The effect of using of i-PRF (injectable platelet rich fibrin) on filling the gap of immediate dental implant in the esthetic zone": Randomized clinical trial

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Abstract

Aim: To assess the possible added value of using i-PRF in association with bone replacement graft filling the buccal gap distance at immediately placed dental implant on hard and soft tissues after 6 months observation period.

Materials and methods: Sixteen non-smoking periodontally free patients with single non restorable tooth in the esthetic zone were included in the study. Patients were randomly assigned into two groups each of 8 implants, Test group, immediate implant placement and filling of a buccal gap of > 2mm between the implant surface and the inner bony wall with bovine bone mineral mixed with injectable platelet rich fibrin, control group; immediate implant placement and filling of a buccal gap of > 2mm with only bovine bone graft. Horizontal buccal bone changes, crestal bone level and bone density at 6 months were evaluated using cone beam computed tomography (CBCT). Thickness of attached gingiva was also evaluated at 6 months compared to the initial levels

Results: The mean buccal horizontal bone thickness was insignificantly reduced at 6 month evaluation period in both groups with no significant differences between groups. No significant difference was observed in crestal bone height between the two groups. At 6 month evaluation period bone density was significantly increased in the test group (p =0.002) compared to control. No significant differences were found between the pre-operative and post-operative gingival biotype in both groups

Conclusion: This study demonstrated that immediate implantation in fresh extraction socket together with xenograft in combination with i-PRF could have an added value of improved bone density, a factor that could be associated with long term crestal bone level stability.

Keywords: Platelet concentrate; immediate implant; gap distance; growth factors; peri implant tissue.

Introduction

Dimensional changes in the alveolar ridge following tooth extraction have been proven in clinical and experimental studies (Tan *et al*., 2012). Such alterations involve both the height and width of the residual ridge which may compromise the outcome of subsequent restorative treatment. Most of these dimensional changes occur during the first 3 months of socket healing (Schropp *et al*., 2003). In order to reduce such early ridge alterations, the use of immediate implant procedures was proposed and the Survival rate of immediate implant reported to be similar to those with a delayed approach (Chen *et al*., 2004); (Hammerle *et al*., 2004); (Noelken *et al*., 2018). However, preclinical and human studies have shown that immediate implant placement per se does not preserve alveolar anatomy, especially at the buccal bone crest which may lead to bony dehiscence and soft-tissue recession (Covani *et al*., 2007). Alveolar resorption following

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immediate implant placement depends on several factors such as the thickness of the buccal wall and the gap size between bone and implant (Ferrus *et al*., 2010).

Following immediate implant placement, significant peri-implant gaps remaining between the implant and extraction socket walls. While the gap can occur at any surface around immediate implant, the buccal surface is of particular clinical significance, especially in the aesthetic zone since the buccal bone is usually thin and showing high tendency for resorption and soft tissue recession (Greenstein *et al*., 2013);(Testori *et al*., 2018). These gap distances generally have been thought to require some sort of grafting to promote bone fill (Fugazzotto, 2003). On the other hand, clinical studies have also reported that, there is a high percentage of spontaneous fill of the marginal gap at immediate implant sites with >90% of gaps filling wider than 2 mm, and the median value representing the percentage fill reported 100% (Botticelli *et al*., 2003); (Sanz *et al*., 2010). Tarnow and Chu reported a case in which a 4.2 mm buccal jumping distance remaining following flapless placement of a cusped immediate implant healed with bone fill up to the implant surface without the use of either grafting or barrier material (Tarnow and Chu, 2011). Despite this controversy regarding the clinical effects of grafting, it seems important to enhance bone density of the newly formed bone within the gap distance, a factor that could improve the long term stability of the buccal bone architecture.

Platelet concentrates are autogenous substances derived from blood that consist essentially of supra-physiologic concentrations of platelets and growth factors (Al-Hamed *et al*., 2019). Alveolar bone preservation following immediate implant placement was reported when platelet concentrates were applied (Kutkut *et al*., 2013); (Rosano *et al*., 2013). On the other hand, studies have shown insufficient evidence to establish the effectiveness of platelet concentrate with immediate implant placement (Taschieri *et al*., 2017). A recent systematic review reported that platelet concentrate combined bone graft show a small unimportant effect or no effect on marginal bone loss of immediate implants when compared to bone grafting alone (Fortunato *et al*., 2020). The technique of injectable platelets rich fibrin (i-PRF) was developed by Choukroun when injected into bone graft particles makes it coagulate and solid free of all movements granules which may improve graft stability and subsequent regeneration.

