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EVALUATION OF ALVEOLAR BONE DIMENSIONAL CHANGES AFTER FLAPLESS IMMEDIATE IMPLANT PLACEMENT

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ABSTRACT

Objectives The aim of this study was to evaluate clinically and radiographically alveolar Bone dimensional Changes after flapless immediate implant placement. **Subjects and methods:** Thirty-two patients were divided into two groups; Group A (control group): received flapped immediate implants combined with xeno graft. Group B (Test group): received flapless immediate implants combined by xeno-graft. Evaluation includes Presence of infection. Wound dehiscence. Implant exposure. Graft exposure or loss. Soft tissue dehiscence. Implant stability. Buccal bone height and lingual bone height of the extracted socket. Ridge width. **Results:** buccal bone height, flapless group showed a significant lower (0.09 mm) Change than flap (1.13 mm). Ridge width, at 2, 4, 6 mm, flapless group showed a significant lower Change than flap. Flapless group showed significant higher implant stability than flap. **Conclusion:** The flapless group has shown a lower reduction in height and width after placing immediate implants and filling the residual gap with an organic bovine bone. More ridge reduction was observed for the flapped group.

KEYWORDS: immediate implant, flapless, dimensional Changes.

INTRODUCTION

Dental implants are a consolidated treatment for missing teeth replacement that allows the restoration of chewing function, language and aesthetics [(1)]. Osseointegration is the primary biological and biophysical process by which dental implant therapy is predictably effective in replacing missing teeth [(2)]. In implantology, the concept of osseointegration was first introduced by Brånemark in 1964, and the guidelines for a direct connection between bone and titanium were described by the same author [(3)]. Traditionally, compromised teeth are removed and the extraction sockets allowed to heal for several months before dental implants are placed. However, resorption of the alveolar ridge after tooth extraction can significantly reduce the remaining bone volume and compromise the favorable implant positioning required for an optimal prosthetic restoration. Such an aspect is even more pronounced in the anterior maxilla, where ridge resorption is more pronounced in the buccal wall, which leads to an unfavorable bucco-lingual discrepancy between implant and prosthesis [(4, 5)].

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Immediate implant placement after extraction is a one-step procedure in which the implant must be placed after tooth extraction with no healing time[6]. Immediate implant placement can reduce the number of clinical visits and surgical procedures compared to delayed implant placement because the patient's morbidity decreases and in some cases allows immediate recovery[7,8]. Extensive bone loss after immediate implantation can jeopardize osseointegration or raise aesthetic concerns, especially in the aesthetic zone of the maxilla, which is often characterized by a thin buccal plate [9].

It has been suggested that immediate implant placement preserve the dimensions of the alveolar bone [10]. However, recent experimental studies and clinical studies do not support this concept and show significant changes in the dimensions of the bone ridge at the immediate implant operation site [11]. The buccal dimensional change is usually greater than that of the lingual or palatal dimension [12, 13]. An experimental study showed that the facial socket wall, which consists almost entirely of bundle bones, can possibly be resorbed in the vertical and horizontal planes [14]. This crestal bone resorption can lead to a recession of the facial mucosa. It has been suggested that an interruption of the vascular supply to the facial bone caused by lifting the surgical flap could be an important factor [15].

Various techniques of immediate flap elevation implantation have already been described, However, increased bone loss and collapse of the interproximal papilla, which can lead to recession of the gingiva, destruction of the papilla, and resorption of the crestal bone [16]. Flapless approach could minimize buccal bone augmentation since the blood supply from the periosteum remains unchanged [17, 18]. The aim of this study was to evaluate clinically and radiographically alveolar Bone dimensional Changes after flapless immediate implant placement.

SUBJECTS AND METHODS

Thirty-two patients were selected from these outpatient clinics of the Department of Oral and Maxillofacial Surgery at the Dental Faculty of Al-Azhar University Boys Cairo

Ethical consideration 440/012019/103f

The clinical part of the study was performed after gaining the ethical clearance from the research Ethics Committee, Faculty of Dentistry, Al-Azhar University.

