Buccal Bone Augmentation Around Immediate Implants With and Without Flap Elevation: A Modified Approach

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Purpose: *The aim of this study was to compare the clinical success and bone healing of implants placed in fresh extraction sockets using a flapless procedure compared to those placed with flap elevation.* ***Materials and Methods:*** *Twenty teeth in 20 patients were selected for this study and were scheduled for tooth extraction and immediate implant placement. Ten implants were placed with flap elevation (control group), and 10 implants were placed without flap elevation (test group). All the sites selected showed a complete bone defect at the facial wall. All the implants included in this study were 2-stage implants placed at the level of palatal/lingual bone in augmented bone. Each surgical site was protected with a collagen membrane and, subsequently, a standardized radiograph was taken to evaluate the distance between the implant shoulder and the first bone-implant contact (DIB). Six months after placement, both control and test implants underwent a second-stage surgery and a clinical examination to determine the implant stability quotient, DIB, and the distance between implant shoulder and the crestal bone at the midbuccal aspect (DIC).* ***Results:*** *One implant failed in the test group. Only 1 implant (test group) showed bone growth over the implant neck at the re-entry procedure. Implant stability quotient (ISQ) and DIB did not show any significant differences between the control and test group; however, a higher DIC was found in the test sites compared to the control sites.* ***Conclusion:*** *Data from this study showed that immediate implants with and without a mucoperiosteal flap elevation can be successfully used even in the presence of bone defects requiring augmentation procedures. It was also noted that the bone regenerated reached a higher coronal level in the group with flap elevation than in the group without flap elevation.* Int J Oral Maxillofac Implants 2008;23: 841–846

Key words: *biomaterial, bone defect, dental implants, extraction sockets, mucoperiosteal flap*

Implants placed in fresh extraction sockets have been shown to reduce not only morbidity rates in patients but also the total time between tooth removal and the final prosthetic restoration. Several clinical human studies have demonstrated high levels of success for implants (all of which were functional subsequent to restoration) placed in fresh extraction socket sites.[1–4] As recent studies have suggested,[5,6] the use of barrier membranes is not always necessary, especially for small bone defects such as small circumferential defects (not exceeding 2 mm) that have the potential to heal spontaneously. Schwartz-Arad and Chaushu[7] reported a successful clinical outcome for 9 single implants placed immediately after tooth extraction without the need for incisions and/or primary flap closure. Complete bone healing was achieved with minimal gingival recession and papilla preservation; the clinical cases with extensive bone loss were excluded from the study. Implant placement without mucoperiosteal flaps has been associated with high success rate and has shown several advantages such as a reduction in intraoperative bleeding and postoperative patient discomfort.[8,9] Bone resorption of varying degrees can occur subsequent to soft tissue flap reflection. This phenomenon can be prevented and/or reduced using a flapless implant procedure due to the reduction in surgical trauma and to the integrity of the blood vascular supply from the periosteum. In addition, excellent soft tissue healing

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and morphology have been observed around implants placed in fresh extraction sockets with a flapless surgical procedure.[10] These clinical results reduced the need for further mucogingival surgery at the time of prosthetic restoration.[10]

The aim of the present study was to evaluate the clinical performance and bone healing of implants placed in fresh extraction sockets with a flapless procedure compared to those placed using flap elevation.

