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EFFECT OF TWO DIFFERENT GRAFTING PROTOCOLS ON THE STABILITY OF IMMEDIATE DENTAL IMPLANTS PLACED INTO INFECTED EXTRACTION SOCKETS IN THE ESTHETIC ZONE

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ABSTRACT

Objectives: Injectable Platelet Rich Fibrin (I-PRF) is an efficient method in wound healing and regenerating of the bone; thus, the purpose of the current research was to assess clinical and radiographic outcomes of a mixture of xenograft with I-PRF around immediate dental implant placed into infected extraction sockets in the esthetic zone. **Subjects and methods:** Twelve patients with non-restorable tooth/teeth in the esthetic zone were selected and randomly divided into two equal groups; Group I (n = 6) patients with immediate implant placement with jumping gap grafted using mixture of I-PRF and xenograft and Group II (n = 6) patients with immediate implant placement with jumping gap grafted using xenograft only. **Clinically,** Implant stability was assessed immediately and after 6 months postoperatively using Ostell device **Radiographically,** the assessment of the bone density at the second postoperative day and six months after implant placement. **Results:** Regarding the change in stability after six months postoperatively, group I (injectable PRF + xenograft) recorded a significantly higher mean (83.83±6.05) ISQ values, in comparison to (73.83±5.81) in group II (Xenograft only). This difference was statistically significant . Regarding the change in bone density, the amount of increase in density after six months postoperatively, in group I (injectable PRF + xenograft) recorded a higher value (225.67±81.89), in comparison to (92.67±82.09) in group II (Xenograft only). This difference was statistically significant. **Conclusion**: The use of mixture of I-PRF and xenograft with immediate dental implant placement offers a new promising, safe, compatible, and effective method for managing the healing process around immediate dental implants .

KEYWORDS: I-PRF, Dental implant, Infected socket, Xenograft.

INTRODUCTION

The benefits of dental implants include restoring function and esthetics, avoiding preparation of abutments adjacent to missing teeth, long-term favorable prognosis, and a high level of patient satisfaction. In the aesthetically area, the main goal of implant treatment is to achieve a superior outcome that is visually pleasing, while minimizing the likelihood of unexpected issues and complications. Immediate dental implant placement refers to insertion of an implant directly after a tooth is extracted, whereas delayed positioning occurs at some later time [1-2].

Recent studies have shown that placing implants in sockets that are infected does not lead to lower survival rates or greater risks, when compared to sockets that are not infected [3].

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After immediate implant installation in fresh extraction socket, there remains a gap between the implant periphery and marginal part of recipient site. A gap can occur on any aspect of an immediately placed implant: Buccal, lingual or proximal. This space between the implant periphery and surrounding bone is called the gap or jumping distance [(4)].

Xenografts are widely used as bone graft materials due to their abundant sources and ease of processing. It forms an osteoconductive framework with a mineral content comparable to human bone and can be integrated into the host bone [(5)].

In the late 1990s, platelet concentration received a colloquial name: platelet-rich plasma (PRP). PRP is composed of 95% platelets and produces a variety of growth factors used to initiate wound healing, in addition to secreted factors that promote cell proliferation, adhesion, and migration of multiple cell types. It requires centrifugation twice in separate steps to increase platelet counts without involving white blood cells, and PRP liquid form is difficult to handle, which limits its potential applications as it needs to be combined with other biomaterials and the lack of PRP in bone Clinically effective regeneration is limited by the production of a minimal growth factor profile [(7-6)].

These limitations gave rise to platelet-rich fibrin (PRF), a second-generation platelet concentrate produced from 100% autologous sources. It is composed of an autologous fibrin matrix and offers several advantages over PRP, including being easier to prepare and requiring no chemical manipulation of the blood, making it a purely autologous preparation. The I-PRF method requires short-term centrifugation to produce concentrated liquid platelets and primarily involves liquid thrombin and fibrinogen prior to fibrin formation [(8-9)].

So, it is valuable to study the effect of a mixture of xenograft with injectable platelet rich fibrin versus xenograft only around immediate dental implants placed into infected extraction sockets.