Inclusion criteria:

Non-restorable tooth in the maxillary aesthetic zone. Age of the patient ≥ 18 years. Good oral hygiene.

Exclusion criteria:

All local or systemic diseases, conditions or drugs that impair healing or osseointegration and can affect the periodontium (uncontrolled systemic disorder such as uncontrolled diabetes mellitus, autoimmune disease, radiation therapy and chemotherapy), Smokers and pregnancy.

Presence of any type of acute infection, any clinical signs of dehiscence or window defects affecting the walls of the facial socket, severely periodontal tooth that is to be replaced. Patients with induced bruxism and para functional habits and inability of patient to return for follow-up visits, were also exculted.

Patients were divided into two groups;

Group A (control group): Sixteen patients received flapped immediate implants replacing non restorable tooth in the maxillary esthetic zone with placement of healing abutment at the day of surgery combined with grafting of the gap between the socket wall and the implant by xeno graft, the implants are conventionally loaded 6 months later.

Group B (Test group): Sixteen patients that were received flapless immediate implants replacing non restorable tooth in the maxillary esthetic zone

with placement of healing abutment at the day of surgery combined with grafting of the gap between the socket wall and the implant by xeno-graft, the implants are conventionally loaded 6 months later.

Sample size calculation:

To study the influence of flap and flapless techniques on alveolar bone dimensions after immediate implant placement, independent t test will be used for comparison. According to a previous study by Mazzocco et al [1], mean difference in lingual height was 0.1433 ± 1.65 and 0.915±1.35 in flap and flapless respectively. A medium effect size of approximately 0.46 is expected.

A total sample size of 32 patient's male and female (16 patients in each group) will be sufficient to detect: an effect size of 0.46, a power (1-β error) of 0.8, Using a two-sided hypothesis test, and Significance level (α error) 0.05 for data

Surgical procedure

Antimicrobial prophylaxis was obtained with mouth rinse of chlorohexidine (orovex, manufactured by Macro) twice a day for seven days starting two days before surgery. Preoperative antibiotics was given orally 1 hour before surgery and twice daily for five days after surgery (Augmentin 1g, Amoxicillin and clavulanic acid, GlaxoSmithKline), or clindamycin phosphate (Dalacin C 300mg, Pfizer) 600 mg, for patients allergic to penicillin.

Following the administration of local anesthesia using infiltration of articaine chlorhydrate 4% containing adrenaline at a concentration 1:100000, (France)

In flapped group circular incision was made by blade #15, full mucoperiostum flap was elevated labially as envelop flap by periosteal elevator

In flapless group circular incision was made without any reflection.

Atrumatic extraction was started by using periotome to sever the periodontal tissue attachment around the root and to luxate the tooth.

Elevators were used when indicated with extreme caution. Then a forceps is used with extreme caution to deliver the tooth out of its socket using gentle movement and avoiding any excessive pressure on the facial socket walls.

The fresh extraction socket was gently curetted with hand instrument and irrigated with saline and chlorohexidine. to remove any granulation tissues or any hard or soft debris that were present after extraction.

Immediately after the extraction a CBCT (planmeca promax 3D Mid with voxel size 200-micron ,90 kV and 12.5 mA, Finland) was taken in order to evaluate the integrity of the facial wall of the socket and to superimpose postextracion image with postoperative 6 months of follow up.

After CBCT scan the length and diameter of the socket was measured using graduated periodontal probe; also, the extracted root length was measured using a periodontal probe.

This measurement together with the measurements obtained from the preoperative radiograph were used to select the appropriate diameter and length of the implant used. Then the implant site was prepared for implant placement according to standard techniques for extraction the pilot drill was used under copious saline irrigation, an osteotomy site was created in the apical third of the socket of the extracted tooth toward the palatal wall, extending 3 to 5 mm apical to the socket base to achieve primary stability for the implant. According to bone density hard or soft, sequential drilling according to the manufacture guidelines was performed.

After proper osteotomy is prepared, the implant was removed from its sterile pack 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 (NUCLEOSS T6 made in turkey) into its final position, implant shoulder was placed 1.5 to 3mm apical to gingival margin.

