



Evaluation of Crestal Bone Resorption around Dental Implants In Flapped and Flapless Surgical Techniques Depending on Cone Beam CT Scan (Comparative Study)

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Abstract

Background: The long term survival of dental implants is evaluated by the amount of crestal bone loss around the implants. Some initial loss of bone around dental implants is generally expected. There is reason to believe that reflecting a mucoperiosteal flap promotes crestal bone loss in the initial phase after an implant has been inserted. The surgical placement of a dental implant fixture is constantly changing and in recent years, there has been some interest in developing techniques that minimize the invasive nature of the procedure, with flapless implant surgery being advocated. The purpose of this study was to compare the radiographic level of the peri- implant bone after implant placement between traditional flapped surgery and flapless approach depending on CBCT during 24 weeks healing period. **Materials and Methods:** A total of 25 Iraqi patients with 46 implants aged 20-60 years .Were randomized into two groups: control group which involved 27 implants inserted by conventional flapped surgical approach and study group which involved 19 implants inserted by flapless surgical approach. The bone level was measured by CBCT for each implant at buccal and palata/ lingual sides at two times, immediately after implant placement (base line data), and after 24 weeks healing period. **Results:** There was no significant difference between study (flapless) and control (flapped) groups in the mean of total crestal bone resorption for buccal and palatal sides. **Conclusions:** Bone resorption around dental implants placed with conventional flap surgery compared to flapless surgery does not seem to be influenced during the healing period before implant loading.

Introduction

Osseo integrated dental implants are usually placed with a flap approach, which is based on soft tissue flap reflection and repositioning with suture after implant placement. This traditional approach has several drawbacks: decreased supraperiosteal blood supply due to flap elevation procedures, which can theoretically lead to bone loss; patient discomfort, which includes pain, bleeding, edema, and a longer surgical time [1, 2]. The objective of modern implant treatment involves not only the successful osseointegration of the dental implant but furthermore an esthetic and functional restoration.

This implant required to be surrounded by stable peri-implant tissue levels that are in harmony with the existing dentition. Stable bone levels at or close to the implant margin (shoulder) are among the factors used to consider implant treatment successful [3, 4].

Successful prosthetic reconstruction by dental implant mainly depends on the preservation of peri-implant bone [5, 6]. In recent years, flapless surgery is increasingly becoming a routine clinical procedure, and has been reported to have a predictable outcome with high success rate. This is facilitated by modern radiographic technologies and dental implant treatment planning software to perform three-dimensional evaluation of bone volume at anticipated implant sites [7]. Flapless surgery has several theoretical advantages. From a patient point of view, it shortens the surgical time, decreases discomfort by reducing swelling and pain and accelerates post-surgical healing.

Moreover, the blood vessels of hard and soft tissues around the implant site are preserved. Some studies state that this less traumatic surgery implies reduced bone resorption [8].

Nevertheless, flapless surgery harbors some risks due to the limitations of exposure in the surgical site. A reported risk is buccal or lingual cortical plate perforation. Therefore, the technique requires advanced clinical experience, and surgical judgement for appropriate case selection (patients with sufficient alveolar three dimensional bones and adequate keratinized gingiva) [9].

Several studies report on bone resorption and ridge alterations after implant placement in humans [10] and animals [11, 12]. Many studies in animals assess that leaving the periosteum in place with flapless implant surgery clearly decreases the bony resorption rate [13, 14], and according to some authors, the flapless procedure is superior to flap implant procedures for maintaining original mucosal shape surrounding implants [15].

Therefore, it can be speculated that similar events may occur in humans after implant surgery. Imaging may aid in evaluating implant therapy outcomes, such as peri implant bone defects and level and bone to implant interface [16, 17]. Radiographic evaluations of the peri implant tissues only at mesial and distal aspects of the implant. This may lead to an underestimation of bone due to poor radiographic visibility of the marginal bone crest on the buccal and lingual aspects of the implants.

Recently, cone beam computed tomography (CBCT) has been heavily marketed for implant-based oral rehabilitation procedures, mainly for treatment planning [18]. Nevertheless, some studies have used the method for assessment of the marginal peri-implant bone level and thickness, primarily of the buccal bone, and outcome of regenerative procedures [19, 20, 21].

Materials and Methods

This clinical prospective study was conducted from December 2017 to November 2018; a total of 25 Iraqi patients with 47 implants aged 20-60 years. (One implant in the control group failed so it is excluded from the statistical analysis except in the analysis of survival and failure rates).