Hence, the purpose of this clinical trial was to report the possible added value of using i-PRF combined with graft material in filling gap distance of > 2mm following immediate implant placement. Cone beam computed tomography (CBCT) was used to evaluate dimensional changes at 6 months including horizontal gap filling, crestal bone changes and bone density.

Materials and methods

Participant Selection

Sixteen patients (15 females, 1 male) were recruited consecutively from the outpatient clinic of Periodontology Department, Faculty of Dentistry, Ain Shams University from March 2020 to April 2021. Research procedures were explained to all patients, and they agreed to participate in the study and signed the appropriate informed consent. The study protocol was reviewed and approved by the ethical committee of the Faculty of Dentistry, Ain Shams University. This prospective, parallel, two-arm randomized clinical trial performed in accordance with the Helsinki Declaration of 1975, as revised in 2000. The study protocol was registered on www.clinicaltrials.gov with an ID: NCT04298294.

Criteria for inclusion included, medically free adults, with adequate oral hygiene, ≥18 years of age, of both sexes, in need of one implant replacing non-restorable maxillary anterior teeth, the site to be treated is surrounded by two natural teeth, intact extraction socket bony walls defined by facial bone crest that deviated ≤ 2 mm from that of the expected normal location of the site with no fenestration or dehiscence, facial bone of at least 1 mm thickness following extraction, a keratinized tissue width of 3 to 5 mm and a horizontal gap >2 mm in size be present following implant insertion. Patients were excluded if they are smoker, has significant untreated periodontal disease (stage III or IV grad C) (Tonetti *et al*., 2018). Furthermore, pregnant females, patients with Para functional habits and uncooperative patients have been excluded.

Injectable PRF preparation

Venous blood drawn into 10 ml tubes (PRF non- coated plastic tubes) without any additives or anticoagulant. This was done as fast as possible and each tube was placed into the PRF centrifuge The tubes were spinned for 3 minutes at 700 rpm (60×g) at room temperature by a Duo Centrifuge[1]. After spin separated RBC and i-PRF became visible as the top part of the tube, the rubber cap was penetrated with a 21G needle mounted on a syringe. The upper liquid layer was collected as i-PRF was aspirated until the level of the red blood cells rose up to the needle bevel and immediately added to the bone graft used for filling the defect around the implant (Miron *et al*., 2017).

Presurgical and surgical therapy

All patients received initial therapy including oral hygiene instructions, scaling and root planning using hand and ultrasonic instruments and followed for 4 weeks until they showed good level of plaque control

[1] Duo Centrifuge (Process for PRF, Nice, France)

(zero plaque and gingival indeces at the surgical sites); (Silness and loe, 1964); (Löe, 1967). Patients were randomly assigned into two groups each of 8 participants, Test group, immediate implant placement and gap distance between the implant surface and the inner bone walls filled with bovine bone mineral mixed with injectable platelet rich fibrin and control group; immediate implant placement and gap filling with only bovine bone graft.

All surgeries were performed by single experienced operator (BA) after patients' random allocation using Computer assessed random sequence[@2] and concealment. The surgeon was not blinded due to the nature of the intervention. Teeth were carefully extracted using a flapless minimally traumatic extraction technique with the use of a periotome[†] and forceps to preserve the bony socket walls. Once the tooth delivered out of the socket, the socket was inspected for the integrity of its four walls. In case of buccal bone fracture during extraction, the patient was excluded from the study. Every attempt was made during implant insertion to go palatally in order to create a gap between the implant surface and the hard tissue walls of the extraction socket of ≥ 2mm. at the buccal aspect of the implant. At the same time, surgical placement of the implants always aimed for an ideal prosthetically driven implant installation. Cylindrical-conical, conventional threaded screw-type implants with rounded apex and SLA surface were used in this study*. The insertion was performed in accordance with the guidelines described in the implants manual with an undersized drilling protocol to achieve adequate primary stability (at least 30 Ncm). Implant diameter of 3.5, 4.0 or 4.5 were chosen to leave at least >2 mm of the buccal gap with the implant platform at the marginal level of the facial bony wall as measured by a periodontal probe. The drilling extended apically 3–4 mm within the native bone in order to get primary stability. A minimum of 1.5 mm distance was maintained between each implant and the adjacent tooth.