SUBJECTS AND METHODS

The current research was a randomized controlled clinical trial, including Patients with non-restorable tooth/teeth with chronic periapical infection indicated for immediate implant placement. Patients were selected from those attending the Outpatient Clinic of Oral and Maxillofacial Surgery, Faculty of Dental Medicine, Al-Azhar University, Cairo, Boys. Before any procedure, all participants were informed about the nature, benefits, and/or risks of being involved in the present study and each participant signed an informed consent document. All patients had undergone an adequate pre-surgical preparation consisting of detailed case history and radiographic examination. Ethically accepted with code 815/2237 from the Research Ethical Committee of Faculty of Dental Medicine ,Al-Azhar University, Cairo, Boys.

Eligibility criteria

Inclusion criteria

Patients having non-restorable tooth/teeth with chronic periapical lesion, maintaining good oral hygiene, having adequate bone quantity, having Intact walls of the socket and age range between 18 and 45 years including both genders

Exclusion criteria:

The presence of acute infection related to the tooth to be extracted or chronic lesion with severs bone loss or patients having immunocompromised state and debilitating diseases (eg, uncontrolled diabetes mellitus) or medication known to interfere with wound and bone healing or patients treated with radiotherapy to the head and neck area within the past 12 months or inability or unwillingness to return for follow-up visits or pregnancy

Sample size calculation:

Based on Kalash et al. (2017) [(10)] and Using G power statistical power Analysis program (version 3.1.9.4) for sample size determination[2], A sample

size (n=12; subdivided to 6 in each group) was sufficient to detect a large effect size (d) = 1.93, with an actual power (1-β error) of 0.8 (80%) and a significance level (α error) 0.05 (5%) for two-sided hypothesis test.

Patients grouping:

Patients who fulfilled the eligibility criteria were randomly divided into two groups (six patients each):

Group I (n=6): extraction of a hopeless tooth with dental immediate implant installation and the gap between the implant and the bony socket wall was grafted with a mixture of xenograft (one graft) and injectable platelet-rich fibrin (I-PRF).

Group II (n=6): extraction of a hopeless tooth with immediate dental implant installation and the gap between the implant and the bony socket wall was grafted with xenograft (one graft) only.

Pre-operative assessment:

Personal, medical, and dental history was taken from patient. Patient was examined clinically and radiographically for the following.

Clinical examination:

Every patient was examined at site of future implantation for the following:

1. Examination of the remaining coronal part of the tooth to be extracted.
2. Inspection of gingiva around non-restorable tooth needed for extraction for any signs of acute inflammation.
3. General periodontal status.
4. Any clinical signs of pathological conditions

Radiographic evaluation:

I. Preoperative panoramic radiographic view for:

1. Screening of patient before inclusion in the study.
2. Assessment of the non-restorable tooth condition & periapical infection.
3. Proximity of the tooth to adjacent vital structure.
4. The divergence of the root adjacent to the operative area for proper implant angulation.

II. Cone Beam Computed Tomography (with voxel size 200 micron, 9 kV and 12.5 mA) used in study to evaluate the following:

1. Exact bone height and width of alveolar ridge.
2. Degree of bone resorption related to the periapical lesion.
3. Dimensions of the implant to be installed.

Surgical procedures:

- Administration of local anesthesia using infiltration of buccal and palatal tissues with **Articaine 4% with 1:100,000epinephrine** and then wait until local anesthesia was found to be profound and effective.
- Atrumatic extraction was started by using periotome to sever periodontal tissue attachment around the root and to luxate the tooth. Straight elevator was used when indicated with extreme caution. Then, forceps was cautiously used to deliver the tooth root out of its socket using gentle movement and avoiding any excessive pressure on the facial socket walls. The extraction socket was carefully curetted to eliminate any residual infective tissue that could compromise the osseointegration.
- After thorough mechanical cleaning, the socket was rinsed with 5 ml of an 0.2% chlorhexidine solution followed by a 25 ml sterile saline rinse to remove tissue debris from the socket. Blunt instrument was used to explore the inner surface of irrigated socket to assess the integrity of socket walls.
- Sequential drilling was done according to the manufacturer instructions Firstly, pilot drill

under copious saline irrigation was used to penetrate the palatal wall of the extraction socket. An osteotomy site was created in the apical third of the socket with palatal bias extending 2 to 3 mm apical to the socket base to achieve proper primary stability.

