Comparative Radiographical Evaluation of Immediate and Immediate -Delayed Implant Placement on the Facial Bone Thickness

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Abstract

Background: The best time at which to replace implant after dental extraction is a matter of controversy. Immediate implant or immediate-delayed implant has been used to replace non periodontally hopeless teeth to avoid socket bone loss if remained untreated especially in maxillary esthetic zone. Immediate implant has many advantages as, very short treatment period, preservation of alveolar bone, and using socket tooth as a reference but there is greater liability of fracture of facial bone during extraction and presence of infection. Thus, immediate delayed-implant (4 - 8 weeks after extraction) was introduced to allow for partial soft tissue healing and also decrease long treatment period of delayed implant.

Objective: The aim of this study was to evaluate and compare radiographically by cone beam computed tomography (CBCT) between immediate and immediate delayed implant placement with delayed loading in non-periodontally hopeless maxillary premolars.

Methods: Twenty non periodontally hopeless maxillary premolars based on clinical and radiographic examination and indicated for extraction were included in this study. The extraction sites were classified randomly into two groups; group (1) receiving 10 immediate implants placement with guided bone regeneration (GBR) and group (2) receiving 10 immediate-delayed implants placement after 6weeks of extraction. Both groups received delayed loading using cemented crowns. CBCT used for radiographic evaluation of facial bone thickness prior implant placement, at base line (48 hours after implant placement) and after 12 months following surgery in both groups.

Results: CBCT results revealed significant loss of vertical facial bone height (VFBH) and horizontal facial bone thickness (HFBT) at (0, 1, 2, 3 mm) from implant plate from for both groups after one year ($P < 0.05$) with no significant difference between them at base line and 12 months post implant placement ($P > 0.05$). Inter-group comparison considering dimensional change of facial bone at middle of implant, there was significant difference in favor to group 2 ($P < 0.05$).

Conclusion: Both immediate and immediate delayed implants in non-periodontally extracted sites reduced time for restoration function and esthetic with 100% success rate for both groups. However, both groups are liable for the same degree of marginal facial bone loss.

Keywords: Immediate Implant; Immediate-Delayed Implant; Premolars; Facial Bone Thickness

Introduction

The loss of a single tooth especially in esthetic region is regarded a common cause of esthetic concerns, leading to psychological implications and non-physiologic occlusion, as a result of tipping of neighboring teeth and super-eruption of opposing teeth. The clinical replacement of lost natural tooth with implant has represented one of the most significant advances in restorative dentistry [1]. The successful use of dental implants for more than three decades has been extensively documented for both conventional and immediate implant therapy [2].

Immediate implant placement (type 1) is placed immediately after tooth extraction, immediate delayed has been classified into early implant placement with soft tissue healing (type 2) in which implant is placed after 4 - 8 weeks after tooth extraction and early implant placement with partial bone healing (type 3) in which implant is placed after 12 - 16 weeks after tooth extraction. Whereas, the late implant placement (delayed implant) is placed 6 months after tooth extraction with complete bone healing [3,4].

Immediate implant placement after tooth extraction has become a common clinical therapeutic approach, alternative to a staged surgical protocol. It induced reduction in the number of surgeries needed with the advantages of a shorter time to rehabilitate function and aesthetic [5].

However, immediate implants are liable to improper soft tissue healing, gingival recession especially with very thin facial bone, fracture of facial bone and presence of infection [6]. Immediate delayed implant after 4 - 8 weeks from tooth extraction allows for proper soft healing and overcomes long treatment period of delayed implant [7].

The primary concern with immediate implant placement is to eliminate the facial gap or osseous defect to achieve bone fill and increase the percentage of bone to implant contact especially when there is a horizontal defect more than 2 mm between socket buccal wall and implant fixture [8]. Therefore, immediate implant placement accompanied by wide facial gap must be filled by using guided bone regeneration (GBR) to prevent gross facial bone dimensional change leading to severe loss of facial bone [9].

Implant loading has been classified into; immediate, early and delayed loading. Immediate loading, has considered when the prosthesis was placed on the same day of implant placement, early loading considered when it is placed before the conventional osseointegration period of 3 to 6 months, and delayed loading considered when it is placed after 3 to 6 months. It is better to perform delayed loading on dental implants rather than immediate loading as immediate and early loaded implants are at great risk for failure especially if the implant site has insufficient primary implant stability [10].