In group I (study group) (Figure 1) the gap distance was packed with i-PRF & bone graft. i-PRF was injected onto xenograft** (0.25-1.0 mm particle size, pores size 250μm and 70% porosity) and left for 1 minute to become sticky where it was gently packed to completely fill the gap space up to the level of the buccal bone crest. Group II (control group) (Figure 2) gap distance was packed with bone graft alone. Graft material was wetted with saline, inserted in the gap and once soaked in blood; it was lightly pressed to the bony walls to completely fill the space. Once the appropriate healing abutments were installed, flaps were adapted and sutured to allow submerged healing with cross mattress suture using 4-0 polypropylene suture.

Post-operative phase and CBCT imaging

Amoxicillin-Clavulonic acid[#] (1 gram/12 hours) for 7 days and Metronidazole 500 mg[$], twice daily for 7 days were prescribed. Diclophenac potassium** 50 mg /12 hours was prescribed for 3 days. Gentle rinsing with chlorhexidine mouthwash^ (every 12 hours) was prescribed starting the day following surgery for 2 weeks. Patients were instructed to remain on a soft diet for 2 weeks and to abstain from trauma on the operative site. Sutures were removed 7 days after surgery. The overall level of oral hygiene were checked and evaluated every month and additional instructions were given as needed.

Using i CAT Next Generation (Kavo) Cone beam Computed Tomography*** that was set at FOV 16 cm, Scanning time 26.9 seconds, 5 Ma, KV 120, voxel size 0.2mm. Images were acquired using Planmeca Romexis TM Imaging and On Demand 3D application (Cybermed). CBCT was done immediately after implant placement and 6 months following surgery. Specific fixed reference points were assigned to allow for the assessment of dimensional alterations (Fig. 3). Horizontal distance evaluation (Labial plate thickness which is the horizontal distance between the implant surface and the outer surface of the buccal bone) was measured at 2, 4, 6 mm apical to the implant platform. Vertical crestal bone level was measured from the rim of the implant to the base of the implant. A line was drawn just parallel to the implant surface starting from the buccal crest of bone till the apical level of the implant and the height was recorded in mm (Fig. 3).

The buccal bone density of each implant immediately following therapy and at 6 months follow up period was measured using the CBCT software. The mean densities and the standard deviations of each area were calculated by Ondemand (South Korea). The outcome assessor (MS.) and the data analyst were unaware of the group intervention during follow-ups.

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+ Excel; Microsoft, Redmond, USA

