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EFFICACY OF PLATELET RICH FIBRIN VERSUS XENOGRAFT ON HEALING AROUND IMMEDIATE DENTAL IMPLANTS IN THE ESTHETIC ZONE

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ABSTRACT

Objectives: The current study aimed clinically and radiographically to evaluate and compare the efficacy of platelet rich fibrin (PRF) versus xenograft on healing around immediate dental implants in the esthetic zone. **Subjects and Methods:** Twelve implants were inserted immediately after tooth extraction for 11 patients aged between 25 and 40 years replacing hopeless teeth in the anterior maxilla. Patients were randomly divided into two equal groups: group (I) (n=6) the jumping gap was filled with PRF, and group (II) (n=6): the jumping gap was filled with xenograft. The patients were clinically and radiographically evaluated for the following: implant stability using resonance frequency analysis (RFA), crestal bone loss and bone density. **Results:** All implants showed acceptable primary stability with a significant improvement in secondary stability that measured at 6 months postoperatively in both groups. The mean value of crestal bone loss and bone density with PRF and xenograft were comparable without significant differences in both groups. **Conclusions:** the use of PRF as a gap filling material is effective in healing around immediate dental implant in esthetic zone and can be compared with xenograft with regards to implant stability, crestal bone loss, and bone density.

KEYWORDS: Immediate implant, PRF, xenograft, implant stability, crestal bone loss, bone density

INTRODUCTION

The loss of a single tooth or multiple teeth in the esthetic zone is one of the most painful experiences[(1)]. Treatment options have been changed by immediate implantation, which has a notable established success rate because it can reduce treatment time, number of surgeries and post extraction bone loss[(2)] .

According to standard norms, the duration of time after tooth extraction for bone remodeling should be from two to three months, with an additional 6 months load free implant to complete osseointegration process. Controlled clinical studies have demonstrated an average of 4.4mm of horizontal and 1.2mm of vertical bone resorption six months subsequent to tooth extraction[(3,4)].

The placement of immediate implant have a problem in primary stability because of the discrepancy in size and form between the extraction

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socket and the implant, typically, there is still room in the vicinity of the implant's coronal section, called " jumping distance " [5].

This space observed between bone and implant after dental extraction may reduce osseointegration. So, autogenous bone grafts and/or xenograft resources have been used in those gaps to correct bone defects and may provide appropriate osseointegration and secondary stability[5-7].

Platelet concentrate are primarily involved in the healing of wounds via blood clot formation and release of growth-promoting elements which initiate and support wound healing[8]. platelet rich fibrin (PRF) was developed by Choukroun et al [9] which is considered a simple method to prepare fibrin gels without exogenously added supplements.

Choukroun PRF is a second generation of platelet derivatives after platelet rich plasma (PRP). It can be prepared by a single step and does not require any additives. PRF provides a fibrin matrix enhanced with platelets, leukocytes and growth factors [10].

These growth factors which are autologous, nontoxic and non-immunogenic, enhance and accelerate the regeneration of soft tissues and bones without inflammatory responses, which either by itself or in conjunction with bone transplants that promote hemostasis, growth of bone and maturation[11].

Nevertheless, the jumping gap can be filled with non-antigenic (treated) bovine bone which is called xenograft material. It is highly suitable for this procedure because it may be more stable due to its slow resorption rate, obtain a purer and more crystalline material[12].

The problems of stability in immediate implant have great distress on implant survival. Several studies suggest the placement of PRF around immediate implants would be better in secondary stability than allograft materials, but to date, there isn't any conclusive proof that one biomaterial is better than another. [13- 16].

The current investigation was conducted to evaluate the validity of PRF placement versus xenograft on healing in the esthetic zone surrounding the immediate dental implant.

Subjects and Methods

It is a controlled, randomized study included twelve implants that were placed immediately following tooth extraction for 11 patients aged between 25 and 40 years replacing hopeless teeth located in the front of maxilla. Patients were randomly split into two equal groups (n=6). Patients were chosen among the attendees the Outpatient Clinic of the Oral and Maxillofacial Surgery. The ethical committee of the Faculty of Oral and Dental Medicine at Al-Azhar University. Approved the study protocol, with code NO. (724 / 313).

