

Influence of flap elevation during immediate implant placement on peri-implant bone remodeling

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Abstract / Objective: The aim of this study was to assess the influence of surgical flaps over bone formation around implants. **Methods:** Seven mongrel dogs had four mandibular pre-molars extracted and four immediate implants placed. The experimental groups were divided into G1 (flapless) and G2 (full-thickness flap), totaling 14 implants in each group. After four months, samples were collected and histomorphometric analysis was carried out with a view to assessing buccal bone-to-implant contact (BIC), total BIC, buccal area, and total area of all implants. For intergroup statistical analysis, Mann-Whitney test was applied ($p < 0.05$). **Results:** The group comprising implants without flap elevation had better BIC rates, both buccal and total BIC, than the flap elevation group. Additionally, data yielded better results in favor of the group without flap, which was statistically significant, particularly with regard to bone formation on the buccal surface of implants. **Conclusion:** The flapless surgical technique produces favorable effects on bone formation around implants. **Keywords:** Osseointegration. Surgical flap. Dental implants.

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INTRODUCTION

The traditional approach to implant placement involves mucoperiosteal flap elevation for access and view of underlying alveolar bone. Alternatively, flapless technique can be used to simplify the surgical procedure in certain scenarios.¹

Immediate implants have been discussed in the literature as better treatment options when compared to delayed implants, mainly due to reduced total treatment time, reduced number of surgical procedures, increased bone preservation, maintenance of socket architecture, and, consequently, maintenance of peri-implant soft tissue esthetics.² A study of dogs that included four treatment modalities for analysis of volumetric changes of the post extraction socket reports that, in groups without flap elevation, significantly lower resorption rates were obtained.⁵

Promising results have been reported in a range of clinical studies extolling flapless surgery.^{3,6-10} These studies provide evidence that a flapless approach can offer additional advantages over traditional protocols with flap, and should be used in daily clinical practice. Studies discuss mucoperiosteal flap elevation which can also be related to increased resorption rates of alveolar crest and consequent loss of osseointegration and bone-implant contact (BIC) in the cervical region of implants.²

Another factor to consider is buccal wall thickness, since the thicker it is,

the smaller the chances of bone-to-implant contact loss. To prevent such a loss, bone plate requires approximately 2 mm thickness¹¹, but research shows that 87% of cases have thickness not exceeding or being equal to 1 mm in the buccal surface of the anterior region.¹²

Thus, the present study aims to determine the influence of mucoperiosteal flap elevation on bone remodeling around implants.

MATERIAL AND METHODS

This study was approved by Universidade de São Paulo, School of Dentistry (Bauru) Institutional Review Board under protocol #14/2006.

Seven adult mongrel dogs, weighing approximately 20 kg and in overall good health, were selected. This number of animals was based on statistical calculation for group formation. From the time of tooth extraction, two groups were formed according to the surgical procedure: with and without flap elevation. In group 1, implants were placed immediately after extraction, flapless and by means of the palatal approach. Similarly, in group 2, implants were placed immediately after extraction; however, with full-thickness flap elevation.

Before the aforementioned procedures were carried out, the dogs were submitted to an association of drugs for sedation, unconsciousness and analgesia. The animals received an intramuscular dose of antibiotics (Pentabiotic, Fort

Dodge-Pfizer[®], Campinas, SP, Brazil) before surgery and during five more days. Sedation was performed with 0.2% injectable acepromazine (0.2% Acepran, Univet[®], São Paulo, SP, Brazil) at a dose of 0.1 to 0.2 mg / kg body weight. Anesthesia was also performed intramuscularly, with injectable xylazine (Anasedan, Vetbrands Ltda[®], Brazil) at a dose of 0.1 mL / kg, and ketamine (Dopalen, Vetbrands Ltda[®], Brazil) at a dose of 0.06 mL / kg. In addition, local anesthetics were also used (lidocaine 1: 100,000 epinephrine, DFL[®], Rio de Janeiro, RJ, Brazil) to supplement the anesthetic effects.

below the alveolar crest and leaving a 2-mm gap between the implant surface and the buccal wall (Figs 2A and B). Thus, each animal received two implants placed by means of the flapless technique and two implants placed with flap elevation.

A total of 28 Morse Taper implants (Neodent[®] Titamax / EX 3.75 x 11 mm) were placed and divided into group 1 (flapless) and group 2 (flap). Immediate implant loading technique was performed with abutments 4.1 mm in diameter and a protective cylinder.