*neobiotch implant system South Korea

**hypro-oss bone graft-Germany

[#] Augmentin, GSK, UK

[$] Flagyl-Novartis-Swiss

** Cataflam, Novartis, Switzerland

^ Listermix Plus, Sigma, Egypt

[†]Kohler Co.,Germany

[@]random.org

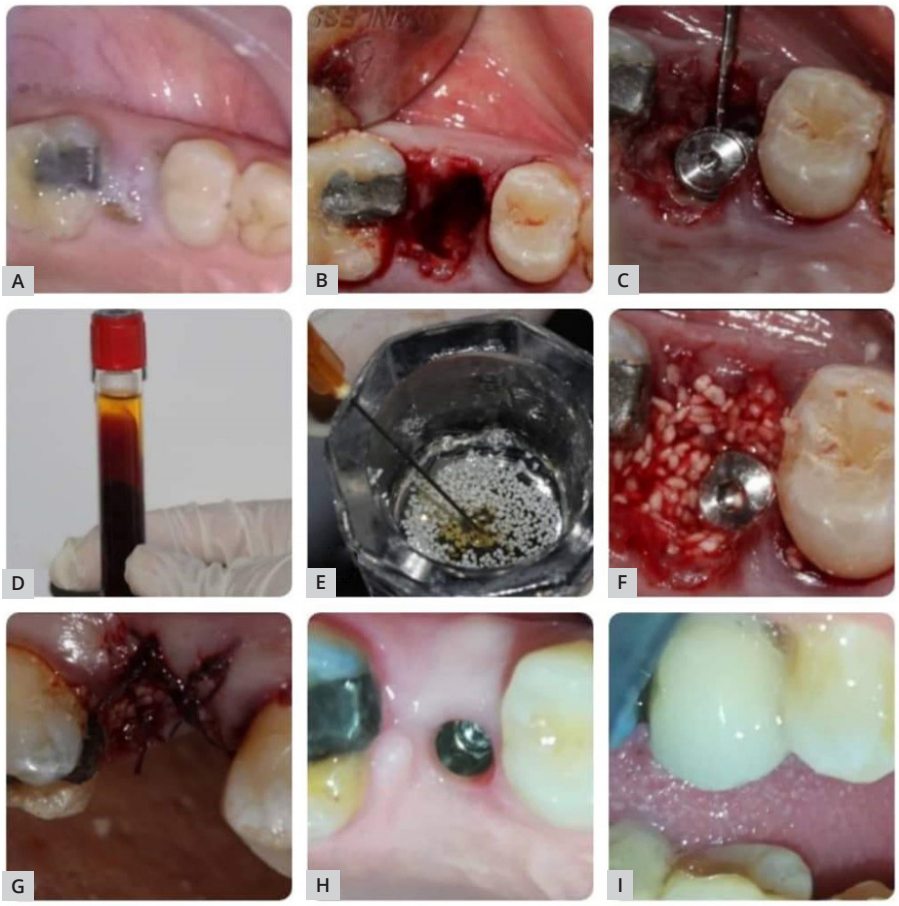

Figure 1. Study group case: (A) Remaining root of upper second premolar (B) extracted socket (C) immediate dental implant placement with measuring the buccal gap distance (D) injectable platelet rich fibrin preparation (E) mixture of i-PRF with xenograft (F) condensing the mixture into the gap (G) suturing (H) 6 months follow up (I) crown placement.