Eligibility criteria:

Patients having non-restorable tooth /root in esthetic zone, with intact facial wall of the socket following tooth extraction and with sufficient apical bone to allow adequate mechanical stability of implant were included in the study.

Exclusion criteria included presence of acute or chronic infection or local pathological condition at the extraction socket, patients with history of any uncontrolled systemic disease which could affect implant surgery or healing, current radiation therapy and inability or unwillingness to return for follow-up visits.

Patient grouping:

All patients were randomly split into two groups:

- Group (I): the jumping gap was grafted with plug of (PRF).
- Group (II): the jumping gap was grafted with xenograft (One graft).

Preoperative evaluation:

- Clinical evaluation: including medical and dental history and complete intra-oral and extra-oral examinations.

- Radiographic evaluation: Cone beam computed tomography *(CBCT)* using (Blue Sky Plan 4 software) to assess the following: bone density by Hounsfield units (HU), alveolar bone dimensions and the implant's dimensions to be installed.

Surgical intervention

(1) Tooth extraction:

Under local anesthetic infiltration to buccal and palatal tissues using Articaine 4% with 1:100,000 epinephrine, a traumatic extraction of the offending tooth was performed. A periotome was used for tearing of gingival and periodontal ligament fibers around the tooth for luxation. Forceps was employed to remove the tooth from its socket using gentle movements and avoiding any excessive pressure on the facial socket walls. Then, curettage of the socket was gently carried out to eliminate any remaining periodontal ligaments, tooth fragments or debris. Any soft tissue remnants (granulation tissue and residual periodontal tissue) were removed and curetted with copious irrigation with normal saline. Inspection and exploration of the wall of the socket after extraction by using blunt instrument was assured to exclude bony defects.

(2) Implant installation:

The pilot drill was used under copious saline irrigation to create an osteotomy site in the apical one third of the socket of the extracted tooth with palatal bias extending 2 to 3 mm apical to the socket base to achieve primary stability of implant. A paralleling pin was placed inside the initial osteotomy, and then a periapical radiograph was taken to verify drilling location and angulation to the adjacent teeth. According to bone density, sequential drilling according to the manufacture guidelines was performed (Clockwise drill speed 800-900 revolution/minute (rpm) and torque of 35 N/cm under copious irrigation). Following a correct osteotomy preparation, the socket was irrigated, the implant (Oxy Implant System, Italy) with length ranged from 11.5mm to 15mm and diameter ranged from 3.5mm to 4.5mm was taken out of its sterile pack, fully seated inside the vertical plane of the prepared socket, and screwed to achieve the maximum manual torque before using a ratchet wrench to seat the implant into its final position.

(3) Measurement of primary stability of implant:

In both groups and immediately after insertion of the implant, a smart-peg was affixed to the implant fixture with a screw connection. Then, the Ostell® device was conducted to evaluate the primary implant stability by Implant Stability Quotient (ISQ). The measurements were performed with the probe directed from two different directions (buccal and mesial directions). The two values for ISQ were recorded and calculated to be used as a mean value. The measurement was recorded as PS then the smart-peg was removed and the cover screw was adapted to the implant platform.

***(4) Jumping gap grafting*:**

Grafting the jumping space between the implant surface and labial cortex was different according to each group. In Group (I), the jumping space was grafted with plug of (PRF), while in Group (II), the jumping space was grafted with xenograft.

(A) Gap grafting in group I:(PRF group):

Preparation of Platelet-Rich Fibrin:

About 5 ml of peripheral venous blood was drawn from patient arm in a sterile evacuated tube without anticoagulant. The tube was placed in a centrifugal machine set at 3000 (rpm) for 10 minutes. The resultant products inside the tube consisted of the following four layers: (a) RBCs at the bottom, (b) shaggy layer of leukocyte above RBCs, (c) PRF clot in the middle, and (d) The most top layer including a cellular platelet poor plasma (PPP).