A periapical radiograph was taken to assess the pilot drill location. Then, the sequences of drilling was continued until the final drill was reached. Bone drilling was done intermittently with speed of 800 rpm and torque 35N. Care was taken to flush out debris as the drill was drawn out. After proper osteotomy preparation, the implant fixture was removed from its pack Neo Biotech implant system (Neo Biotech Co, Seoul, Korea) and seated completely within the confine of the prepared socket in vertical plane and screwed manually to reach the maximum manual torque then continue with ratchet wrench to seat the implant into its final position.

- Primary implant stability was evaluated by RFA technique through using Ostell* device (Osstell ISQ, Third generation, Gutenberg, Sweden). Osstell uses Resonance Frequency Analysis to determine implant stability. The result was presented as an ISQ value of 1-100. The higher the ISQ, the more stable the implant. The SmartPeg was attached by screwing it into the internal thread of the implant. Then, the Osstell probe was placed in close proximity to the SmartPeg and emits magnetic pulses that cause the SmartPeg to resonate. The resonance varies depending on the lateral stability of the implant and the rigidity of osseointegration, and was interpreted using resonance frequency analysis.

Preparation of injectable platelet rich fibrin (I-PRF) [11].

Sample of autologous blood was collected from vein by needle connected with a sterile syringe without anticoagulant. The entire blood was moved to a 5 mL plain tube and centrifuged for 3 minutes at 700 rpm at room temperature. A liquid form I-PRF was then achieved on top of the tube and the red corpuscles at the bottom. Subsequently, the I-PRF liquid form was collected from upper yellow fluid layer on top of the tube by a sterile plastic Syringe.

The smart pig was removed & the cover screw was inserted. The gap between the implant and the bony socket wall was grafted either with a mixture of xenograft and I-PRF **Figure (1) (Group I)** or with xenograft only **(Group II)**. Then, healing abutment was selected and screwed in.

The height of healing abutment was selected in a way to ensure that there was no functional loading of the implant Suturing of buccal and palatal tissue was made with 4/0 resorbable suture materials .

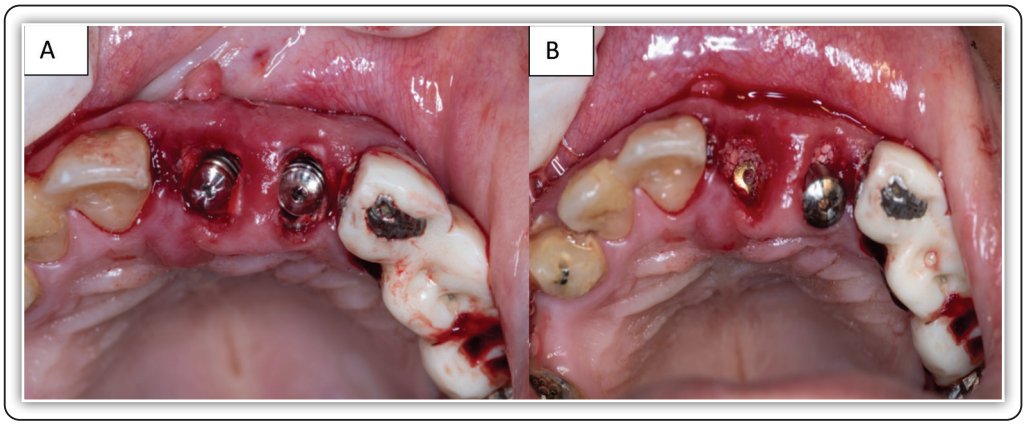

FIG (1) Grafting of the jumping space (A,B) A: Space between the implant body and the bony walls of the extraction socket B: Filling space between the implant body and the bony walls of the extraction socket with mixture of xenograft and (I-PRF)

Post-operative care and instructions:

Cold fomentation was applied for the first 24 hours, oral hygiene instruction, soft diet recommended, warm Chlorhexidine mouth wash was used from the next day every 6 hours for one week. Antibiotic [Amoxicillin 875mg + Clavulanic acid 125mg] was administered twice daily for 7 days. A non-steroidal anti-inflammatory drug [Ketorolac 10mg] was taken for 5 days 3 times daily. The patiens were instructed to avoid eating or drinking for one hour after surgery. Soft and cold meals was recommended for first postoperative one day.