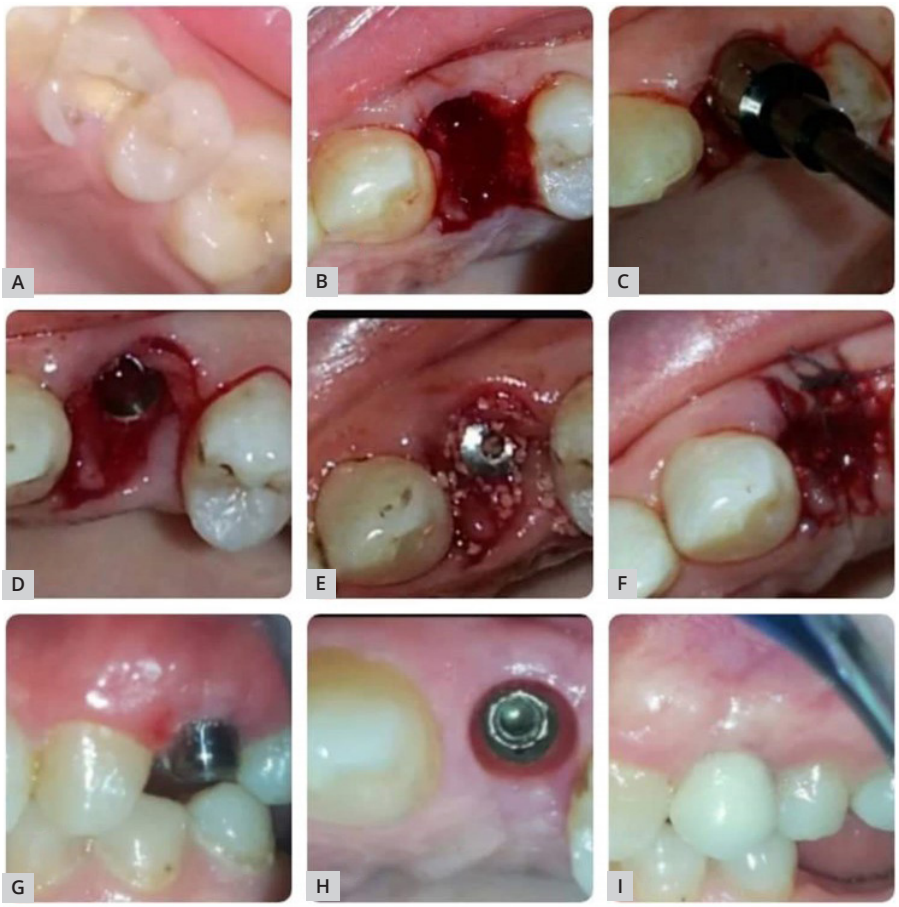

Figure 2. Control group case: (A) Remaining root of upper first premolar (B) extracted socket (C) checking parallism (D) immediate dental implant placement (E) filling the gap with xenograft (F) suturing (G) healing abutment (H) soft tissue healing (I) crown placement

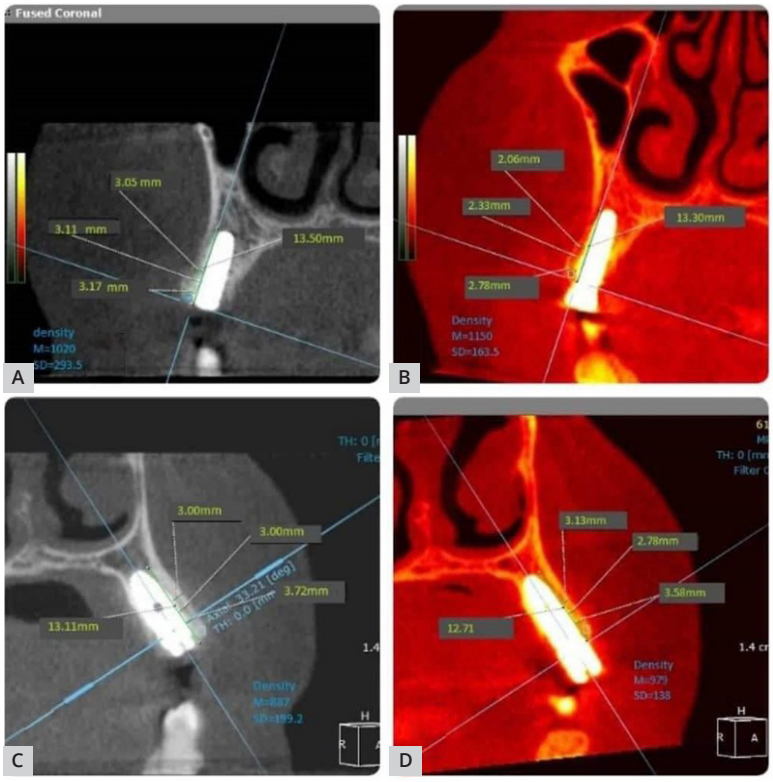

Figure 3. A) Test case pre-fusion baseline horizontal measurement at 2, 4, 6 mm, vertical bone level and density. B) Test case post-fusion (6 months follow up) horizontal measurement at 2,4,6 mm, vertical bone level and density. C) Control case pre-fusion baseline horizontal measurement at 2, 4, 6 mm, vertical bone level and density. D) Control case post-fusion (6 months follow up) horizontal measurement at 2, 4, 6 mm, vertical bone level and density.

Bone density value (as grey value) was automatically illustrated the difference in the gray value in numbers by moving the pointer from area to another. the bone density was taken at a fixed point. To ensure measuring the density of grafted gap. The bone density was taken into two planes, coronal and sagittal.The coronal plane is at the level of the platform and the sagittal is just buccal and parallel to the implant and away from titanium artifact at the bone-implant interface.

Each image (primary post-surgery and secondary at 6 months evaluation period) were given a color code for identification by On Demand 3D application software (Cybermed). The post-surgery image was fused to the six months image by first using manual registration through anatomical landmarks. Superimposition was completed automatically by On Demand 3D application allowing the best possible accuracy. First measurements were recorded on the primary image. Then the measurements on the primary image were left & the primary image itself was cancelled leaving the secondary image. New measurements were recorded on the secondary image on the same plane direction & cut the primary image ensuring standardization.