Then PRF clot then was separated by scissor from the remaining fractions. The gap between the outer surface of the implant and labial alveolar bone in Group (I) was packed with PRF plug. (Figure 1)

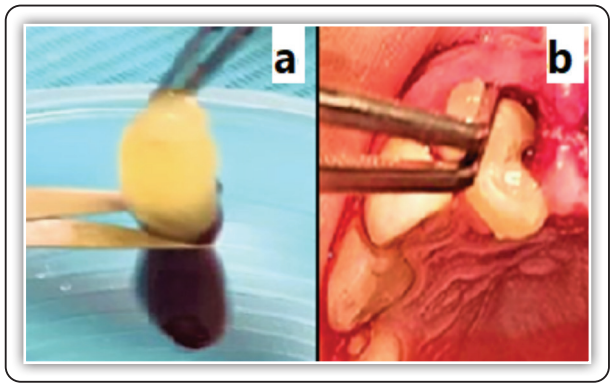

FIG (1) PRF plug; a) RBCs clot separation from PRF plug, b) PRF plug insertion into the gap (group I)

(B) Gap grafting in group II:(xenograft group):

After implant placement, bovine bone (One xenograft company, Germany) substitute was mixed with a few drops of saline for producing a plastic mix which allow to easy packing into the gap from implant body to the socket walls. (Figure 2)

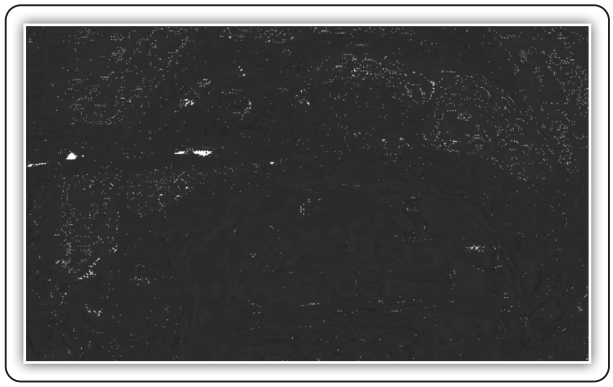

FIG (2) The graft being packed into the gap for upper left central incisor (group II)

(5) Healing abutment adaptation and suturing:

For both groups and after grafting the jumping gap, the healing abutment was selected and screwed in. Healing abutment used to help in contouring the gingival architecture, to avoid second stage of surgery and act as a socket seal. The height of healing abutment was selected in a way to ensure that there wasn't a functional loading on the implant. A 3-0 black silk was used for closure of the soft tissue by simple interrupted technique.

(6) Postoperative care and medications:

Regular postoperative instructions were given to the patients, and postoperative medications were prescribed as follow: Amoxicillin/Clavulanate tabs. 1000mg every 12 hours, Metronidazole tabs. 500mg every 8 hours, and Ibuprofen tabs. 400 mg. every 8 hours. The patients were instructed to attend for the follow-up 7-10 days postoperatively for suture removal and checkup.

Postoperative assessment

The patients were clinically and radiographically evaluated for the following: secondary implant stability using resonance frequency analysis (RFA) at six months postoperatively, bone density and loss of crestal bone by CBCT using Blue Sky Plan 4 software.

Statistical analysis

Statistical analysis was carried out using a commercially available software program Statistical Package for the Social Sciences (SPSS Chicago, IL, USA). Numerical data was described as mean and standard deviation or as median and range as appropriate according to the normality of the data. The degree of significance will be set at $P < 0.05$.

RESULTS

The total number of patients in the current investigation was 11 received 12 immediate dental implants. The sample was split into two equal groups; group I (PRF) was utilized to fill the jumping gap including 6 implants (n = 6) and group II (xenograft) was utilized to fill the jumping gap including 6 implants (n = 6). Oxy dental implant system was used for all patients with a diameter ranging from 3.5 to 4.5 mm, while the length ranged from 11.5 to 15 mm. During the course of the study, implant healing was uneventful. Throughout the trial, all 12 implants stayed stable and did not exhibit any signs of discomfort, suppuration, or peri-implant infection

1) Implant stability:

As illustrated in table (1), implant stability was assessed immediately as primary stability and at six months following surgery as secondary stability using RFA by Osstell device. For Group I, immediate stability was recorded to be 58.66±5.60 ISQ, and at six months following surgery was 69.83±5.03 ISQ. The difference exhibited statistical significance. (p=0.001*).

For Group II, immediate stability was recorded to be 60.00±5.05 ISQ, and at six months following surgery was 69.83±2.48 ISQ. The difference exhibited statistical significance (p≤0.001*). In comparing both groups, the difference was statistically non-significant at both intervals; (p=.675) for immediate and (p= 1.000) for 6 months.