Four months after surgery, the dogs were euthanized by an injection of 19% potassium chloride (1 mL / 5 kg) and had their jaws sectioned, fixed and embedded in historesin for histomorphometric analysis. Specimens were sectioned (150-300 µm) along the longitudinal axis with a system of stainless steel diamond discs known as Precise 1 Automated System (Assing[®], Rome, Italy). Subsequently, the sheets were refined again by the Exakt system until 80-µm cuts were obtained. Final samples were stained with toluidine blue and acid fuchsin.

Analysis (Figs 1 and 2) was carried out by means of clear field microscopy and images were evaluated by AxionVision 4.8.3 software (Zeiss, Germany). One calibrated evaluator assessed buccal BIC, lingual BIC, total BIC, buccal area and lingual area. For measurement taking, an area limited to 150 µm

During healing, the animals received anti-inflammatory and analgesic drugs (Banamine Pet, Schering-Plough[®], São Paulo, SP, Brazil) (1 mg / kg) for the first three days, and were periodically evaluated once a week.

Experimental groups were randomly determined during surgery, given that two mandibular pre-molars were extracted by flap elevation while two other were extracted with no flap elevation. The procedure started with an intrasulcular incision, followed by odontosection buccolingually. This allowed roots to be removed separately with the aid of a forceps, the most atraumatic way possible.

Surgical site drilling was performed as recommended by the manufacturer. Implant anchorage was performed by means of the palatal approach technique, positioning the implant 2 mm

buccally and lingually as from the implant platform was determined. Similarly, BIC measurements were taken from the implant platform to its apex.

For intergroup statistical analysis, Mann-Whitney test (Statistica 6.0) was applied. Statistically significant differences were accepted as for $p < 0.05$.

RESULTS

Table 1 discloses the results yielded by descriptive statistical analysis in relation to total BIC percentage. It reveals a considerable advantage for the flapless

group, with a difference of 10 percentage points in bone-to-implant contact between flapless (45% BIC) and flap (35% BIC) groups. To validate this hypothesis, intergroup statistical analysis was carried out by Kruskal-Wallis test in Statistica 6.0 software.

A box plot chart (Fig 3) shows that although standard deviation presents BIC values of the flap group (G2), in which some samples are similar or even exceed the values obtained by some samples in the flapless group (G1), standard error, which determines

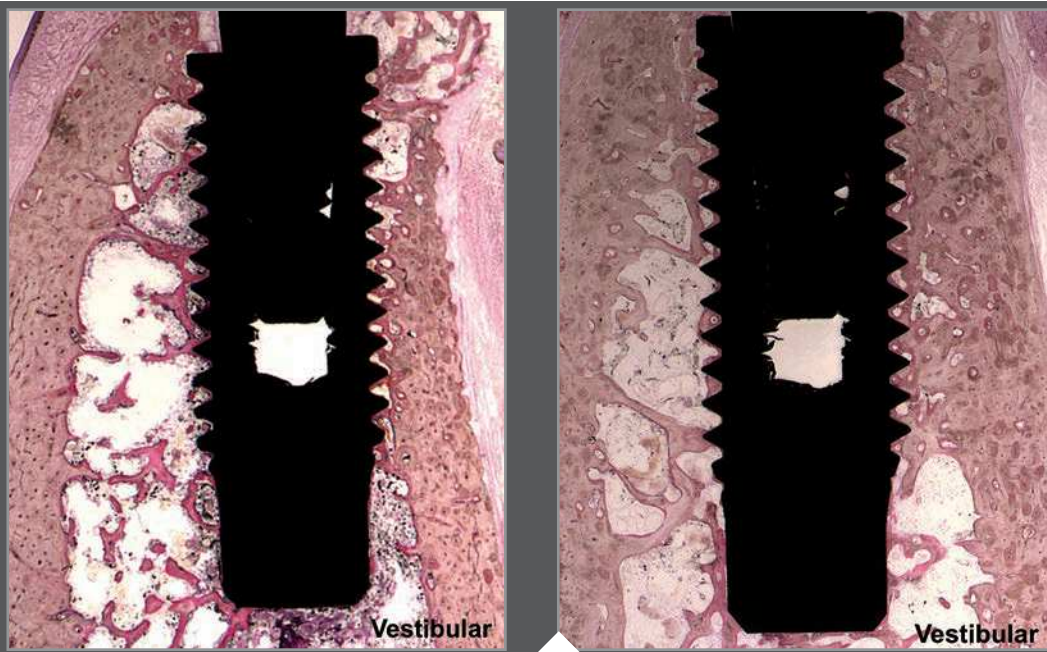


Figure 1. Histological slide of implant placed with flap elevation. Note bone remodeling and lack of osseointegration in the cervical buccal bone wall where flap elevation was performed.

