



EVALUATION OF IMMEDIATE DENTAL IMPLANT WITH SOCKET SEALING BY A PROVISIONAL RESTORATION

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ABSTRACT

Objectives: The objective of this study was to evaluate immediate implant placement with socket sealing by a provisional restoration. **Subjects and methods:** The study included 12 patients: 9 males and 3 females, the study was designed Randomized controlled clinical study. The study protocol involved atraumatic extraction with flapless technique immediate implant with bone graft protected by a provisional restoration, all patients followed up for 6 months. **Results:** The results of the present study showed the mean implant stability was increased from 67 ± 3.46 immediately after treatment to 76 ± 2.31 the mean bone density was increased from 539.5 ± 63.25 preoperatively, to 649.25 ± 37.4 after 6 months, regarding the mean of horizontal bone loss the greatest mean value was 0.58 ± 0.08 . The mean value of the vertical bone loss was 0.59 ± 0.24 mm after 6 months. **Conclusions:** Immediate implant with a provisional restoration as socket seal device shown preservation of the labial bone plate thickness and height and potentially enhanced the thickness of the peri-implant soft tissues coronal to the implant abutment interface Implant stability and bone density were increased with these procedures.

KEYWORDS: Atraumatic extraction; flapless technique; immediate implant; socket seal.

INTRODUCTION

Alveolar ridge resorption following tooth removal is a physiologically undesirable but unavoidable phenomenon⁽¹⁾. In most cases the residual ridge defect becomes a problematic site that is difficult to be restored both functionally and esthetically either by conventional tooth-supported restoration or by an implant- anchored restoration⁽²⁾. When a tooth is extracted, the dimensional change of height and width of the alveolar ridge will occur. The reduction

of the height of the bony wall is more pronounced at the buccal than lingual aspect of the extraction socket⁽³⁾. It has been well documented that major contour changes of the alveolar process take place during the first 6 months following tooth extraction. This reduction interferes with the placement of dental implants and influences the success of the prosthesis with regard to esthetics⁽⁴⁾. Immediately placing the implant after extraction helps to shorten the treatment time and may reduce the amount of ridge width reduction that accompanies tooth ex-

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traction⁽⁵⁾. It has been suggested that placement of implants into fresh extraction sockets with a bone-to-implant gap of 2 mm or less would limit remodeling and hence maintain the original shape of the ridge⁽⁶⁾.

Immediate implant placement reduces the number of surgical interventions, shortens time to final restoration, may offer a fixed provisional restoration alternative to a removable interim prosthesis, and may partially support the peri-implant tissues prior to collapse from the extraction socket remodeling⁽⁷⁾.

Clinically immediate anterior implant placement into fresh extraction sockets has evolved from two stages with full-thickness flaps to a one stage often flapless. Sometimes an immediate provisional restoration placed at the same appointment without compromising implant survival rates^(8:10).

Today the challenge for clinicians utilizing immediate anterior implant placement is no longer just achieving Osseo-integration, that have extremely high rates. Instead, the challenge is improving on protocols that allow for less traumatic, more time-efficient and highly predictable esthetic treatment outcomes in the anterior region. Also improvements in implant designs have helped advance successful immediate anterior implant placement into fresh extraction sockets^(11:14).

The contemporary patient's demands are not only a "functionally stable implant", but moreover an aesthetic and functional rehabilitation in short treatment time. Thus, on principle, the treatment concept of immediate insertion and provisionalization seems to fit perfectly to the anterior aesthetic zone⁽¹⁵⁾.

Clinical techniques described in this study can help practitioners to achieve predictable esthetic success using a method that limits the amount of labial contour change of the extraction site ridge and potentially enhances the thickness of the peri-implant soft tissues coronal to the implant and abutment interface. This approach involves

atraumatic tooth removal without flap elevation, and placing a bone graft into the residual gap around an immediate anterior implant with a provisional restoration acting as a prosthetic socket seal device⁽¹⁶⁾.

The provisional restoration can act as a "prosthetic socket-sealing" device that protect, contain, and maintain the blood clot and bone graft material during the healing phase of treatment⁽¹⁷⁾.

The aim of this study was to evaluate clinically and radiographically immediate implant placement with socket sealing by provisional restoration comparing soft and hard tissues' architecture immediately and after 6 months.

SUBJECTS AND METHODS

Study design: single arm study.

The selected participants fulfilled the following criteria:

- ***The inclusion criteria:***

Presence of a non-restorable maxillary anterior or premolar tooth indicated for extraction.

- ***Exclusion criteria:***

Limited mental capacity patient or suffering from a known psychological disorder,. Patient on chemotherapy or radiotherapy, presence of acute periapical pathosis related to the offending or neighboring teeth which could affect surge, Pregnancy or lactating period, Heavy smoking patients.(more than 20 cigarette per day),Patient who was receiving or had been exposed to bisphosphonate therapy.