Primary implant stability was evaluated by RFA (resonance frequency analysis) technique through using osstell device (Osstell ISQ, Third generation, Gutenberg, Sweden.)

In two groups after implant placement, bovine bone substitute with biocompatible collagen type 1 was filled in the gap between the implant body and the socket wall. The bone graft used in this study is (Hypro-Oss, Giessen, Germany), Fig 1.

Then healing abutments were selected and positioned. The height of healing abutment was selected in a way to ensure that there was no functional loading of the implant. Healing abutment used to help in contouring the gingival architecture, to avoid second stage of surgery and act as a socket seal device.

Patient was be instructed after that to rinse daily with an antiseptic mouthwash twice daily and to refrain from removing plaque by mechanical means at the surgical site for 2 weeks and the patient asked to do plaque removal at the exposed healing abutment with soft-bristled toothbrush anti-inflammatory and analgesic drug is prescribed twice daily for five days (Brufen 400 mg, Abbott)

Assessment:

Each patient is examined clinically and radiologically for the following:

Clinical evaluation:

Presence of infection, wound dehiscence, implant exposure, graft exposure or loss, soft tissue dehiscence were checked. All patients were clinically examined at the following intervals: Immediately, 3 days, one week, two weeks, three months, and six months postoperatively. Except for implant stability, it was assessed immediately and 6 months postoperatively.

Radiographic evaluation:

After 6 months a CBCT scan (Planmeca ProMax 3D Mid, Finland) was performed to overlay CBCT1 after extraction and CBCT2 to collect this data of buccal bone height and lingual bone height of the extracted socket, with the buccal bone height and lingual bone height of the cup after 6 months of implant placement. The width of the ridge of the extended base at three different points. Ridge width of the extracted socket at three different points of height 2, 4, 6 mm of height of the ridge.

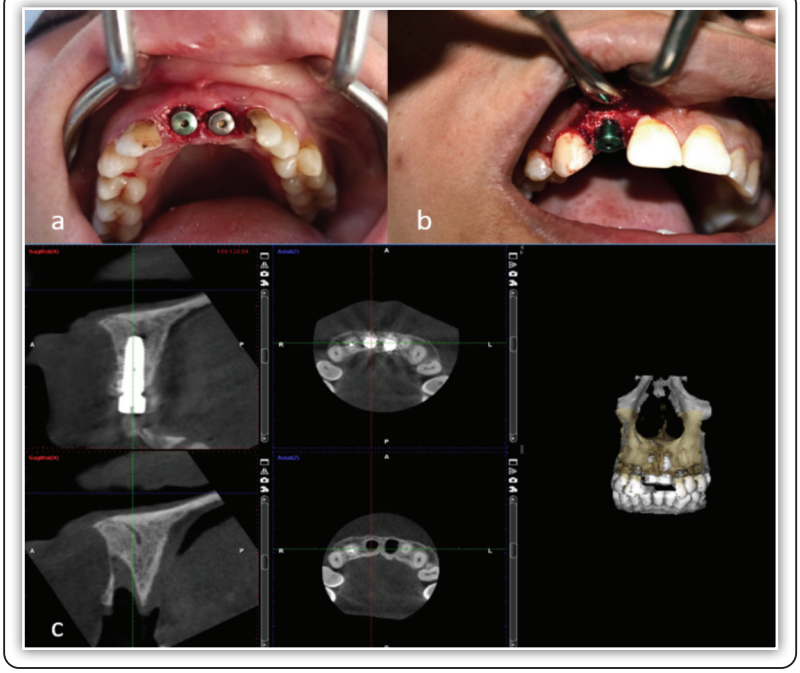

FIG (1) a), Bovine bone graft filling gap around implant after flapless, b), Bovine bone graft filling gap around implant after flap reflection, and c), superimposition of CBCT.