Statistical Analysis

Categorical data were presented as frequency and percentage values and were analyzed using Fisher's exact test. Numerical data was represented as mean and standard deviation (SD) values. Shapiro-Wilk's test was used to test for normality. Homogeneity of variances was tested using Levene's test. Data were normally distributed, had variance homogeneity across different groups and were analyzed using independent and paired t-tests for inter and intragroup comparisons respectively. The significance level was set at $p<0.05$ within all tests. Statistical analysis was performed with R statistical analysis software version 4.1.3 for Windows[2].

A power analysis was designed to have adequate power to apply a 2-sided statistical test of the research hypothesis that there is no difference between tested groups. According to the results of Kalash, *et al*., 2017 effect size (d) was found to be (1.51). By adopting an alpha (α) level of 0.05 (5%), and a beta (β) level of 0.20 (20%) i.e. power=80%; the predicted sample size (n) was found to be a total of (16) cases i.e. (8) cases per group. Sample size calculation was performed using G*Power version 3.1.9.4.[3]

Results

The study population consisted of 18 subjects that were screened for participating in this prospective randomized clinical trial. Of these patients, two were excluded according to the criteria pre-established, one because of non-intact socket wall explored by a probe after tooth extraction and one did not comply with the oral hygiene instructions during the follow ups. A total of 16 implant sites in 16 subjects (mean age of 26.38±6.65 for the study and 27.62±6.57 for the control group) were finally recruited, randomized and included in the clinical trial (8 subjects per group). All implant sites healed

uneventfully and no complications were reported. Indications for tooth extraction in both groups included hopeless un-restorable carious lesions (10 cases) and root or crown fractures (6 cases).

Summary of demographic data were presented in Table 1. There was no significant difference between both groups regarding gender, age, implant site and the used implant diameters (p>0.05). Table 2 shows the changes in bone dimensions in the two study groups. The mean buccal horizontal bone thickness at 2, 4 and 6 mm were insignificantly reduced at 6 months evaluation period in both groups with no significant differences between groups. Initially at 2 mm away from the crestal bone level, it was 3.02±0.34 and 3.17±0.56 for the study and control groups respectively and at 6 months evaluation period it was insignificantly reduced to 2.97±0.39 and 3.06±0.51. At 4mm away from the alveolar crest it measured 2.53±0.26 and 2.63±0.34 for the study and control group respectively immediately after implant placement and insignificantly reduced to 2.37±0.43 and 2.54±0.44 six month later. The apical measure 6 mm away from the alveolar crest was 2.22±0.30 and 2.21±0.38 for the study and control groups which again reduced insignificantly to 2.12±0.33 and 2.07±0.33 respectively. The differences between the two groups were statistically insignificant (P = 0.892). This represented 1.55±5.75% , 6.17±16.26 % and 4.73±8.38% reduction in test group and 3.08±3.06 % , 3.96±6.65 % and 0.14±0.19 % reduction in control group.

At baseline (immediately following implant placement), the mean vertical distance between the most coronal point on the buccal alveolar bone crest and the apical part of implant was 13.04±1.40 mm in the test and 13.28±0.82 for control group. After 6 months, the mean reduction in buccal alveolar bone height was 0.04±0.17 mm for the test and 0.41±0.54 mm for the control group (0.26±1.23 % and 3.04±4.03 % in test and control group respectively). No significant difference was observed in bone height reduction between the two groups. The mean baseline bone density was 721.67±293.27, 747.83±199.90 in the test and control group respectively. At 6 months evaluation period it was significantly increased to 784.00±294.51 (5.25±1.17%) in the test group (p =0.002). Control group showed insignificant increase of density by 2.07±0.37% measured 777.33±229.90 after 6 months follow up. No significant differences were found between the pre-operative and post-operative gingival biotype in both groups (Table 3).

Table 1. Baseline group demographics.