A) Clinical evaluation:

Implant stability:the stability of the implant was assessed immediatly and at 6 months post operatively by using an Ostell device .

B) Radiographic evaluation:

Postoperative CBCTs was taken at the second day and six months to evaluate bone density changes around dental implant.

Data management and analysis:

Data was collected, tabulated, and statistically analyzed using a commercially available software program statistical package for social sciences (SPSS Chicago, IL, USA). Numerical data will be described as mean and standard deviation or as median and range as appropriate according to the normality of the data. The level of significance will be set at P≤0.05.

RESULTS

Stability

I-a- In group I (injectable PRF + xenograft) stability was measured for patients using an Ostell device immediate post-operative ,the mean and standerd deviation were (61.83±6.97) ISQ and after 6 months, were (83.83±6.05) ISQ .

Group I (injectable PRF + xenograft) showed a statistically significant higher value after 6 months compared to immediately post-operative (p=0.000)

II-b- In group II (Xenograft only) stability was measured for patients using an Ostell device immediate post-operative, the mean and standerd deviation were (59.17±5.95) ISQ and after 6 months, were (73.83±5.81) ISQ

Group II (xenograft only) showed a statistically significant higher value after 6 months compared to immediately post-operative (p=0.004)

II-c- Comparison between groups

Immediate post-operative: Group I (injectable PRF + xenograft) recorded mean (61.83±6.97) ISQ, in comparison to (59.17±5.95) in group II (Xenograft only). This difference was not statistically significant (p=0.492)

Six months post-operative: Group I (injectable PRF + xenograft) recorded a significantly higher mean (83.83±6.05) ISQ, in comparison to (73.83±5.81) in group II (Xenograft only). This difference was statistically significant (p=0.015)

TABLE (1) Descriptive statistics and comparison of value of Stability (ISQ) within the same group (Paired t test), comparison of mean value between groups (independent t test) and comparison of amount of difference & percentage change between groups (Mann Whitney U test)

	Group I (injectable PRF + xenograft)	**Group II (xenograft only)**	**P value (between groups)**
	Mean ± SD	**Mean ± SD**	
Immediate pre-operative	(61.83±6.97)	(59.17±5.95)	.492 ns
6 months Post operative	(83.83±6.05)	(73.83±5.81)	.015*
P value (within group)	.000*	.004*	

*Significance level p≤0.05, *significant, ns=non-significant*

Bone density

A- In Group I (injectable PRF + xenograft) bone density was measured by scanning the areas of interest using cone beam computed tomography (CBCT), immediate postoperative, the mean and standerd deviation were (1887±298.5) and after six months post-operative, the mean and standerd deviation were (2112.67±298.69)

Group I (injectable PRF + xenograft) showed a significantly higher value after 6 months compared to immediately post-operative (p=0.001)

B- In group II (Xenograft only) bone density was measured by scanning the areas of interest using cone beam computed tomography (CBCT), immediate postoperative the mean and standerd deviation were (757.17±266.45) and after six months post-operative the mean and standerd deviation were (849.83±321.72)

Group II (xenograft only) showed a statistically significant higher value after 6 months compared to immediately post-operative (p=0.040)

C- Comparison between groups

Immediate post-operative: Group I (injectable PRF + xenograft) recorded a significantly higher mean (1887±298.5), in comparison to (757.17±266.45) in group II (Xenograft only). This difference was statistically significant (p=0.000)

Six months post-operative: Group I (injectable PRF + xenograft) recorded a significantly higher mean (2112.67±298.69), in comparison to (849.83±321.72) in group II (Xenograft only). This difference was statistically significant (p=0.000)