Study protocol:

Twelve patients were selected from those attending outpatient clinic of Oral and Maxillofacial Surgery Department at Faculty of Dental Medicine, Cairo, Boys, Al-Azhar University. All patients followed up for 6 months.

1. Phase I therapy & Pre-surgical Assessment and protocol:

Prior to surgery, an irreversible hydrocolloid impression (Alginate Impression Material) was taken and an acrylic "eggshell" temporary crown was fabricated. Patients were subjected to scaling, oral hygiene measures before surgical procedure, Antimicrobial prophylaxis was obtained with mouth rinse of chlorohexidine mouth wash twice a day for seven days starting two days before surgery.

Ethical consideration: Nature of the study was explained to patients; enrolled patients should sign a written consent form.

Sample size: A total sample size of 12 will be sufficient to detect an effect size of 0.684 at a power of 0.8 ($1-\beta$ error = 0.8) and using a two-sided hypothesis test and a significance level 0.05 (α error = 0.05) for data.

2. Surgical procedures:

- a. After the administration of local anesthesia using infiltration of buccal and palatal tissues the tooth was removed atraumatically as much as possible.
- b. Then the socket was debridement with a surgical curette, and cleaned with saline irrigation.
- c. Drilling sequence according to manufacture instructions was adopted to prepare the implant site more palatal and into a depth of 3 mm from the free gingival margin equivalent to the mid-facial osseous crest by using of appropriate drills under copious irrigation.
- d. The implant was removed from its sterile pack and seated within the prepared socket by rotary hand piece then continue with ratchet wrench to seat the implant into its final position
- e. The smart peg was screwed into implant fixture and primary implant stability was evaluated by RFA (Resonance Frequency Analysis) technique through using osstell device, then The appropriate screw-retained abutment has been placed using the platform-switch concept during the provisional restoration phase.
- f. The acrylic eggshell provisional crown was tried on the abutment after preparation of the abutment to provide sufficient space. The provisional crown then filled with an auto polymerizing acrylic resin, seated onto the abutment in the proper facial and vertical positions and allowed setting partially prior to removal.
- g. The provisional crown then removed for removal of excess and polished. All the provisional crowns were relieved out of occlusion with an approximate clearance of 1 mm, and the patients were instructed to avoid functional overload.
- h. Then the provisional crown was cemented with light cure flowable composite for 6 months.
- i. After 6 months, the provisional restoration was removed for the first time and smart peg was attached for implant stability measuring. Then impression was taken, and the dental laboratory fabricated a cement-retained restoration. Then the final restoration was cemented.



FIG (1) Showing; (A) showing rotary implant insertion; (B) bone graft placement; (C) the provisional restoration in position after cementation; (D) the final restoration after cementation.

3. Assessment:

Clinical Assessment:

Clinical evaluation was done to evaluate success of implants after one week, 3 and 6 months. Infection, Wound dehiscence, Implant exposure, Graft exposure or loss, or Soft tissue dehiscence were assessed.

Implant stability was evaluated by Resonance Frequency Analysis (RFA) technique through using osstell device (Osstell ISQ, Third generation, Gutenberg, Sweden) immediately after 6 months.

Radiographic Assessments:

- Horizontal bone loss:** CBCT was used to measure the alveolar horizontal width using Planmeca Romexis® software using a roller tool by 3line (A AE, M ME, B BE) perpendicular to the vertical long axis of the implant immediately and after 6 months. where points A, M and E on implant surface where A 2nd thread apically, B 2nd thread coronally and M at the middle of fixture and AE, ME and BE on the external labial surface ⁽²¹⁾.
- Vertical bone loss:** by horizontal implant bevel plane perpendicular to the vertical axis of the implant a line exactly from alveolar crest to the implant bevel plane was measured by rolled tool using Planmeca Romexis® software immediately and after 6 months.⁽²¹⁾
- Bone density:** Square 4x4mm will be selected at the alveolar bone 3mm apical to the implant fixture.

RESULTS

The study included 12 patients: 9 males (75%) and 3 females (25%), the mean age was 35.3 ± 12.2 , ranging from 25 to 49 years. There was no statistically significant difference between genders or the mean of age distributions.

The clinical parameters such as infection, wound dehiscence, implant exposure and graft exposure or loss were evaluated and the results showed no statistically significant (Table 1, 2).

Also the implant stability was evaluated and the results showed increasing in the implant stability from 67 ± 3.46 immediately after treatment to 76 ± 2.31 after 6 months, with a significant difference between different observations (Table 3).