Figure 2. Histological slide of implant placed without flap elevation. Note excellent bone formation as from the implant platform and filling of threads with new bone, since this buccal region was a gap area.

statistical significance, is presented separately. That is, as observed in Figure 3, standard error for the flapless group (43-47%) is higher than that of the flap group (33-48%), which leads us to affirm that total BIC percentage is greater when flap is preserved.

Since the major goal of the present study is to assess buccal bone wall remodeling, BIC was also analyzed separately and in μm on the buccal surface, only (Fig 4). As observed for total BIC, this assessment followed the same pattern of results, with the standard error

Table 1. BIC percentage per implant in G1 (flapless) and G2 (flap). Note the greatest percentage of osseointegration for G1.

BIC PERCENTAGE (%)		
	G1 - FLAPLESS	G2 - FLAP
Implant 1	43	21
Implant 2	34	26
Implant 3	44	38
Implant 4	39	27
Implant 5	50	52
Implant 6	55	31
Implant 7	42	34
Implant 8	55	26
Implant 9	43	34
Implant 10	45	43
Implant 11	37	35
Implant 12	40	42
Implant 13	58	39
Implant 14	50	46
Total (%)	45	35

of the flapless group ranging between 820 and 740 μm , while the flap group had lower values ranging between 480 and 560 μm . Results proved even more impressive and statistically significant, suggesting greater osseointegration on the buccal surface when flap elevation is not performed.

As for bone formation around implants, despite standard deviation values being quite high, once again group 1 (flapless) showed increased bone neoformation in the gap area (1510 to 1600 μm^2) when compared to group 2 (1420 to 1450 μm^2), with statistically higher values in the buccal surface (Fig 5).

DISCUSSION

Flapless implant placement has numerous advantages, such as reduced surgical time, maintenance of soft and hard tissues, decreased postoperative bleeding, faster recovery and greater patient comfort. Furthermore, the maintenance of the periosteum may contribute to better peri-implant healing.¹³

It is known that the periosteum plays an important role in wound healing, since periosteal cells are committed to become cells that actively participate in bone formation.¹⁴ In 1969, a study in rat calvaria showed that new bone deposition occurred by intact periosteum cells and not by periosteal cells that

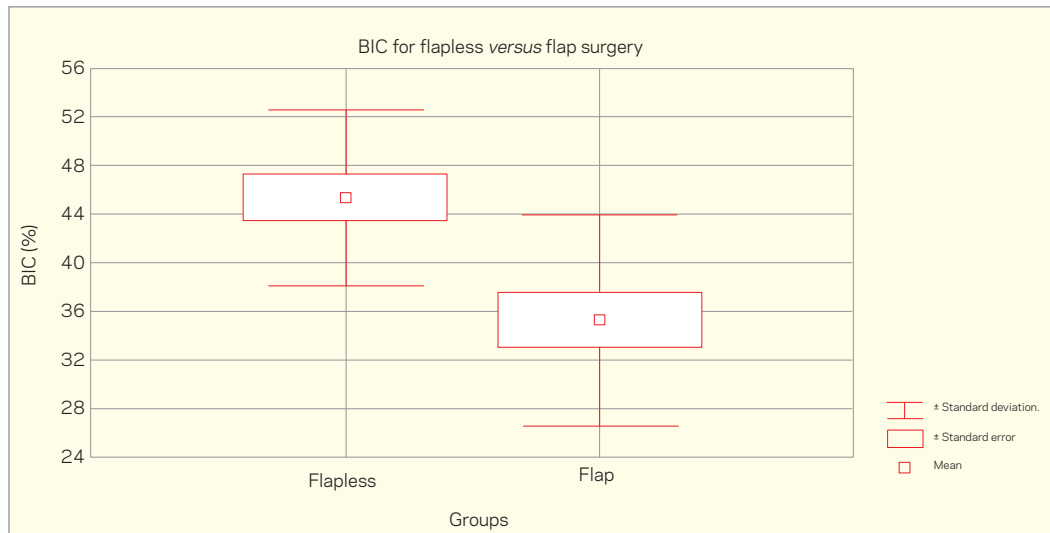


Figure 3. Comparative chart for BIC in flap and flapless surgery.