Were randomized into two groups: control group which involved 27 implants inserted by conventional flapped surgical approach and study group which involved 19 implants inserted by flapless surgical approach.

Preoperative clinical and radiographic assessments were done for all patients and estimation of alveolar bone was done for study group by bone (ridge) mapping procedure. One implant system was utilized in the study (Nucleoss Co., Turkey).

Inclusion Criteria

- Only those patients who did not need any soft or hard tissue augmentation.
- A minimum distance of 2 mm to adjacent anatomical structures (mandibular canal, maxillary sinus, mental foramen, and adjacent teeth).
- Implants to be placed at least 6 months after teeth extraction (healed sites).
- The Presence of attached non-mobile soft tissue at least 1.5 mm in thickness above the crest of bone in the area receiving the implant, as measured by reamer and stopper.
- The presence of adequate bone width at least 5 mm, 3 mm apical to crest measured by bone caliper after measurement of soft tissue above the crest, precluding the need for bone augmentation procedures.
- Patients had to be at least 18 years of age.
- Patients with good oral hygiene.

Exclusion Criteria

- Insufficient keratinized tissue above the implant site (less than 2 mm above the ridge crest).
- Insufficient bone width (less than 5 mm, 3 mm apical to crest).
- Presence of any pathological condition adjacent to proposed implant site or at the implant zone.
- Any medical conditions that could not withstand implant surgery or conditions that would interfere with normal healing mechanism including uncontrolled diabetes, osteoporosis, psychosis, current pregnancy at the time of surgical procedures.
- Heavy smokers (more than 20 cigarette per day)
- Head and neck radiotherapy or chemotherapy over the past 5 years.

- History or clinical evidence of para-functional habits such as bruxism and clenching.
- Patients with periodontitis.
- Any dehiscence or fenestration of alveolar bone happened during the operation of implant placement.

Surgical Procedures

Flap Procedure (Control Group)

Anaesthetization of the planned surgical field with Lidocaine 2% by infiltration technique then three sided flap (extensive flap design) or two sided flap was made initiated via paracrestal incision with palatal bias for better visibility, preserving a wider band of keratinized attached gingiva for more solid wound closure and avoiding wound dehiscence. Full thickness mucoperiosteal flap reflection to expose crestal and buccal alveolar bone using Haworth periosteal elevator. The implant bed was prepared by the conventional drilling procedure. The predetermined DI size installed in its position, followed by subjoining the cover screw into the fixture. Bone closure achieved with 3/0 black silk non absorbable suture (simple interrupted technique).

Flapless Procedure (Study Group)

Anaesthetization of the planned surgical field with Lidocaine 2% by infiltration technique, the surgical stent was rubbed by antiseptic alcohol and was placed in the mouth, the hole in it help in determining the point in which the punch cut by localizing it with pilot drill before using the punch. This step was followed by using the tissue punch with speed 400-600 rpm to remove the soft tissue and expose the bone in which the implant to be driven in. The drilling procedure was started by pilot drill, and then the parallelism and angulation of drilling holes checked with the aid of parallel pins. Followed by sequential stepped drilling until reaching the appropriate final drill size according to manufacturer instructions.

The thickness of mucosa that was measured at the beginning of procedure should be added to the length of the drill to avoid merging of the margin of the implant above the bone level. The predetermined DI size installed in its position and the margin of implant checked by periodontal probe to ensure that it was with the level of the

surrounding bone followed by subjoining the cover screw into the fixture. Then single 3/0 black silk suture was used for just to preserve blood clot above the implant area. After six months the patients re-attended for second stage surgery and placement of healing abutments for about (10-14) days, then the patients were referred for prosthesis fabrication.

Data Collection and Post-operative Radiological Assessment

All patients in both surgical groups were informed to taking CBCT (time 1) in the same day or at the second day of surgery to assess the position of the implants within the bone (especially for implants placed with flapless procedure as this technique is blind), the relation of the implant/s to the other dentition, vital structures and the relation of the implant to the crestal bone level in 3 planes. Data were collected first at the seventh day after surgery (first follow up) when patients were attended for suture removal and checkup they brought CBCT.

Determination of bone level immediately that represents as base line data was done for each implant in both group on two sides, buccal side and palata/lingual side, in first a vertical line was drawn at the center with the long axis of the dental implant passing through the notch of the cover screw which represent a reference point, then another horizontal line was drawn at the top of implant to determine its level with the crestal bone, also another two vertical lines along the buccal and palatal/lingual sides of implant were drawn where from these lines about 1mm the bone level was measured on each side in implants placed in posterior area when the bone thickness was enough, or about 0.5 mm in implants placed in anterior region, Fig. (1 A).