Parameter			Study	Control	Statistic	p-value
Gender	Male	n	1	0	0.00	1
		%	12.5%	0.0%		
	Female	n	7	8		
		%	87.5%	100.0%		
Age (years)	Mean±SD		26.38±6.65	27.62±6.57	0.38	0.711
Implant site	Lateral	n	2	2	1.14	0.767
		%	25.0%	25.0%		
	Canine	n	0	1		
		%	0.0%	12.5%		
	First premolar	n	4	3		
		%	50.0%	37.5%		
	Second premolar	n	2	2		
		%	25.0%	25.0%		
Implant diameter (mm)	3.5	n	1	1	0.31	0.856
		%	12.5%	12.5%		
	4.0	n	5	4		
		%	62.5%	50.0%		
	4.5	n	2	3		
		%	25.0%	37.5%		

Table 2. Inter and intragroup comparisons of different clinical parameters.

Measurement	Groups	Baseline	6 months	t-value	p-value	Difference	Percentage change (%)
Labial bone thickness (mm) at 2 mm	Study	3.02±0.34	2.97±0.39	**0.37**	**0.571**	0.05±0.19	1.55±5.75
	Control	3.17±0.56	3.06±0.51	**7.63**	**0.052**	0.10±0.09	3.08±3.06
	t-value	**0.56**	**0.36**			**0.66**	**0.58**
	p-value	**0.587**	**0.729**			**0.525**	**0.577**
Labial bone thickness (mm) at 4 mm	Study	2.53±0.26	2.37±0.43	**1.02**	**0.358**	0.16±0.39	6.17±16.26
	Control	2.63±0.34	2.54±0.44	**1.95**	**0.222**	0.09±0.16	3.96±6.65
	t-value	**0.58**	**0.67**			**0.39**	**0.31**
	p-value	**0.574**	**0.518**			**0.706**	**0.765**
Labial bone thickness (mm) at 6 mm	Study	2.22±0.30	2.12±0.33	**2.33**	**0.188**	0.11±0.17	4.73±8.38
	Control	2.21±0.38	2.07±0.33	**3.68**	**0.113**	0.14±0.19	6.10±7.33
	t-value	**0.06**	**0.26**			**0.37**	**0.3**
	p-value	**0.954**	**0.797**			**0.718**	**0.769**
Overall labial bone thickness (mm)	Study	2.59±0.44	2.49±0.52	**0.5**	**0.485**	0.10±0.26	4.15±3.59
	Control	2.67±0.58	2.56±0.59	**0.44**	**0.513**	0.11±0.15	4.38±3.77
	t-value	**0.47**	**0.38**			**0.14**	**0.08**
	p-value	**0.642**	**0.703**			**0.892**	**0.936**
Vertical bone level	Study	13.04±1.40	13.00±1.31	**0.38**	**0.565**	0.04±0.17	0.26±1.23
	Control	13.28±0.82	12.87±0.89	**3.38**	**0.125**	0.41±0.54	3.04±4.03
	t-value	**0.36**	**0.2**			**1.58**	**1.62**
	p-value	**0.727**	**0.847**			**0.146**	**0.137**
Bone density	Study	721.67±293.27	784.00±294.51	**32.82**	**0.002***	62.33±26.65	5.25±1.17
	Control	747.83±199.90	777.33±229.90	**3.61**	**0.116**	29.50±38.05	2.07±0.37
	t-value	**0.18**	**0.04**			**1.73**	**2.19**
	p-value	**0.86**	**0.966**			**0.114**	**0.036***

*significant (p<0.05)

Table 3. Frequencies (n) and Percentages (%) of gingival biotype in both groups

Measurement	Groups	Study group		Control group		P-value
		%	(n)	%	(n)	
Baseline	Thick	37.5%	(3)	25.0%	(2)	0.500ns
	Thin	62.5%	(5)	75.0%	(6)	
6 months	Thick	37.5%	(3)	25.0%	(2)	0.500ns
	Thin	62.5%	(5)	75.0%	(6)	

*; signifiant (p ≤ 0.05) ns; non-signifiant (p>0.05)