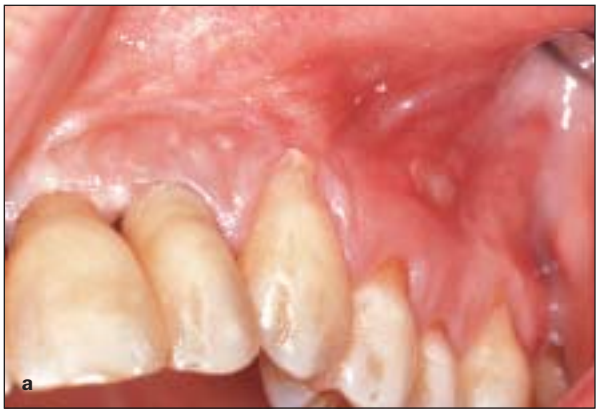
MATERIALS AND METHODS

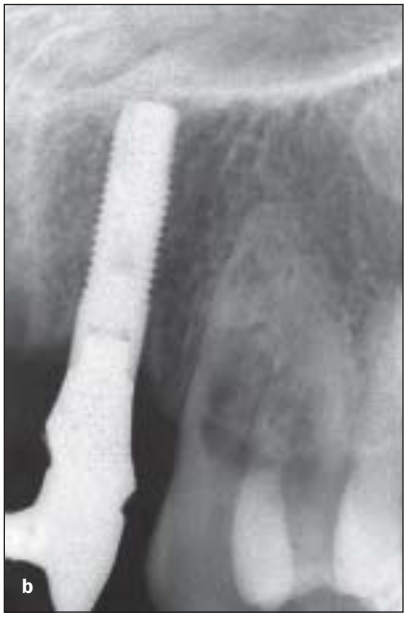
Twenty patients (8 male and 12 female) aged 30 to 67 years were included in the study. All the patients selected for this study required the extraction of a natural tooth and were scheduled for immediate implant replacement (Figs 1a and 1b). The criteria adopted for accepting patients into the study group were as follows: presence of a noncontributory past medical history that would inhibit a physiological wound healing response; indication for tooth extraction and presence of 3 mm of bone beyond the root apex to guarantee primary implant stability. Heavy smokers (more than 10 cigarettes per day) and multirooted teeth were excluded from this study. The patients had to sign an informed consent for treatment to enter the study. Each case was accurately evaluated with diagnostic casts to assess the interarch relationship, periapical and/or panoramic radiographs, and computerized tomography where necessary. Following these analyses, all the patients underwent scaling, root planing, and oral hygiene instructions and any periodontal treatment necessary to provide an oral environment more favorable to wound healing. Surgical procedures were performed under local anesthesia and in aseptic conditions. All the implants used for the study were submerged implants with a titanium plasma-sprayed coated surface (Premium, Sweden & Martina, Padova, Italy) and were placed by the same surgeon. The teeth were carefully removed and the sockets debrided; subsequently, a periodontal probe was used to explore and estimate the integrity of the residual bone walls (Fig 2). All the sites selected for this investigation showed a complete absence of bone at the facial wall, which required bone augmentation. The sites were assigned either to the control or test group according to a computer-generated randomization list. The sites in the control group received intrasulcular and vertical incisions to raise a mucoperiosteal flap that extended over the mucogingival junction. Subsequently, the implant sites were prepared using a standardized sequence of drills, and the implants were placed into the bone site at the planned depth. All the immediate implants in the control group were grafted with a mixture of collagen gel and corticocancellous porcine bone (Osteobiol; Tecnoss, Torino, Italy) and covered with bioabsorbable membranes (Osteobiol). Primary soft tissue closure was achieved on all control implants.

The sites in the test group did not receive any incision or flap elevation. The implant sites were prepared with standard drills using the bony walls as a guide. Thereafter, all the test sites were grafted by filling the residual alveolus with a mixture of collagen gel and corticocancellous porcine bone (Osteobiol) and subsequently placing the implants into the prepared sites. The surgical sites were protected at the level of gingival wound with a collagen membrane (Osteobiol); moreover, the soft tissue edges were sutured (Fig 3). Primary closure for soft tissues was not carried out for the test sites. The depth of preparation for all experimental implants (control and test groups) was planned in order to place the top of the implant at the palatal/lingual bone level. The implant placement according to tooth position is reported in Table 1. A standardized radiographic examination was obtained for each implant to evaluate the distance between the implant shoulder and the first bone-implant contact (DIB) mesially and distally, as described previously by other authors.[11] Briefly, a paralleling device (Rinn, Elgin, IL) and individualized bite blocks made of polyvinyl siloxane impression material (Flexitime; Heraeus/Kulzer, Hanau, Germany) were used for the standardization of the x-ray geometry.