Cone beam computed tomography (CBCT) was used as advanced image modality for proper planning and placement of implants to replace missing teeth [11]. As, it provides information in all three planes (sagittal, coronal and axial) allows software manipulation of the data and visualization for proper implant treatment plan [12] leading to proper assessment of facio-palatal bone thickness precisely which cannot be done by conventional radiographs [13].

Due to lack of the studies concerning dimensional change of facial bone thickness around different implant protocols in replacing non periodontally hopeless teeth. The present study was designed to compare radiographically using CBCT between immediate and immediate-delayed implant placement with delayed loading in non-periodontally hopeless maxillary premolars.

Materials and Methods
Patient selections

Approval for this study was obtained from Faculty of Dentistry, Tanta University Research Ethics Committee (REC). The purpose of the present study was explained to the patients and informed consents were obtained.

Twenty patients with non-periodontally hopeless maxillary premolars based on the clinical and radiographic examination were selected from patients who fulfilled the following inclusion criteria: patients in good health with absence of relevant medical condition that

contraindicate implant placement e.g. uncontrolled diabetes mellitus or blood coagulation disorder, age ranged from 20 - 40 years old, adequate bone height to allow placement of implant at least 11 mm length ensure primary implant stability and optimal compliance as evidenced by no missed treatment appointments and a positive attitude toward oral hygiene.

The exclusion criteria included the following: Presence of persistent and unresolved infection in the implant site, smoker patients, pregnant, absence of buccal bone after tooth extraction, Presence of dehiscences or fenestrations, patients with parafunctional occlusal habits as bruxism and clenching, insufficient vertical inter-arch space, history of radiotherapy or chemotherapy in the head and neck region and use of bisphosphonate therapy.

Radiographical evaluation

Radiographic evaluation had been made including periapical radiographs (Figure 1) and (Figure 2) for immediate implant group and immediate-delayed implant group respectively to check periapical region to be sure no signs of periapical infection. CBCT was carried out for immediate group before extraction (Figure 3) and for immediate-delayed group after one month from extraction (Figure 4).

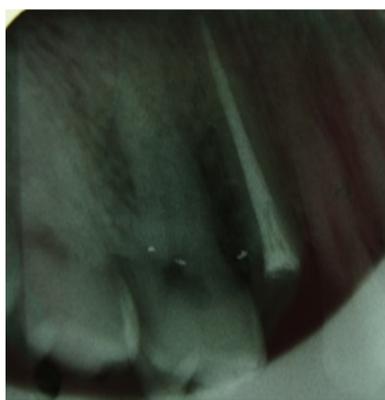*Figure 1:* Pre-opertive radiograph of immediate implant group.

Figure 2: Pre-opertive radiograph of immediate-delayedimplant group.

Figure 3: Pre-opertive CBCT radiograph of immediate implant group.

Figure 4: Pre-opertive CBCT radiograph of immediate-delayed implant group.

The selected patients were randomly classified using sealed envelope into two groups as follows: Group (1): immediate implant group, in which ten immediate implants[1] were placed using guided bone regeneration (GBR) with Bio-Oss Collagen[2] and collagen membrane[3] and Group (2): immediate-delayed implant group included ten implants4 placement which were scheduled four weeks after atraumatic tooth extraction without GBR.

[1]Biohorizons implant system American

[2]Geistlich Bio-OssCollagen 100 mg, Geistlich Pharma AG, Wolhusen, Switzerland

[3]Colla guide Kore

[4]Biohorizons implant system American

For all the patients full mouth scaling and root planning were carried out as well as comprehensive oral hygiene instructions. All required restorative and endodontic treatments were performed prior to implant placement. Re-evaluation was conducted after four weeks to evaluate the patient response to phase I therapy.

Surgical procedure

All surgical procedures performed by the same operator. Prior to the surgery, patients of both groups were instructed to rinse with 0.1% chlorhexidine gluconate for 30 seconds.

In group 1

Anesthesia obtained by administration of 2% lidocaine with epinephrine 1:200,000. Intra-sulcular incision around neck of the hopeless tooth with two vertical incisions were made at mesial and distal side of the flaps. The full thickness facial pyramidal flap reflected beyond the mucogingival line to allow for tensionless flap movement. The hopeless involved tooth had been derived from its periodontal ligaments (PDL) with particular care using periotome and dental forceps used to extract tooth atraumatically to preserve the integrity of alveolar bone walls.