Discussion

The immediate implant placement in post-extraction socket has been proven to be a reliable and predictable treatment approach with a very high success rate (Noelken *et al*., 2018). Gap defects often exist around immediate implants due to morphological differences between the natural tooth extraction socket and the dental implant (Greenstein and Cavallaro, 2013). Although many authors recommend the use of graft material with immediate implant placement to fill buccal gap distance, the evidence for this additional treatment is unclear from controlled clinical trials (Araújo *et al*., 2009);(Caneva *et al*., 2012). The beneficial effect of platelet concentrate in bone regeneration remains a matter of controversy among the authors. Little evidences exist to confirm the ability of their claimed growth factors content to enhance bone healing when mixed with grafting materials (Choukroun *et al*., 2006); (Rodriguez *et al*., 2014). Nevertheless, some authors claimed that the use of platelet concentrate with allogeneic or xenogeneic graft facilitates new bone formation . The present randomized clinical study was

conducted to assess the possible added clinical, and radiographic values of using bone graft in combination with injectable platelet rich fibrin compared to bone graft alone in immediate implant buccal gap distance filling

In this study, all implants were totally submerged keeping the implant out of function and no implant-supported temporary restorations were used for the first 6 months in order to reduce micro movement to allow for better evaluation for the effects of the applied treatment (Severson *et al*., 2000). Teeth were removed atraumatically using a periotome in order to keep the labial bone intact. Flapless approach was used to minimize ridge dimensional alterations. Tarnow *et al*., 2014 reported significantly lower hard tissue alterations using flapless approach compared to conventional one. CBCT radiologic assessment that was used in the present study proved its reliability as a prognostic factor for bone density, quality and implant stability as well as long-term prognosis of dental implants in the maxilla (Samer *et al*., 2019). CBCT- was also reported in a systematic review to be a promising tool for evaluating radiographic bone mineral density (Guerra *et al*., 2017).

This study demonstrated that buccal gaps around immediately placed implants in fresh extraction socket can heal predictably with bone fill as evidenced by radiographic evaluation in both groups. The use of highly porous (70 %) slowly resorbable graft material in the present study may allow for predictable natural bone remodeling specially in a highly contained buccal gap distance. In addition, we did not find significant differences in bone height changes between the two study groups. After 6 months, the mean reduction in buccal alveolar bone height was 0.04±0.17 mm for the test and 0.61±0.54 mm for the control group (0.26±1.23 % and 3.04±4.03 % in test and control group respectively). Degidi *et al*., 2013 showed a similar outcome in grafted gap distance of a mean vertical crest reduction of about 0.76 ± 0.96 mm. On the other hand deM Sartori *et al*., studied immediate implantation in the anterior maxilla without using graft material. They reported a mean resorption of 3.31 mm in the apical direction in the buccal bone crest after 6 months. Sanz *et al*. also demonstrated that the mean vertical crestal bone loss in immediate implantation without using bone graft was about 1mm at the buccal and 0.5 mm at the palatal aspects (Sanz *et al*., 2010).

The mean percentage change in test group bone density (5.25±1.17) was significantly higher than the control group (2.07±0.37) (P=0.036). i-PRF was reported to increase the quality (density) of the newly formed bone and enhance the rate of new bone formation which may be explained by the presence of concentrated growth factor. i-PRF fibrin network could maintain and protects bone graft and its fragments, and serving as biological connectors between bone particles (Choukroun, 2014). Fibrin network also could promotes cellular migration, necessary for neo-angiogenesis, vascularization and survival of the graft. Platelet cytokines (PDGF, TGF-b, IGF-1) are creating a steady process of healing gradually released as the fibrin matrix is resorbed (Choukroun and Ghannati. 2018). Statistical analysis showed no association between the present study pre-operative and post-operative gingival biotype which suggests that jumping gap augmentation did not improve the soft tissue quality of the peri-implant mucosa. Frost *et al*. reported no association between thin and thick gingival biotype and the thickness of the labial bone plate (Frost *et al*., 2015). In addition, Arora and Ivanovski reported no correlation between the pre-operative thickness of the LBP and the thickness or type of the gingival biotype (Arora and Ivanovski, 2017) .

In conclusion this study demonstrated that immediate implantation in fresh extraction socket together with xenograft alone or in combination with i-PRF could enhance buccal gap horizontal augmentation. Graft blended i-PRF could have an added value of improved bone density, a factor that could improve the long term stability of the buccal bone architecture. More studies with larger sample sizes should be conducted for better elucidation of the impact of i-PRF on buccal bone remodeling around dental implants.

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