Amount of difference: Group I (injectable PRF + xenograft) recorded a higher value (225.67±81.89), in comparison to (92.67±82.09) in group II (Xenograft only). This difference was statistically significant (p=0.025)

TABLE (2) Descriptive statistics and comparison of value of bone density within the same group (Paired t test), comparison of mean value between groups (independent t test) and comparison of amount of difference & percentage change between groups (Mann Whitney U test

	Group I (injectable PRF + xenograft)	Group II (xenograft only)	P value (between groups)
	Mean±SD	Mean±SD	
Immediate Post operative	1887.00±298.50	757.17±266.45	.000*
6 months operative	2112.67±298.69	849.83±321.72	.000*
P value (within group)	.001*	.040*	
Amount of Difference	225.67±81.89	92.67±82.09	.025*

DISCUSSION

Immediate implant placement is a well-accepted treatment modality that has been shown to have high cumulative survival rates ranging from 92-100%[12]. Immediate implant had demonstrated successful clinical outcomes with high survival rate and stable crestal bone level, similar to delayed implant placement. With the improvement of implant design and surface technology, immediate implantation has become a common[13].

Patients in the present study were randomly divided into two equal groups (six patients each), in group I extraction of a hopeless tooth with dental immediate implant installation and the gap between the implant and the bony socket wall was grafted with a mixture of xenograft and I-PRF. In contrast, and the gap between the implant and the bony socket wall in group II was grafted with xenograft only.

Regarding implant stability, the primary and secondary (6-month post-operative) implant stability was assessed using the RFA technique. Osstell® resonance frequency analysis device is

effective for measuring primary and secondary implant stability, it is a simple, non-invasive diagnostic device that many clinicians currently use, the RFA device provides a useful measurement to assess osseointegration and communicate with other providers and researchers[14].

Immediate post-operative, group I (injectable PRF + xenograft) recorded Mean ±SD (61.83±6.97) ISQ, in comparison to (59.17±5.95) in group II (Xenograft only). This difference was not statistically significant

After six months post-operatively, Group I (injectable PRF + xenograft) recorded a significantly higher Mean ± SD (83.83±6.05) ISQ, in comparison to (73.83±5.81) in group II (Xenograft only). This difference was statistically significant (p=0.015) The results of the present study demonstrate that injectable platelet rich fibrin with xenograft during implant surgery enhanced the stability of implants when compared to xenograt only, after six month of surgery.

These finding are in accordance with El Komi H, et al[15], evaluate the implant stability with injectable-PRF after immediate implant. The results of this study demonstrate that the application of injectable platelet rich fibrin during implant surgery enhanced the stability of implants.

CBCT was being more frequently used to bone assessment because of higher efficiency, the accessibility of dental CBCT, due to its compact size, reasonable dose, low cost and ease of use. In the current study CBCT was used to determine the bone density immediately and 6 months post implant insertion[16].

The bone density measured with Hounsfield units (HU) at region of interest using the Planmeca Romexis imaging software. In the present study the mean bone density in group I increased from (1887±298.5) immediate postoperatively, to (2112.67±298.69) after 6 months,and in group II increased from (757.17±266.45) immediate postoperatively to (849.83±321.72) after 6 months, with a significant difference between different groups.

These finding are in accordance with Reda R, et al.[17], compared the effect of xenograft versus mixture of xenograft and I-PRF when placed in jumping space in ethetic area The xenograft group showed an increase in its bone density by 74.83±19.31. The xenograft and I-PRF group showed an increase by 154.16± 42.44, this increase was with a highly statistically significant difference (p= 0.03).

CONCLUSION

The use of Injectable Platelet Rich Fibrin around the immediate dental implants may be able to increase and improve healing around dental implants by the anti-inflammatory and antibacterial properties and increase the success rate of dental implants by increase the bone density and stability of dental implant.

RECOMMENDATION

Further studies on the use of injectable platelet Rich fibrin with an immediate dental implant with a longer period of follow-up the cases and larger sample size are needed.

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