All the patients were investigated by CBCT (time 2) after 24 weeks post-operatively to assess the DI with same relations of (time 1), also assessment of osseointegration, survival & early failure rate with the aid of Alberkton criteria of success (implant immobility, no peri-implant radiolucency, asymptomatic), and checking for any complication that may occurred. Determination of crestal bone level after 24 weeks done with the same route at same positions of first follow up for each implant, any difference will be measured, both

relations (the first one immediately after implant placement and the second one after six months) will be compared and the difference will be calculated which represents bone loss that showed as a shadow in the

area, Fig. (1 B).In order to view the same section in the CBCT & to avoid any errors that may affect the result in reading the section, the notch of the cover screw is used as a reference point.

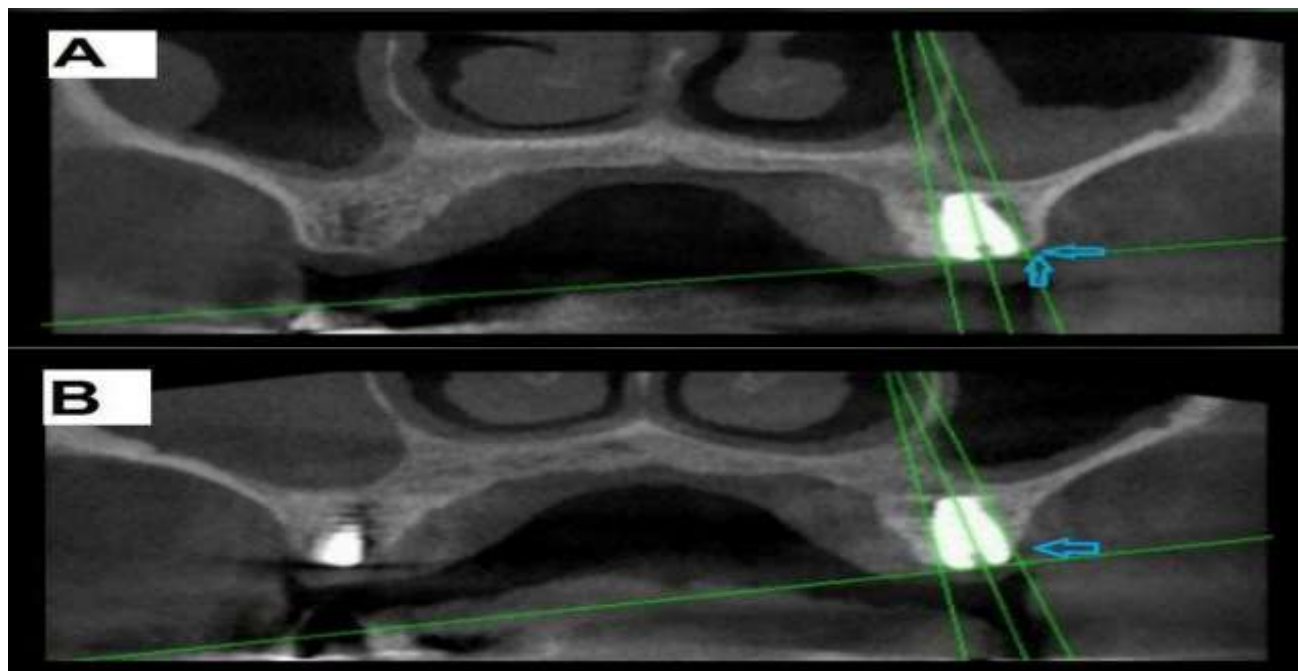


Figure 1: CBCT (oblique view) for the same posterior DI placed with flapped procedure. (A) Immediate post-operative CBCT illustrating the buccal side bone level of DI (arrows) in relation to the horizontal line. (B) 24 weeks post-operative CBCT illustrating the difference in bone level (arrow) that presented as shadow

Table 1: Comparison according to total mean bone loss in buccal and palatal sides between two surgical groups

Sides	Total Bone Loss in Surgical Groups		P- Value
	Flapped Group Mean ± SD	Flapless Group Mean ± SD	
Buccal Side	0.5 ± 0.43	0.39 ± 0.35	0.393
Palatal Side	0.13 ± 0.18	0.06 ± 0.14	0.214