TABLE (1) Comparison between the two groups based on implant stability (ISQ)

Stability (ISQ)	Group I	Group II	T	P
Immediate	58.66±5.60	60.00±5.05	-.432	.675
6 months	69.83±5.03	69.83±2.48	.000	1.000

P: probability value, t: independent t test

2) crestal bone loss:

As shown in table (2), the crestal bone loss was evaluated for all patients of both groups immediately and at six months postsurgically. For Group I, immediately after implantation, crestal bone level was recorded to be 2.28±.38 mm above the implant platform. At six months postsurgically was 1.03±.54mm. The difference exhibited statistical significance. (p=.002*).

For Group II, immediately after implantation, level of crestal bone was recorded to be 2.13±.22 mm above the implant platform. At six months postsurgically was 1.01±.37mm. The difference exhibited statistical significance (p≤0.001*). In comparing both groups, the difference was statistically non-significant at both intervals; (p=.426) immediately after implantation and (p=.952) for six months postsurgically.

TABLE (2) Comparison between both groups based on crestal bone loss

Crestal bone level	Group I	Group II	t	P1
Immediate	2.28±.38	2.13±.22	.829	.426
6 months	1.03±.54	1.01±.37	.062	.952
P2	p=.002*	p ≤0.001*		
Crestal bone loss	1.25±.16	1.12±.15		

*p1: p value for comparing between both groups at both observation intervals, p2: p value for comparing between time periods for each group, t: independent t test. *: Statistically significant at p≤0.05*

3) Bone density:

As shown in figure 3, the bone density was evaluated for all patients of both groups immediately after implantation and at six months postsurgically. For Group I, immediate bone density around the implant was recorded to be 684.00±121.28 HU, at six months postsurgically was 694.33±107.82 HU. where the difference was statistically non-significant (p=.713).

For Group II, immediate, bone density was recorded to be 710.00±99.04 HU, and at six months postsurgically was 730.16±102.68 HU, the difference was statistically non- significant (p=.271). In comparing both groups, the difference was statistically non-significant at both intervals; (p=.693) and (p=.569) for immediate and six months postoperative readings respectively.

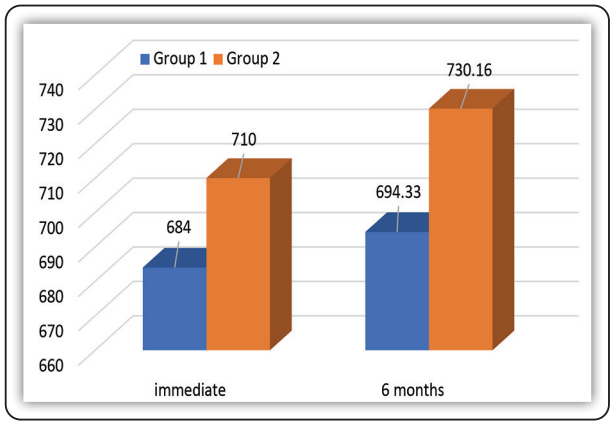

FIG (3) Bar chart showing comparison between both groups at both observation intervals according to bone density

DISCUSSION

The implant stability was recorded by Ostell device (RFA). According to Bajoghli et al.[19], Ostell device (RFA) provides more accuracy and convenience due to its recent updates and developments.

Implant stability has improved significantly for either group after 6 months follow up. While, at secondary stability assessment after 6 months, the ISQ values of group II were higher than group I but the difference was statistically insignificant. This is in consistent with Qu et al.[20]. who attributed positive improvement of implant stability due to that autogenous PRF which is nonimmunogenic, release a several growth factors improving osseointegration and implant stability. Moreover, Correia et al.[21] has evaluated the effectiveness of xenograft on implant stability and found that, it significantly improved after xenograft bone augmentation. According to El-Sheikh et al.[22]. Their results showed that, the implant stability was higher in xenograft group than both PRF and alloplast groups with no statistically significant difference between all groups.

In contrary, Rageh et al.[23] found that PRF provides better implant stability than xenograft as space filling material. They attributed these results to the presence of PRF which has regenerative potential for wound healing, it is autogenous and nonimmunogenic.