The socket walls were debrided thoroughly by surgical spoon curette. The implant bed was prepared according to the manufacturer's instructions using the recommended drills sequence. Drilling was done under a constant stream of sterile irrigation. A pumping motion employed with a gradual drill sequence to prevent over-heating the bone. The implant installed with implant platform 0.5 - 1 mm below the facial bone crest.

The gap between implant and alveolar crest was filled with Bio-Oss Collagen bone graft and covered the implant site and bone graft with collagen membrane. The gingival incision closed by interrupted sutures and a periodontal dressing was placed.

In group 2

Six weeks after atraumatic tooth extraction using periotome and dental forceps to preserve integrity of the facial bone, the surgery was performed under local anesthesia. Full thickness flap was created through using crestal incision, intrasulcular incision around the necks of the adjacent teeth of both sides with two vertical releasing incisions. After flap had been reflected, the bucco-lingual and mesio-distal implant position partially determined by the morphology of the alveolus. Then, the implant placed 0.5 - 1 mm below the facial bone crest. The primary closure achieved using simple interrupted suture followed with a periodontal dressing.

All patients received delayed loading after six month using cemented CAD-CAM zirconia crowns. After Prosthetic installation, the patients were instructed for meticulous care of their oral hygiene.

Radiographic assessment
Facial bone assessment of both groups after implant placement

All the CBCT scans were taken by a single trained technician pre- and post-surgery at base (48 hours after surgery) and one year post implant placement. CBCT images were taken 48 hours after surgery (base line) for group 1 (Figure 5a) and for group 2 (Figure 6a) and 12 months after implant placement for group 1 (Figure 5b) and for group 2 (Figure 6b) for both groups using CBCT software[#] to obtain the following:

1. Vertical facial bone length in black (VFBL) is the perpendicular distance from implant platform (0) to most coronal point of the facial bone.

[#]on demand 3D soft ware

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2. Horizontal facial bone thickness in red (HFBT) is the thickness of facial bone in anterior-posterior direction in the following regions in respect to implant fixture:

   a. Horizontal bone thickness was measured at margin of platform level 0, 1, 2 and 3 mm from implant platform level.
   b. Horizontal bone thickness was measured at middle and apex of implant fixture.
   c. Dimensional changes of facial bone thickness were made by subtracting the dimension of facial bone at base (B) from the facial bone dimension at (A12) from implant placement of both groups.
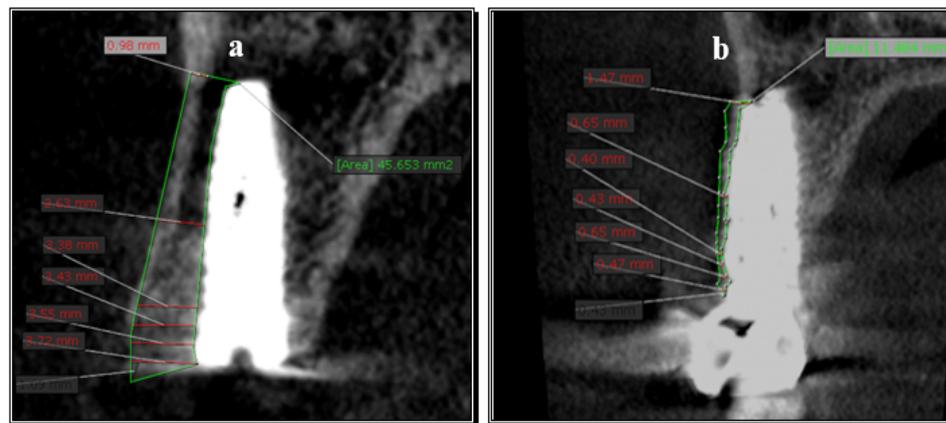

Figure 5a and 5b: *(a): Facial bone thickness 48 hours post implant placement with VFBL in BLACK and HFBL in red from coronal view. (b): Facial bone thickness one year post implant placement with VFBH in BLACK and HFBT in red from coronal view.*