The horizontal and vertical bone loss was assessed and the results showed:

In the mean of horizontal bone loss the distance from the 2nd thread of fixture coronally to labial bone plate (B BE) line) showed a mean horizontal bone loss 0.26 ± 0.07 , in comparison to 0.16 ± 0.04 in Distance from the middle of fixture to labial bone plate (M ME); while the distance from apex of fixture to labial bone plate (A AE) showed the greatest mean value (0.58 ± 0.08). The difference between the 3 distances was statistically significant (Table 4).

In the mean of vertical bone loss the mean value was 0.59 ± 0.24 mm by measuring the vertical distance between crest of labial bone and horizontal implant plane (Table 4).

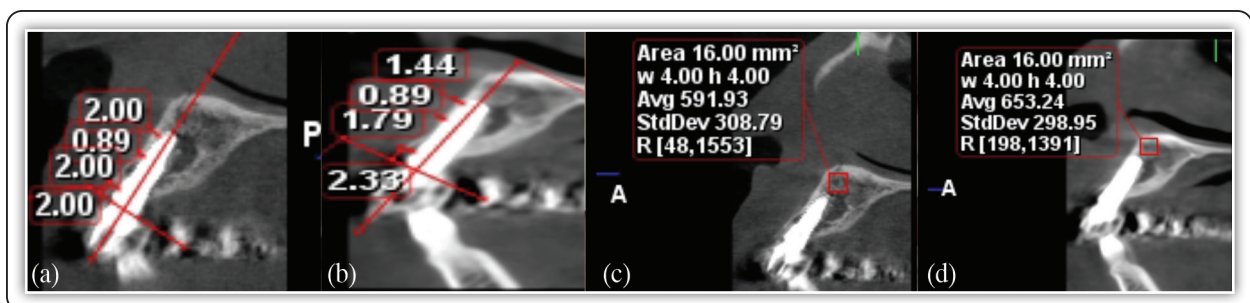


FIG (2) Showing: (A, B) CBCT sagittal view showing vertical height and horizontal thickness of labial bone immediate and after 6 months; (C, D) bone density, immediate and after 6 months.

TABLE (1) Frequency of different clinical findings (chi square test)

Time	Infection	Graft exposure	Satisfaction	Dehiscence	
				Buccal	Palatal
One week	Yes=0 No=100%	Yes=0 No=100%	Score3=100%	Yes=0 No=100%	Yes=25% No=75%
3 months	Yes=0 No=100%	Yes=0 No=100%		Yes=0 No=100%	Yes=0 No=100%
6 months	Yes=0 No=100%	Yes=0 No=100%	Score2=25%	Yes=0 No=100%	Yes=0 No=100%
X ²	0.0	0.0	Score3=75%	0.0	6,54
P	1 ^{ns}	1 ^{ns}	Score3=100%	1 ^{ns}	0.037*

Significance level $p \leq 0.05$, *significant, ns=non-significant

TABLE (2) Mean pain score at different observation time

	One week	3 months	6 months
Score	Score2: 25% Score3: 25% Score4: 25% Score5: 25%	Score0: 100%	Score0: 100%
Mean ±SD	3.5±1.29	0±0	0±0
X ²		24	
P		0.0005*	

Significance level $p \leq 0.05$, *significant.

TABLE (3) Comparison of implant stability at different observation times (Paired t test)

	Immediate	6 months
Pre-operative	67.00	76.00
	3.46	2.31
T		4.32
P value		0.005*

Significance level $p \leq 0.05$, *significant.

TABLE (4) Descriptive statistics and comparison of horizontal and vertical bone loss at A EA, M EM and B EB lines . (ANOVA test)

	Horizontal bone loss			Vertical bone loss
	B	M	A	
Mean	0.26	0.16	0.58	0.59
SD	0.07	0.04	0.08	0.24
F		44.78		
P		0.00*		

Significance level $p \leq 0.05$, *significant

The bone density with also assessed and the result showed the mean bone density in the increased from 539.5±63.25 preoperatively, to 649.25± 37.4 after 6 months, with a significant difference between different observations (Table5).

TABLE (5) Comparison of bone density at different observation time(ANOVA test)

	Bone density	
Pre-operative	Mean	539.50
	SD	63.25
After 6 months	Mean	649.25
	SD	37.40
F		6.158
P		0.021*

Significance level $p \leq 0.05$, *significant

DISCUSSION

Different strategies have been developed in order to minimize bone loss around implants. Immediate implant has been done to decreasing bone resorption but until now it doesn't prevent buccal bone resorption. The results of this investigation show that immediate implant placement with simultaneous grafting does not entirely avoid bone resorption. Thus, a mean reduction of around 0.5 mm in height and width were observed.