Medications prescribed to all patients consisted of antibiotics (amoxicillin 500 mg QID for 4 days), antiinflammatory (nimesulide 100 mg BID for 3 days), and chlorhexidine mouthrinse (BID for 21 days). Removable prostheses were worn for the first 3 weeks only for esthetic reasons and thereafter for functional and esthetic reasons. Sutures were removed after 7 days, and the patients were seen as often as necessary to maintain clinical health during the healing phase. After at least 6 months of healing the surgical re-entry procedure was performed. Mucoperiosteal flaps were elevated to allow access to marginal portions of the implant sites (Figs 4 to 6) and the following clinical measurements were performed for all experimental implants:

- Presence or absence of mobility
- Presence or absence of suppuration
- Presence or absence of peri-implant bone defects at the palatal, mesial, and distal aspects
- Distance between implant shoulder and the crestal bone measured in mm at the midbuccal aspect (DIC)





Figs 1a and 1b Initial examination. *(a)* Clinical view and *(b)* periapical radiograph of a maxillary canine scheduled for extraction due to root caries.

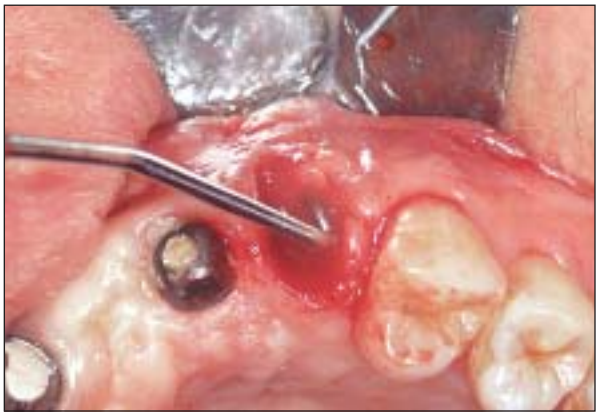


Fig 2 The fresh extraction site without flap elevation; a periodontal probe was used to estimate the integrity of the residual bone walls.

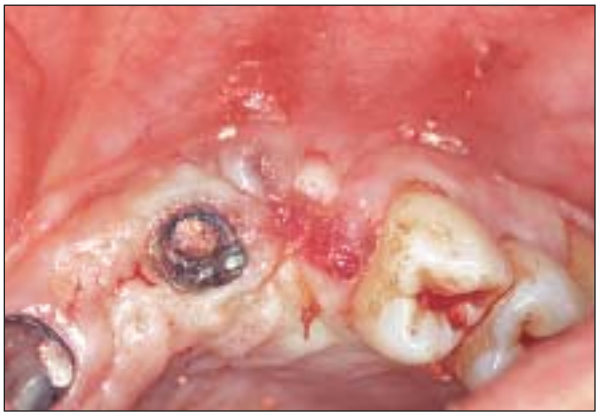


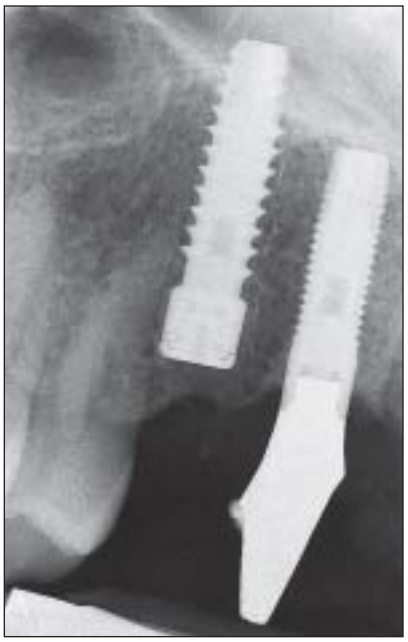
Fig 3 Suture after grafting procedure and implant placement.

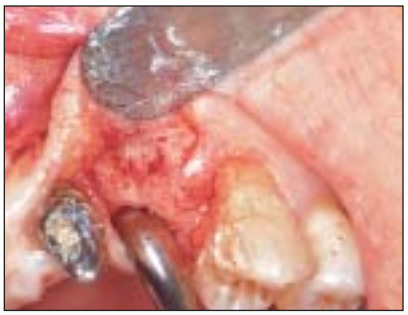
- Implant stability evaluated using the Osstell machine and expressed as an ISQ
- Radiographic examination in a standardized manner to evaluate changes for the DIB values

Upon completion, the surgical closure screws were removed and healing abutments were inserted on the implants. The flaps were then adapted and sutured to the implant healing abutments. An implant was only classified as successful when it fulfilled the criteria of success as defined of Buser et al.[12] Implant failure was defined as a mobile implant or an implant showing bone loss greater than one third of the total length, even if still immobile.