Figure 6a and 6b: *(a): Facial bone thickness 48 hours post implant placement with VFBL in BLACK and HFBL in red from coronal view. (b): Facial bone thickness one year post implant placement with VFBH in BLACK and HFBT in red from coronal view.*
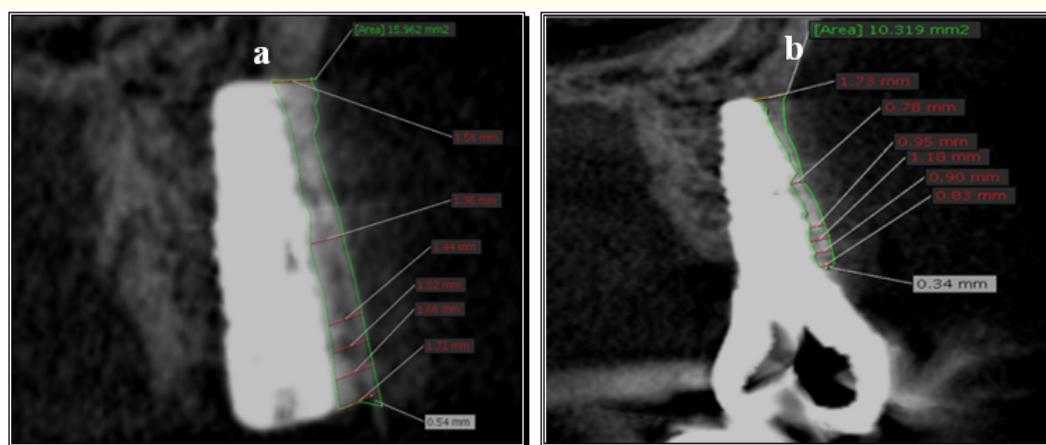
Implant survival (IS)

The implant survival according to Naert., *et al.* [14] was assessed at 18 month post implant placement and had considered successful if the implant remained in its place with no clinical signs as pain, mobility and infection.

Data analysis

The VFBH and HFBT at B (48 hours after implant placement) and A12 (12months post implant placement) measurements were analyzed using paired t test for intra-group comparison and student t test for inter-group comparison.

Results

In the current study, CBCT was used for radiographic evaluation of facial bone thickness between immediate and immediate-delayed implant groups. CBCT techniques was taken at base line (48 hours after implant placement) and after 12 months following surgery. CBCT radiographic evaluation involve the assessment of vertical facial bone height (VFBH) and horizontal facial bone thickness (HFBT) at 0, 1, 2, 3 mm from implant platform, m (middle) and a (apex) of implant fixture from coronal view.

CBCT results of assessment of facial bone thickness
Intra-group comparison of Immediate implant group

Intra group comparison between B (base) and A12 (after 12 months implant placement) showed mean value of VFBH at base 0.9200 ± 0.3620 while after 12 was decreased to 0.4743 ± 0.2691 which was significant p < 0.05. The HFBT at different levels from implant platform (HFBT-0, HFBT-1, HFBT-2, HFBT-3, HFBT-m) at base their mean values were 2.516 ± 0.7648, 2.586 ± 0.9655, 2.624 ± 1.074, 2.850 ± 0.8891 and 2.576 ± 0.7243 respectively while after 12 months the mean values were decreased to 1.037 ± 0.6613, 1.350 ± 0.6782, 1.341 ± 0.6740, 1.473 ± 0.6849, 1.419 ± 1.074 respectively which was significant p < 0.05. However, at the HFBT-a mean was 3.200 ± 1.571 that was slightly decreased to 3.0268 ± 1.629 after 12 months post implant placement, there was no significant difference p > 0.05 (Table 1).

Intra group comparison of Immediate-delayed implant group

Intra group comparison between B (base) and A12 (after 12 months implant placement) that showed mean value of VFBH at base was 0.8671 ± 0.3195 while after 12 was decreased to 0.5267 ± 0.1861 with significant difference p < 0.05. The HFBT at different levels from implant platform (HFBT-0, HFBT-1, HFBT-2, HFBT-3) at base their mean values were 2.349 ± 0.5702, 2.354 ± 0.6484, 2.351 ± 0.6920 and 2.537 ± 0.7777 respectively while after 12months the means were decreased to 1.187 ± 0.6151, 1.408 ± 0.5633, 1.503 ± 0.5342 and 1.552 ± 0.5730 respectively which was significant difference p < 0.05. However, at the HFBT-m and HFBT-a, mean values were 1.904 ± 0.6639 and 2.756 ± 0.9475 respectively that, were slightly decreased to 1.703 ± 0.7563 and 2.753 ± 0.9001 after 12 months post implant placement, there were no significant difference p > 0.05 (Table 1).