Values are expressed in mean ± SD

Table 2: Comparison between Total Resorption of Buccal and Palatal sides

Group	Total Bone loss of Buccal and Palatal Sides		P- Value
	Buccal side Mean ± SD	Palatal side Mean ± SD	
Flapped group	0.5 ± 0.43	0.13 ± 0.18	0.001
Flapless group	0.39± 0.35	0.06 ± 0.14	0.001

Values are expressed in mean ± SD

Results

There was no significant difference between study (flapless) and control (flapped) groups in the mean of total crestal bone resorption for buccal and palatal sides after 24 weeks from implant placement (P= 0.393 for buccal side and P= 0.214 for palatal side), Table (1). There was highly significant differences between buccal and palatal sides regarding crestal bone loss around implants measured by CBCT after 24 weeks from implants placement for both flapped and flapless surgical techniques (P = 0.001), Table (2).

Discussion

According to our data flapless surgery cannot fully avoid bone resorption this was true with all implants placed by flapless technique in this study as they were evaluated by CBCT. This agree with a study done by Nickenig et al [22]. They found that mean crestal bone loss of (0. 5 mm) for implants placed with flapless surgery after a healing period determined radiographically using digital panoramic radiographs. So it possible to say that gentle flap raising does not hamper bone healing around dental implants in humans.

Based on the results obtained from this study, the choice of type of surgical approach does not affect peri-implant bone resorption. According to this study the measurement and evaluation were taken place before implants loading, so we can expect that significant difference between the two surgical techniques may occurs after implants loading and function. Our data on bone resorption are in line with the majority of data in the literature Lin et al [23]. That reported no significant reduction of marginal bone resorption with flapless technique.

Interestingly, also studies showed that crestal bone loss was comparable among implants placed either using flapped or flapless surgical technique [24, 25]. The findings of this study disagree with Tsoukaki et al [8]. Who reported that no bone resorption around flapless implants and [26] who reported a significantly lower resorption around implants in flapless group. According to this study findings, there was significant difference between total mean of buccal and palatal aspects ($P = 0.001$) for both flapped and flapless group. There was obvious that bone resorption in buccal side much more than palatal / lingual side in both groups.

Also bone resorption in buccal side was a little higher in maxilla than mandible and anteriorly more than posteriorly for the flapped group, while for flapless group was nearly the same?

The data from this study can be accounted for the following reasons:

- According to anterior maxilla the bone loss in buccal/facial side was higher than palatal side in both flapped and flapless groups, this may be related to the little thickness of the facial plate that leading to more bone resorption after implant placement. This was supported by EL Nahass & Naiem [27]. They reported that in the incisor region, the buccal bone plate around a tooth was thinner than 1 mm in 86% of the cases as demonstrated by Computerized tomography.

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- According to posterior maxilla and mandible in flapless group also the bone loss was higher in buccal side than palatal/lingual side, there was no clear interpretation for this result but after evaluation of the buccal plates for implants placed with flapless procedures, we noticed that most of them were thinner than palatal/lingual plates, this may be either they were initially thin or implant were deviated slightly towards buccal side during placement made them more thin. So it is, however noteworthy that thin buccal plates lost more bone than thick buccal plates. The deviation of implants supported by a study done by Van de Velde et al [28].

Performed an in vitro model study to analyze deviations in the position and inclination of implants placed with flapless surgery compared with the ideal, virtual planned position and they concluded that location of implants installed with a flapless approach differed significantly from the ideal position. The above two causes (1&2) were supported or in line with a hypothesis reported by [29, 30], stated that a thin buccal plate is less resistant to the different types of trauma an implant can endure and would therefore be more prone to resorption and buccal implant exposition.

According to posterior maxilla and mandible in flapped group the buccal bone loss was higher than palatal/lingual bone; this may be related to the flap elevation during surgical procedure on the buccal side and subsequent trauma that occurred more buccally rather than palatal/ lingual sides where there was no flap elevation. This was supported and in accordance with the fundamental studies reported by Merheb et al [30]. Stated that flap elevation lead to a bone resorption from the surgical trauma of up to 0.4 mm. Conclusions: Bone resorption around dental implants placed with conventional flap surgery compared to flapless surgery does not seem to be influenced during the healing period before implant loading. Bone resorption in buccal side facing dental implants compared to palatal side seems to be influenced in conventional flap and flapless surgery.

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