Table 1 Implant Location According to Tooth Position

	Incisor	Canine	Premolar	Total
Test				
Maxilla	1	2	3	6
Mandible	—	1	3	4
Control				
Maxilla	1	4	2	7
Mandible	—	—	3	3
Total	2	7	11	





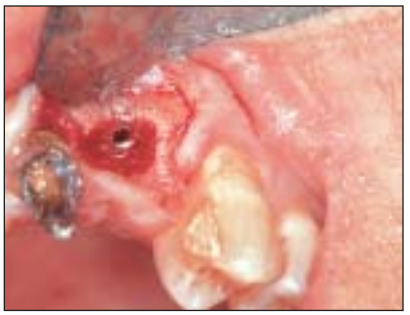


Fig 4 *(Left)* A periapical radiograph obtained 6 months after implant placement.

Fig 5 *(Center)* Second surgical stage. The neck of the implant was covered with regenerated bone.

Fig 6 *(Right)* Clinical view of the access to the surgical screw.

Statistical Analysis

Clinical measurements of the 20 implants were calculated per patient by averaging the clinical parameter for the implants per patient, since the intrasubject variation was much lower than the intersubject variation. Subsequently, the means and medians were calculated per patient.

Comparison between the 2 groups was performed with the independent Student *t* test (statistically significant at a level of $\alpha = .05$). The significance level was set at $P < .05$ with the Bonferroni adjustment for multiple comparisons.

RESULTS

Each of the 20 patients had 1 implant placed immediately after tooth extraction. All grafting procedures were successfully carried out as planned without any complications. The postsurgical healing phase was uneventful for all patients; pain and swelling were the most frequently mentioned signs and symptoms. Nineteen implants were successfully osseointegrated at the second surgical stage. Only 1 implant was considered to have failed to achieve osteointegration. This implant was considered a failure in the present study; however, the site later received a new implant which, subsequently, was functional after restoration.

No peri-implant bone defect was observed or probed around any of the successful implants at the second surgical stage.

The mean distance between implant shoulder and the crestal bone, measured 6 months after implant placement in mm at the midbuccal aspect (DIC), was 0.3 ± 0.4 mm in the control group and 0.8 ± 0.9 mm in the test group. The difference between the control and test groups was statistically significant, indicating a less predictable bone augmentation in the flapless group compared to the group where the flaps were elevated.

The neck of only 1 of the implants from the flapless (test) group was covered with regenerated bone at the re-entry phase (6 months after implant placement). It was necessary to use a chisel to access the surgical screw of the implant. The vertical distance between implant shoulder and buccal bone was assigned a value of 0.

Tables 2 and 3 show the ISQ and DIB values by group. Table 4 shows the DIB values at baseline and at 6 months after implant placement in the test and control groups. The ISQ and DIB measurements did not show any statistically significant differences between the control and test group.

DISCUSSION

This study evaluated the clinical success and bone healing at the second surgical stage in 2 groups of patients who received implants in fresh extraction sockets with and without flap elevation. All the implants included in this study required bone augmentation due to bone defects at the buccal wall. The augmentation procedures were performed with a mucoperiosteal flap (control sites) and without a flap (test sites). The purpose of choosing this experimental model was to analyze the bone healing process around postextraction implants requiring

Table 2 Mean Values and Standard Deviation of Clinical Measurements for 10 Implants in the Control Group 6 Months After Surgical Placement

Patient	DIC (mm)	ISQ	DIB (mm)
1	0	72	0.5
2	1	78	0
3	0	68	0
4	1	70	0.5
5	0	75	0
6	0	69	0.5
7	0	68	0
8	0	71	1
9	0	70	0
10	1	72	0
Mean (± SD)	0.3 (± 0.4)	71.3 (± 3.1)	0.25 (± 0.3)

DIC = distance between implant shoulder and the crestal bone at the midbuccal level; ISQ = implant stability quotient; DIB = distance between the implant shoulder and the first bone-implant contact evaluated using radiographs.