Inter-group comparison between both groups
Inter-group comparison at base (B)

Inter-groups comparison between B (base) of group1 and group 2 in which mean values of VFBL and HFBT at different levels from implant platform (HFBT-0, HFBT-1, HFBT-2, HFBT-3, HFBT m, HFBT-a) of group 1 were 0.9200 ± 0.3620, 2.516 ± 0.7648, 2.586 ± 0.9655, 2.624 ± 1.074, 2.850 ± 0.8891, 2.576 ± 0.7243 and 3.200 ± 1.571 respectively whereas, mean values of VFBH and HFBT at different levels from implant platform (HFBT-0, HFBT-1, HFBT-2, HFBT-3, HFBT m, HFBT-a) of group 2 were 0.8671 ± 0.3195, 2.349 ± 0.5702, 2.354 ± 0.6484, 2.351 ± 0.6920, 2.537 ± 0.7777, 1.904 ± 0.6639 and 2.756 ± 0.9475 respectively. These results showed non-significant difference p > 0.05 (Table 1).

Inter-group comparison at 12 months post implant placement (A12)

Inter-groups comparison after 12 months post implant placement (A12) between both groups showed mean values of VFBH and HFBT at different levels from implant platform (HFBT-0, HFBT-1, HFBT-2, HFBT-3, HFBT m, HFBT-a) of group 1 were 0.4743 ± 0.2691, 1.037 ± 0.6613, 1.350 ± 0.6782, 1.341 ± 0.6740, 1.473 ± 0.6849, 1.419 ± 1.074 and 3.026 ± 1.629 respectively whereas, means of VFBH and HFBT

at different levels from implant platform (HFBT-0, HFBT-1, HFBT-2, HFBT-3, HFBT m, HFBT-a) of group 2 were 0.5267 ± 0.1861, 1.187 ± 0.6151, 1.408 ± 0.5633, 1.503 ± 0.5342, 1.552 ± 0.5730, 1.703 ± 0.7563 and 2.753 ± 0.9001 respectively. These results showed non-significant difference p > 0.05 (Table 1).

Measurements	G1B	G1A12	P(Bvs A12)[#]	G2B	G2A12	P(Bvs A12) [#]	P(G1vsG2) B [##]	P(G1vsG2) A12 [##]
VFBH	0.9200 ± 0.3620	0.4743 ± 0.2691	0.0160*	0.8671 ± 0.3195	0.5267 ± 0.1861	0.0153*	0.7770ns	0.6964 ns
HFBT-0	2.516 ± 0.7648	1.037 ± 0.6613	0.0107*	2.349 ± 0.5702	1.187 ± 0.6151	0.0042**	0.6513 ns	0.6829 ns
HFBT-1	2.586 ± 0.9655	1.350 ± 0.6782	0.0118*	2.354 ± 0.6484	1.408 ± 0.5633	0.0047**	0.6082 ns	0.8706 ns
HFBT-2	2.624 ± 1.074	1.341 ± 0.6740	0.0253*	2.351 ± 0.6920	1.503 ± 0.5342	0.0058**	0.5824 ns	0.6450 ns
HFBT-3	2.850 ± 0.8891	1.473 ± 0.6849	0.0076**	2.537 ± 0.7777	1.552 ± 0.5730	0.0015**	0.4968 ns	0.8279 ns
HFBT-m	2.576 ± 0.7243	1.419 ± 1.074	0.0010***	1.904 ± 0.6639	1.703 ± 0.7563	0.1934ns	0.0957 ns	0.5980 ns
HFBT-a	3.200 ± 1.571	3.026 ± 1.629	0.5765ns	2.756 ± 0.9475	2.753 ± 0.9001	0.6555ns	0.5337 ns	0.7233ns

Table 1*: Comparison of facial bone dimensions at base B (48 hours post implant placement) and A12 (12 months post implant placement) of group 1 (G1) and group 2 (G2). Significance: p* < 0.05, p** < 0.01, p*** < 0.001; ns: Not Significance; #Paired t Test, ## Student t Test.*

Inter-group comparison of facial dimensional change (A12-B) between both groups

Dimensional changes of facial bone thickness were made by subtracting the dimension of facial bone at base (B) from the facial bone dimension at (A12) for both groups.