The present investigation revealed that PRF has acceptable effect in reducing bone loss at the end of follow up period for group I and the difference was statistically significant between the 2 intervals of follow up. This corresponds with Qu et al.[20]. Their study showed that, in the short term, platelet concentrates can dramatically lower marginal bone loss. They attributed this positive effect due to release of multiple growth factors which could preserve the bone.

Also, the present investigation revealed that the xenograft had a great influence in preserving the bone level for group II and the difference was statistically significant between the 2 intervals of follow up. This is consistent with Hammad et al.[24]. Their study showed that, xenograft showed minimal bone loss compared to mixture of allograft with xenograft. They attributed this favorable outcome of xenograft on alveolar bone loss owing to its osteoconductive properties and slow substitution rate which serve to maintain tissue volume during healing.

After 6 months of follow up for the current study, the buccal alveolar bone loss was 1.25±16 for group I, and for group II was1.12±15. In comparing both groups, the group II showed a slight reduction in bone loss than group I with no statistically significant difference. This is in accordance with Elbrashy et al.[18]. They came to the conclusion that using xenograft material instead of PRF produced better results when used as a gap filling material. They attributed these results to that, it is believed that PRF's ability to produce growth factors for up to 10 days is not long enough to affect the bone remodeling process that occurs after implant insertion and extraction, which can take up to 6 months. Conversely, xenografts exhibit a delayed rate of resorption and function as a scaffold to enable osteoblast cells to populate and repair bone within the jumping area.

In contrast to these findings, Rageh et al.[23] found that, PRF has much better results than xenograft

in preserving alveolar bone dimensions around immediate dental implant in mandibular premolar area.

Bone density is an important factor that reflects the bone quality and affects the initial stability and survival rate of the implants. At the current study, CBCT was used in measurements of bone density. According to Morar,[25] CT technology has had a significant impact on oral implantology and is currently the most used tool for assessing bone quantity and quality during dental implant planning. A study conducted by Razi et al.[26], showed a robust association between HU in CT scans and the voxel grayscale in CBCT and suggested that the voxel value in CBCT can be utilized for the estimation of bone density.

The current study revealed that, PRF has a beneficial impact on improvement of bone density around immediate dental implant at the end of follow up period for group I, but the difference was statistically nonsignificant between the 2 intervals of follow up. This is in agreement with Shaaban et al [27]. Their study showed that, immediate implant placement and loading with using PRF in the jumping gap as a grafting material is effective procedure for enhancing bone density around implants. They attributed this favorable outcome of PRF on bone density owing to slowly release a significant amount of fibrin with growth factors during the first week which accelerate the healing process and stimulate tissue generation.

Regarding to xenograft at the current study, it also showed a favorable outcome in improvement of bone density around immediate dental implant at the end of follow up period for group II, but the difference was statistically nonsignificant between the two intervals of follow up. This is in consistent with Jiannah et al.[28]. They concluded that, the xenograft positively effects on bone density and was biocompatible in treatment of a critical defect in a rat femur model.

In comparing both groups at the end of follow up period of the current study, the group II showed a slight increase in bone density than group I with no statistically significant difference. This is in accordance with El-Sheikh et al.[22]. They concluded that the group II (xenograft) was higher than group I (PRF) and group III (alloplast) in regards to bone quality and quantity with no statistically significant difference between all groups.

In contrary, Reda et al.[17]. Their study showed that, the study group (I-PRF and xenograft) revealed a greater improvement in bone density at the end of follow up period than the control group (xenograft alone) with a statistically significant difference. They attributed these results due to effect of PRF in increasing cell migration of osteoblast and consequently, more bone formation and more dense bone.

CONCLUSIONS

Within the limitations of the current study, it could be concluded that:

1. Utilization of PRF in oral surgery is considered an easy, simple and cost-effective technique that provides concentrates of growth factors needed for either soft or hard tissue healing and nearly achieve equivalent outcome to a xenograft.
2. Using xenograft for grafting the jumping gap around immediate dental implants positioned in the maxillary esthetic zone has provided better results than grafting with PRF plug however, the difference was statistically insignificant.

RECOMMENDATIONS

In the maxillary esthetic zone, longer follow-up periods are advised for a more accurate long-term assessment of alveolar bone loss surrounding immediately inserted dental implants.

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