Ridge width of the socket after implant placement at three different points of height 2,4,6 mm of height of the ridge. After the superimposition and data was collected from CBCT 1 and CBCT2 measurements, changes was occurred in vertical and horizontal alveolar bone dimension was evaluated and documented from two groups to detect the difference. 3D imaging software used in the study (Planmeca Romexis) to giving superimposition between CBCT post extraction and CBCT after implant placement with 6 months follow up.

Statistical analysis of the data:

Data were fed to the computer and analyzed. Significance of the obtained results was judged at the 5% level. The used tests were Chi-square test, Fisher's Exact, Student t-test, and Paired t-test.

RESULTS

In the present study, buccal bone height, flapless group showed a significant lower (0.09 mm) Change than flap (1.13 mm). Lingual bone height, flapless group showed a significant higher Change (0.91mm) than flap (0.21mm). Ridge width, at 2 mm, flapless group showed a significant lower Change (0.30 mm) than flap (1.28 mm). At 4 mm, flapless group showed a significant lower Change (0.19 mm) than flap (1.03 mm). At 6 mm, flapless group showed a significant lower Change (0.27 mm) than flap (0.95 mm). In the present study, at 2 mm, flapless group showed a significant lower Ridge width Change (0.30 mm) than flap (1.28 mm). In the present study, buccal bone height, flapless group showed a significant lower (0.09 mm) Change than flap (1.13 mm). in the flap group, the buccal plate height decreased 1.03 mm and ridge width up to 1.37 mm. Flapless group showed significant higher implant stability than flap.

TABLE (1): Comparison between the two groups according to Age (years) and Implant stability.

	Control (flap)	Test (flapless)	p
	Mean ± SD	Mean ± SD	
Age (years)	30.81 ± 4.07	30.87 ± 3.88	0.965
Implant stability			
Immediate	62.50 ± 2.58	66.69 ± 1.25	<0.001*
6 months	66.87 ± 2.22	71.69 ± 1.20	<0.001*
Change (Increase)	4.38 ± 0.50	5.0 ± 0.37	<0.001*
Buccal bone height			
Baseline	21.19 ± 0.75	19.44 ± 0.72	<0.001*
6 months	20.06 ± 0.72	19.35 ± 0.72	0.010*
Change (decrease)	1.13 ± 0.06	0.09 ± 0.01	<0.001*
Lingual bone height			
Baseline	17.25 ± 0.72	19.34 ± 0.73	<0.001*
6 months	17.04 ± 0.72	18.44 ± 0.72	<0.001*
Change (decrease)	0.21 ± 0.02	0.91 ± 0.01	<0.001*

p: p value for comparing between the studied groups.

**: Statistically significant at p ≤ 0.05*

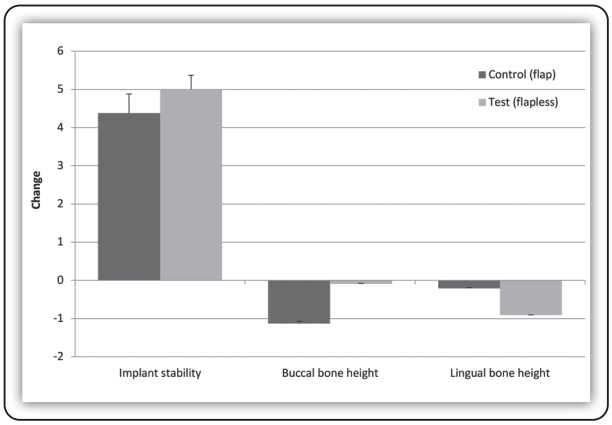

FIG (2) Comparison between the two groups according to different parameters

TABLE (2): Comparison between the two studied groups according to Ridge width height and bone change