There was a decrease in facial bone thickness of both groups with mean values of VFBH (A12-B) and HFBT (A12-B) at different levels from implant platform (HFBT-0, HFBT-1, HFBT-2, HFBT-3, HFBT-a) of group 1 were -0.4457 ± 0.3550, -1.479 ± 1.073, -1.259 ± 0.9647, -1.259 ± 0.9647, -1.407 ± 1.163, -1.390 ± 0.9022 and -0.1714 ± 0.7805 respectively whereas, mean values of VFBH (A12-B) and HFBT (A12-B) at different levels from implant platform (HFBT-0, HFBT-1, HFBT-2, HFBT-3, HFBT-a) of group 2 were -0.3033 ± 0.2056, -1.225 ± 0.6048, -0.8600 ± 0.5153, -0.7867 ± 0.4185, -0.9533 ± 0.3691 and 0.1950 ± 1.008 respectively which were non-significant p > 0.05. However, HFBT-m (A12-B) of group 1 showed greater facial bone lose with mean value -1.157 ± 0.5107 than HFBT-m (A12-B) of group 2 with mean value -0.1950 ± 1.008, there was significant difference p < 0.05 (Table 2).

Measurements	G1(A12-B)	G2(A12-B)	P (G1(A12-B) vs G2(A12-B))[##]
VFBH (A12-B)	-0.4457 ± 0.3550	-0.3033 ± 0.2056	0.4066ns
HFBT-0(A12-B)	-1.479 ± 1.073	-1.225 ± 0.6048	0.6191ns
HFBT-1(A12-B)	-1.259 ± 0.9647	-0.8600 ± 0.5153	0.3855ns
HFBT-2(A12-B)	-1.407 ± 1.163	-0.7867 ± 0.4185	0.2474ns
HFBT-3(A12-B)	-1.390 ± 0.9022	-0.9533 ± 0.3691	0.2934ns
HFBT-m(A12-B)	-1.157 ± 0.5107	-0.03667 ± 0.3934	0.0011**
HFBT-a(A12-B)	-0.1714 ± 0.7805	-0.1950 ± 1.008	0.4752ns

Table 2: *Comparison of facial bone dimensional change (A12-B) between group1 (G1) and group 2 (G2). Significance: p* < 0.05, p** < 0.01, p*** < 0.001; ns: Not Significance; ##: Student t Test.*

Implant survival

After 18 months post implant placement both groups did not show any signs of implant failure with 100% success.

Discussion

With advanced image modality as CT and CBCT, it became possible to overcome some of the limitations of intra-oral radiographs, to examine the implant and its surrounding tissues in several orthogonal planes and to scroll through the slices to visualize the 3D anatomy [15].

In the present study, delayed leading was applied as, it considered the most safest approach without disturbance of osseointegration process [16] unlike immediate loading which imposes a greater risk for implant failure when compared to conventional loading [17].

In our study, cone beam computed tomography (CBCT) was used for radiographic evaluation of facial bone thickness involving the assessment of vertical facial bone height (VFBH) and horizontal facial bone thickness (HFBT) at 0, 1, 2, 3 mm from implant platform, m (middle) and a (apex) of implant fixture from coronal view between both groups through follow up period one year after implant placement.

Upon comparing mean values between both groups regarding VFBH and HFBT (0, 1, 2, 3, m, a) at base and 12 months post implant placement there was no significant difference between them. This could be explained that we used immediate delayed type 2 which characterized by soft tissue healing without partial bone healing as type 3 according to ITI Consensus Conferences classification [3,4] which made it liable to the same degree of bone loss as immediate implant. These results are in agreement with Palattella., *et al*. [18] who compared clinically and radiographically regarding marginal bone loss between immediate implant and immediate delayed (test group) implant placement after 8 weeks from teeth extraction with immediate non-functional loading after 48 hours from surgery in maxillary anterior region using periapical radiographs immediately after implant and recalling visits through 2 years. The result revealed no significant difference between 2 groups.

In addition, our results agreed with Annibali., *et al*. [19] who compared and evaluated clinical and radiographical outcome between immediate and early implant placement and late (delayed) implant of single hopeless non periodontology involved either maxillary or mandibular molar. The radiographic evaluation included marginal bone loss (MBL) with follow up periods one year after permanent restoration using periapical radiographs. There was no significant difference between the three groups with mean values of MBL after one year from permanent restoration 1.09 ± 0.35, 1.04 ± 0.25 and 1 ± 0.21 for immediate, immediate-delayed and delayed implant groups respectively.