Table 3 Mean Values and Standard Deviation of Clinical Measurements for 10 Implants in the Test Group 6 Months After Surgical Placement

Patient	DIC (mm)	ISQ	DIB (mm)
1	2	67	0.5
2	1	70	0.5
3	0	73	0.5
4	1	65	0
5	Failed	Failed	Failed
6	2	72	1
7	0	73	0
8	0	65	0
9	0	74	0
10	2	77	0.5
Mean (± SD)	0.8 (± 0.9)	70.6 (± 4.2)	0.33 (± 0.3)

DIC = distance between implant shoulder and the crestal bone at the midbuccal level; ISQ = implant stability quotient; DIB = distance between the implant shoulder and the first bone-implant contact evaluated using radiographs.

bone regeneration procedures with and without the need for flap elevation. Findings from the present study demonstrated that the clinical success of implants placed in fresh extraction sockets did not show any significant difference between control and test groups. However, a higher DIC value was found in the test sites compared to the control sites, although no differences were observed in the ISQ or in the marginal bone loss.

Implant placement without mucoperiosteal flap elevation has not only been recognized as a successful procedure, but also as a procedure that reduces postoperative swelling and patient discomfort.[13] Soft tissue reflection to allow the implant placement is generally associated with some degree of bone resorption. This phenomenon may be caused by the micro-architecture of the crestal bone, which is not well vascularized. When soft tissues are elevated the blood supply to the bone is interrupted, predisposing the crestal (cortical) bone to resorption. In fact, it has been clearly demonstrated that mucoperiosteal flap elevation can stimulate a wound healing process along with the angiogenesis of the vascular plexus and the resorption of the alveolar bone.[14,15]

Several studies have shown that peri-implant marginal defects that occur following implant insertion after tooth extraction can have complete bone healing even if no guided bone regeneration procedures were applied. The peri-implant bone defects, which had complete bone healing without any augmentation procedure, were 4-wall socket sites with no fenestrations and dehiscence and with a discrepancy between the implant surface and surrounding bone walls lower than 2 mm.[2,5,16] There are hypotheses to suggest that the spontaneous bone healing in circumferential peri-implant bone defects was due to implant primary stability and to the integrity of the bone walls, which allowed clot maturation in a protected environment.

Table 4 Distance (mm) from Implant Shoulder and First Bone-Implant Contact for 20 Implants Placed in Fresh Extraction Sockets

	Baseline Mean (± SD)	6-mo evaluation Mean (± SD)
Control group (10 implants)	0.20 (± 0.2)	0.25 (± 0.3)
Test group (10 implants)	0.25 (± 0.3)	0.33 (± 0.3)

Moreover, other authors have reported that osseointegration and favorable percentages of bone-implant contact can be achieved not only in horizontal defect dimensions measuring lower than 2 mm but even in defects greater than 4 mm.[17] The authors suggested that the results, which were observed for postextraction implants, may have been the effect of the use of a collagen membrane (which completely covered the implant) and of the implant surface (SLA).[17] More recently, some authors in a study with 21 implants inserted in fresh extraction sites have demonstrated that horizontal bone defects greater than 3 mm can completely heal after 4 months. These results appeared to be similar to those obtained in more narrow gaps.[18]

The present study showed that implants placed immediately after tooth extraction with vertical bone defects can be successfully treated either with or without flap elevation. Most of the studies in which a bone remodeling pattern was observed after tooth extraction and implant placement considered a flap elevation procedure in animal as well as human models.[5,19,20] On this basis, it must be considered that surgical trauma due to flap elevation can cause a wound healing response which in turn induces alveolar bone resorption in the exposed area. These considerations supported the adoption of a flapless procedure in order to reduce patient discomfort; avoid dimensional alteration of the alveolar crest eventually related to flap elevation; and obtain a better quality of the soft tissue around postextraction implants, thus reducing the need for further mucogingival surgery at the re-entry procedure.

Further clinical reports and follow-up examinations are needed to support the findings in this study before this new technique can eventually be adopted into daily implant practice.

CONCLUSION

This study showed that implants placed in fresh extraction sockets with and without mucoperiosteal flap elevation can be successfully used even with a complete absence of facial bone, which required augmentation procedures. Moreover, it should be noted that the buccal bone showed a higher level in the group with flap elevation than in the group without flap elevation. These findings suggested more favorable outcomes in terms of regenerated bone for the flap elevation group.

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