	Control (flap)	Test (flapless)	p
	Mean ± SD	**Mean ± SD**	
Ridge width height			
At 2mm			
Baseline	9.83 ± 0.68	9.04 ± 0.72	0.003*
6 months	8.55 ± 0.72	8.74 ± 0.71	0.452
Change (decrease)	**1.28 ± 0.07**	**0.30 ± 0.01**	**<0.001***
At 4mm			
Baseline	10.26 ± 1.37	10.24 ± 0.72	0.957
6 months	9.23 ± 1.41	10.05 ± 0.72	0.051
Change (decrease)	**1.03 ± 0.12**	**0.19 ± 0.01**	**<0.001***
At 6mm			
Baseline	10.83 ± 2.12	11.01 ± 0.67	0.754
6 months	9.88 ± 2.01	10.73 ± 0.72	0.127
Change (decrease)	**0.95 ± 0.13**	**0.27 ± 0.08**	**<0.001***
Bone change			
Buccal bone height			
Change (decrease)	1.13 ± 0.06	0.09 ± 0.01	<0.001*
Lingual bone height Change (decrease)	0.21 ± 0.02	0.91 ± 0.01	<0.001*
Ridge width At 2mm			
Change (decrease)	1.28 ± 0.07	0.30 ± 0.01	<0.001*
At 4mm			
Change (decrease)	1.03 ± 0.12	0.19 ± 0.01	<0.001*
At 6mm			
Change (decrease)	0.95 ± 0.13	0.27 ± 0.08	<0.001*

p: p value for comparing between the studied groups.

**: Statistically significant at p ≤ 0.05*

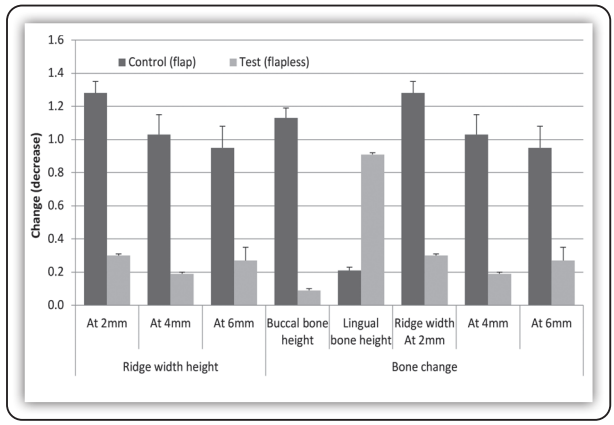

FIG (2) Comparison between the two studied groups according to Ridge width height and bone change

DISCUSSION

In the present study, both groups had no infection, wound dehiscence, implant exposure, graft exposure or loss, or soft tissue dehiscence. In the present study, Buccal bone height, flapless group showed a significant lower Change than flap. Lingual bone height, flapless group showed a significant higher Change than flap. Ridge width, at 2, 4 , 6 mm, flapless group showed a significant lower Change than flap. These are in line with the results of a recent meta-analysis which reported a mean vertical reduction of 0.78 mm in the buccal wall and 0.50 mm on the lingual plate. The bone dimensions of the immediate implantation sites showed a reduction in vertical and horizontal aspects of about 0.5 to 1.0 mm 4-12 months after surgery [7].

Jung et al. [19] using CBCTs showed a mean horizontal reduction of 0.6 mm and a vertical reduction of 1.2 mm at extraction sites that were filled with an organic bovine bone with no flap elevation after 6 months of healing. Although immediate implant placement may lead to a similar reduction in width as ridge preservation, it limits the number of surgical interventions and chair time, increasing thereby patient's satisfaction. The buccal plate receives blood supply from the periodontal ligament, the bone mar-

row and the outer periosteum [20]. If we consider that the buccal bone wall in maxillary anterior teeth is in most cases <1 mm thick [21], the bone at this site will be mostly comprised by cortical bone. When a tooth is removed, the blood supply disappears from the periodontal ligament and the only remaining reservoir is from the periosteum. When a flap is raised, this last source disappears and as a result the buccal plate can resorb. For this reason, it seems reasonable to assume that: a) a thinner buccal plate at the start of the study can lead to greater bone resorption and b) sleepless surgery can minimize bone loss. Regarding the first hypothesis, a moderately positive correlation was found between the initial thickness of the buccal bone plate 1 mm below the ridge and a buccal bone height after 6 months. The thinner the buccal plate, the more the height decreased.

