w) and (12w) groups where ($p < 0.001$).

A statistically significant difference was found between (0w) and each of (2w), (4w), (6w), (10w) and (12w) where ($p < 0.001$).

Also, a statistically significant difference was found between (2w) and each of (4w) and (6w) where ($p < 0.001$). While no statistically significant difference was found between (2w) and each of (10w) and (12w) where ($p = 0.202$) and ($p = 0.997$).

A statistically significant difference was found between (4w) and each of (10w) and (12w) groups where ($p = 0.010$) and ($p < 0.001$). While no statistically significant difference was found between (4w) and (6w) where ($p = 0.999$).

Also, a statistically significant difference was found between (6w) and each of (10w) and (12w) groups where ($p = 0.016$) and ($p < 0.001$).

No statistically significant difference was found between (10w) and (12w) groups where ($p = 0.451$).

TABLE (4): The mean, standard deviation (SD) values of stability of different groups regardless of groups

Variables	Stability	
	Mean	SD
0w	71.79	3.02
2w	65.50	3.68
4w	60.42	3.12
6w	60.54	3.50
10w	63.46	2.32
12w	65.08	2.60
<i>p-value</i>	<0.001*	

*, significant ($p < 0.05$) ns; non-significant ($p > 0.05$)

DISCUSSION**Discussion of Methodology****Patient Selection**

Twelve patients were selected with the age ranged from 20-50 years and Patients over 50 were excluded. Changes that happen for the patient within this age range are not extreme and therefore the homogeneity and standardization of the results can be obtained. ^[8]

Older patients may have potentially longer healing time, more systemic health problems, difficult adaptation to new prosthesis, as well as decreased ability to maintain good oral hygiene. Also they may suffer from decrease in calcitonin and vitamin D absorption and activation, which may lead to delayed osseointegration. Moreover, patients at the selected age are relatively more co-operative and have adequate neuromuscular control. ^[8]

Patients with good general health were selected to avoid the effect of any systemic disorder on the bone condition, postoperative healing and hence osseointegration. ^[9] Patients with systemic diseases affecting osseointegration of dental implants were excluded from the study

A critical factor that needs to be evaluated during the diagnosis and treatment planning phase for patients seeking implant is the presence of adequate buccal bone. The amount of buccal bone is critical for osseointegration. Implants were installed in the socket with at least 3mm apical engagement of the body of the implant into the residual alveolar bone between the socket and the superior border of the mental nerve.

Moreover uncooperative patients with bad oral hygiene were excluded as it has a bad effect on the marginal gingiva and bone height. ^[10]

Surgical Procedure and Implant stability

Immediate implant placement after extraction

has become a favored treatment protocol with many clinicians worldwide. Placement of an implant directly into a prepared extraction socket at the time of extraction has several advantages that have the potential to improve patient acceptance of the procedure. The advantages are elimination of the waiting period for socket ossification, fewer surgical sessions required, shortened edentulous time period, reduced overall cost, preservation of alveolar bone height and width, decreased operatory time with less trauma to the tissues and less discomfort to the patient. By using the extraction site that follows the natural long axis of the tooth, easier implant orientation and better Prosthodontics rehabilitation can be achieved. Several authors have reported placement of implants into extraction sockets. [11-15]

Discussion of results

Implant stability is a well-known indication of implant survival. In this study the ISQ values in both deproteinized bovine bone and platelet rich fibrin groups showed increase in stability values. In agreement with Öncü et al., [16] who researched the positive effects of PRF on osseointegration which concluded that it may improve the amount and rate of bone formation and accelerated osseointegration of the implants.

This study showed that the measurements of primary stability for immediately extracted sockets with PRF and implant placement were greater than that with the xenograft; there was a statistically significant difference between the PRF group and the control group (xenograft) regarding measurements of primary stability this can be attributed to the Presence of PRF which has been researched thoroughly for its regenerative potential for wound healing it is autogenous and is not associated with any issues related to immune reactions or infections.

SUMMARY

The present study investigated the bone regeneration potential of xenografts versus Platelet-Rich fibrin in immediate implants in mandibular premolars.

Twelve patients with an age range from 20-50 were enrolled in this study. All patients were indicated for immediate implant placement with a total of 12 implants placed. The selection criteria was patient with sufficient alveolar bone height between the apices and the coronal part of the mental nerve to avoid nerve injury, sufficient buccal bone, and absence of any pathological lesion preoperative CBCT, and free of any medical conditions that may impair bone healing.

Aatraumatic extraction was carried out using periostomes. Implants were placed into the socket of mandibular premolar followed by filling of jumping gap with xenograft in control group and PRF in study group.

Implant stability was measured after implant insertion, 2 weeks, 4 weeks, 6 weeks, 10 weeks and 12 weeks

The results showed that the measurements of primary stability for immediately extracted sockets with PRF and implant placement were greater than that with the xenograft; there was a statistically significant difference between the PRF group and the control group regarding measurements of primary stability.

The higher mean value was found in (PRF) group, while the lowest mean value was found in (Xenograft) group.

CONCLUSION

From the results of the current study we can conclude that:

PRF provides better primary implant stability than xenograft as space filling material.

PRF is an effective material for management of jumping gap after immediately placed dental implants.

Further studies are recommended for long term evaluation of PRF as space filling material.

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