Implant placement was done in the present study can help practitioners to achieve predictable aesthetic success using a method that limits the amount of labial contour change of the extraction site ridge and enhances the thickness of the peri-implant soft tissues coronal to the implant and abutment interface. This approach involved (1) atraumatic tooth removal without flap elevation to avoid tissue reflection, that compromising the blood supply to the labial bone plate and to avoid increasing bone resorption and (2) placing a bone graft into the residual gap around an immediate fresh-socket anterior implant with (3) a provisional restoration acting as a "prosthetic socket-sealing" device that protect, contain, and maintain the blood clot and bone graft material during the healing time⁽¹⁷⁾. Also support the peri-implant mucosa and maintain its architecture to be favourable for receiving the final restorations.

The present study 12 patients: 9 males (75%) and 3 females (25%). The mean age was 35.3 ± 12.2 , ranging from 25 to 49 years. However, there were no statistical significant effects of sex, age on the obtained results. This may be due to decreasing number of cases in the present study.

Implant placement was done in the present study with flapless to avoid tissue reflection, that would have compromised the blood supply to the labial bone plate and to avoid increasing bone resorption, as described by Buser et al.⁽¹⁸⁾.

Tarnow et al 2014⁽¹⁹⁾ proved that bone grafting into the gap with a contoured healing abutment or a provisional restoration at the time of implant placement as in our study resulted in the smallest amount of ridge contour change.

Clinical evaluation was done to evaluate success of implants. Clinically, all patients have no infection, wound dehiscence, implant exposure and graft exposure or loss was assessed

In addition, Resonance Frequency Analysis (RFA) was done to determine implant stability. All implants in the present study were successful with primary and secondary stability assessed with resonance frequency analysis. The mean implant stability increased from 67 ± 3.46 immediately after treatment to 76 ± 2.31 after 6 months. These results agreed with Degidi et al^(20,21) study in 2010, who reported that all the implants with an initial ISQ below 46 ISQ failed, while those with ISQ over 60 showed successful osseo-integration.

Radiographic evaluation was done with CBCT, In the current study CBCT was used to determine the bone density and bone loss in vertical and horizontal direction, immediately and 6 months post implant insertion. The bone density measured with Hounsfield units (HU) at region of interest using the Planmeca Romexis imaging software. The mean bone density increased from 539.5 ± 63.25 preoperatively, to 649.25 ± 37.4 after 6 months, with a significant difference between different observations. These are in accordance with the outcomes presented in the effect of Osseo densification on implant stability and bone density done by Hinid et al.⁽²²⁾, where the mean postoperative bone density measured at the apical area of the implant site demonstrated a significant increase compared with the mean preoperative density of the same area.

Regarding the mean of horizontal bone loss the greatest mean value was 0.58 ± 0.08 . The mean value of the vertical bone loss was 0.59 ± 0.24 mm by measuring the vertical distance between crest

of labial bone and horizontal implant plane. These are in accordance with the outcomes presented in a recent meta-analysis, done by Lee C et al.⁽²³⁾, Where a mean vertical reduction of 0.78 mm in the buccal wall. The bone reduction in vertical and horizontal aspects 4-12 months following surgery of immediate implant sites demonstrated approximately 0.5-1.0mm.

Jung et al.⁽²⁴⁾ using CBCTs showed a mean horizontal reduction of 0.6 mm and a vertical reduction of 1.2 mm at extraction sites filled with an organic bovine bone with no flap elevation at 6 months of healing. However, immediate implant placement may lead to a similar reduction in width as ridge preservation, it increases the patients satisfaction as it limits the number of surgical interventions and chair time. The buccal plate receives blood supply from the periodontal ligament, the bone marrow and the outer periosteal⁽²⁵⁾.

Horizontal and vertical dimensional changes of peri-implant facial bone following immediate placement and provisionalization of maxillary anterior single implants was measured by Roe p et al.⁽²⁶⁾, who found that the mean Horizontal Facial Bone Thickness (HFBT) changes ranged from 1.23 to 0.08 mm and the mean Vertical Facial Bone level (VFBL) change was 0.82 mm after 1 year.

Morimoto T et al.⁽²⁷⁾, described change following tooth extraction in the maxillary anteriors of the facial bone around single implants for immediate placement and provisional restoration by using CBCT. The horizontal bone resorption was 0.26 mm, and the vertical bone resorption was 0.25 mm that agreed with our results.

They concluded that immediate placement and provisionalization of single implants procedure in the maxillary anterior showed excellent outcomes with the small facial bone alterations around the implants. Although they reported neither preoperative facial bone thickness nor horizontal gap distance influenced the amount of facial bone resorption In

the present study, vertical and horizontal bone were preserved with decreasing of bone loss therefore, it may be speculated that this technique may have the potential to avoid the marked resorption of the buccal bone plate after tooth extraction.

CONCLUSION

Immediate implant with a provisional restoration as socket seal device shown preservation of the Labial bone plate thickness and height and potentially enhanced the thickness of the peri implant soft tissues coronal to the implant abutment interface. Implant stability and bone density were increased with these procedures.

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