In the present study, the flapless group showed a significantly smaller change in ridge width at 2 mm (0.30 mm) than the flap (1.28 mm). Huynh-Ba et al.[21] also observed a mean buccal bone thickness of 1 mm, but emphasized that it was between 0.5 and 1 mm in 71% of the cases. In addition, Januario et al.[9] A mean buccal bone thickness of 0.5–0.6 mm in the upper incisors and canines 5 mm apical to the crest in CBCTs. In the present study, buccal bone height, flapless group showed a significant lower (0.09 mm) Change than flap (1.13 mm). in the flap group, the buccal plate height decreased 1.03 mm and ridge width up to 1.37 mm. Meanwhile, in the flapless group, the buccal height remained almost stable (0.08 mm difference) and the reduction in ridge width ranged from 0.2 to 0.31 mm.whle in Lingual bone height, flapless group showed a significant higher Change (0.91mm) than flap (0.21mm). At the lingual crest, a difference of 0.15 and 0.92 mm in height was observed in the control and treatment groups, respectively. A more palatal placement of the implants in the flapless group could explain the increased lingual height reduction as well as the greater stability of the buccal wall height in this treatment group [22].

A greater combined ridge loss of 2 mm was reported[23] 4 months after an immediate flap implantation even though the peri-implant gap had been transplanted. Blanco et al. [24] investigated the healing process of the marginal soft tissue after flap or flap surgery with immediate implant placement in a dog model. The clinical evaluation of immediate implant placement after 3 months of healing indicated that buccal soft tissue retraction was less in the flapless group with no significant differences. The mean values of the longitudinal dimension of the biological width in the buccal area were higher in the flap group than in the flapless group, this difference being mainly due to a thinner biotype in this region.

Wadhwa et al. [25] investigated and compared the effect of flapless and open flap techniques during implant placement on the crestal bone height (CBH) level around implants. Both techniques showed a decrease in CBH over time, but the flapless technique showed a smaller decrease. Therefore, the flapless technique can be seen as a better treatment approach for implant placement, especially when there is sufficient width and height of available bone. On the contrary, some other studies found no significant differences in changes in bone level between the two surgical protocols. Caneva et al. [26] compared the reshaping of the alveolar process in implants placed directly in extraction sockets using a flap or a “flapless” surgical approach in a canine model. The “flapless” implant placement in extraction sockets did not prevent alveolar bone resorption and had no influence on the dimensional changes of the alveolar process after tooth extraction compared to the usual placement of implants that lift the mucoperiosteal flap. In addition, Froum et al.[26] found similar mesial and distal bone levels measured on standardized periapical radiographs in flap and flapless groups at 6 months and 1 year after placing one-piece implants.

Stoupel et al.[28] compared the effect of immediate placement and immediate single-tooth im-

plants in the aesthetic zone without a flap or with a flap. Flapless and a flap with immediate implant placement in the aesthetic zone led to a comparable remodelling of the peri-implant mucosa, the interproximal bone and the buccal ridge after 6 and 12 months.

Mazzocco et al. [29] evaluate the bone dimensions after immediate implant placement with simultaneous grafting of the buccal gap to determine whether the initial buccal bone width had an influence on bone remodeling and to compare the changes in bone volume with a flap or a flapless approach after 6 months of healing. After placing immediate implants and filling the remaining gap with an organic bovine bone, a mean reduction in height and width of around 0.5 mm can be expected. No significant association was found between the initial buccal bone width and the ridge width after 6 months. No statistically significant differences were found between the two treatment protocols, although greater crest reduction was observed for the flap group. The Flapless group showed a significantly higher implant stability than the flap. Jeong et al. [30] conducted a study on dogs and reported that flapless implant surgery increases the vascularity of per implant mucosa and, therefore, increases the initial stability of an implant in comparison to implant placed after reflection of the mucoperiosteal flap. In summary, after placing immediate implants and filling the remaining gap with an organic bovine bone, the flapless groups showed less reduction in height and width.

CONCLUSION

In summary, the flap less group has shown a lower reduction in height and width after placing immediate implants and filling the residual gap with an organic bovine bone.

More ridge reduction was observed for the flap group.

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