In contrary to our results, Hof., *et al*. [20] conducted a retrospective study aimed to compare and evaluate clinically and radiographically between different implants protocols in anterior maxilla including immediate implant placement (IIP) without guided bone regeneration (GBR), early implant placement (EIP), delayed implant placement (DIP) and IMP with GBR, DIP after 3 months from autologous bone block grafting with follow up period ranging from 4.5 to 7.4 years after one year from implant placement. Standardized periapical radiographs were taken to evaluate peri-implant bone loss. The results revealed the lowest bone loss with EIP (1.4 ± 0.8) and greatest bone loss in implant placed after autologous bone block (1.8 ± 0.9) followed by IMP with GBR (1.7 ± 0.7) with significant difference between EIP and IMP with GTR. This can be explained that GBR was used not to close the facial gap but on cases with mild facial bone dehiscence that may lead to improper bone formation as sound bone with no bone loss like our study.

Intergroup comparison regarding dimensional change of facial bone showed significant bone loss in favor of immediate-delayed which showed less dimensional facial bone loss at middle of dental implant than immediate implant. this can be explained by liability of immediate implant to have residual periapical infection which may lead to improper bone healing at this region which is confirmed by many papers [9,21]. Liability for infection with immediate implant is considered one of its major disadvantages.

Intra-group comparison between base and 12 months post implant placement showed significant bone loss related to VFBH and HFBT at (0, 1, 2.3) for both group with no significant difference related to HFBT at (m, a) for group 2 and at (a) for group 1. This may be explained by fact that, whatever the type of dental implants even with intact facial bone, vertical bone resorption still take place and lead to flatten of the facial contour [7]. In addition, presence of facial gap during immediate implants can lead to major dimensional change in hard and soft tissue surrounding the implant which can be reduced with GBR [6]. Also, there was liability of bone dimensional change of immediate delayed as we used type 2 not type 3 that have only soft tissue healing without bone healing that increasing liability for horizontal facial bone loss [3,4].

Our results were confirmed by Roe., *et al*. [22] who evaluated and compared facial bone dimensional changes vertically and horizontally around immediate implants with provisionalization in maxillary anterior teeth on 21 patients by using CBCT tomography at base (T1) and after one year (T2). Vertical facial bone height (VFBH) and horizontal facial bone thickness (HFBT) were measured at different levels from implants platform at 0, 1, 2, 4, 6, 9, 12 mm by drawing this lines parallel to implants platform. The results showed significant difference between T1 and T2 in relation to VFBT and HFBT at 0, 1, 2, 4, 6 and 9 with no significant difference at 12 mm level.

Similar findings were found with Kumar., *et al*. [23] who compared clinically and radiographically pre-implant soft tissue and proximal bone between immediate and delayed implants with delayed loading. Both groups were evaluated clinically at 9 and 18months for thickness of pre-implant mucosa, papilla index, plaque index, soft tissue index and pocket depth. Also, radiographical evaluation was performed at base line, 4months, 9 and 12 months via panoramic and digital periapical radiographs to evaluate bone length and density. At the end of the study, it was found a statistically significant marginal bone loss occurred in each group, but there was no significant difference between 2 groups.

In contrary to results of significant horizontal facial bone loss in both groups, Morimoto., *et al*. [13] recorded increased facial dimensional from 0.54 to 1.46 around immediate implant in anterior maxillary region after one year from implant placement through using CBCT. This might be explained due to initial facial bone thickness was measured before implant placement so volume of bone graft was not measured after implant placement unlike most studies that measured facial bone thickness after implant placement including volume of bone grafts from the start. In addition, using flapless technique during implant placement with using slowly resorbed hydroxylapatite bone grafts reduced gross dimensional facial bone remolding.

However, studies comparing between immediate and immediate delayed implant placement radiographically using CBCT are very few. So, further studies are highly recommended.

Conclusion

Both implant technique gave satisfactory outcomes. In case when esthetic is the first consideration for the patients and the need to shorten the treatment time between tooth extraction and implants especially in the maxillary esthetic zone, immediate-delayed implants are recommended. Since the addition of guided bone regeneration to immediate implant group gave comparable outcomes so, the use of immediate-delayed implant instead of expensive immediate implant with GBR especially in case of patients who are concerned about the cost.

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