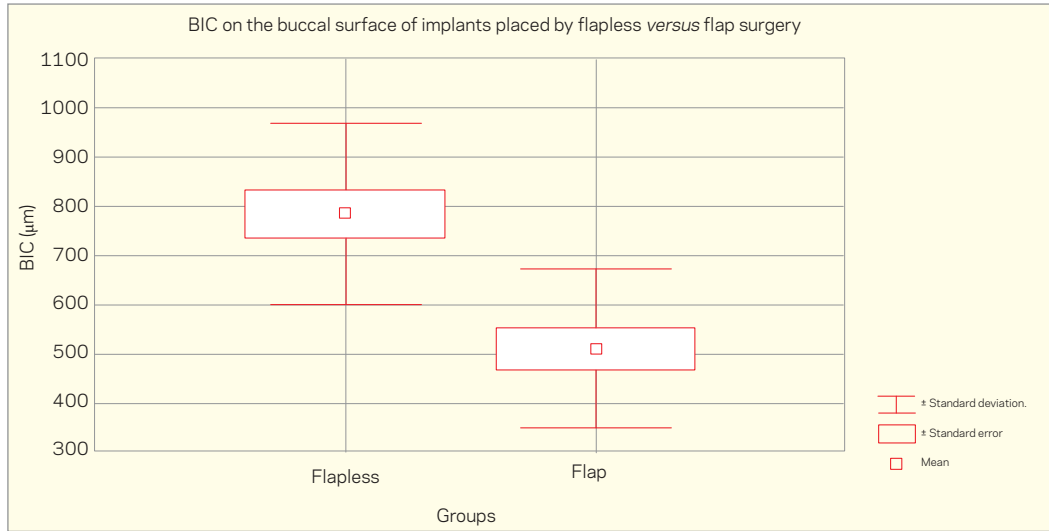


Figure 4. Comparative chart for BIC on the buccal surface of implants placed by flapless versus flap surgery

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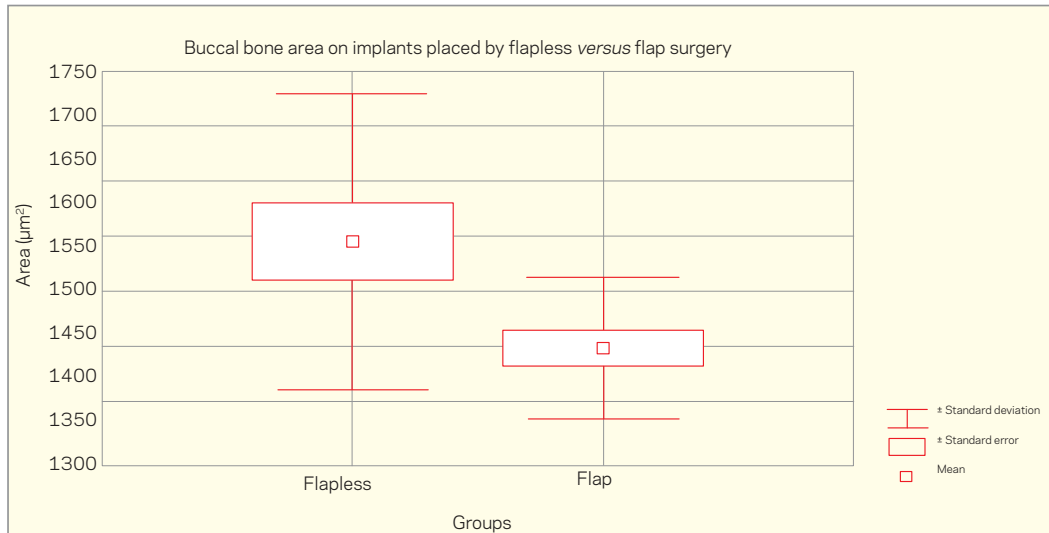


Figure 5. Comparative chart for buccal bone area on implants placed by flapless versus flap surgery

had been elevated and repositioned. This study shows that intact periosteum cells gave rise to osteoblasts that established relatively small amounts of bone callus, which is utterly important for bone formation in the buccal gap.¹⁵ Although most of the research comparing flapless *versus* flap surgery suggests no statistical difference in BIC and bone remodeling,^{2,3} many authors are adamant about the fact that maintenance of the periosteum decreases alveolar resorption rates.^{5,16} The findings yielded by the present study corroborate these existing statements,^{5,16} since group 1 (flapless) had total BIC statistically greater than group 2 (flap).

A previous meta-analysis reveals that there is no statistical difference between flap and flapless implant placement surgeries, regardless of the type of study analyzed. This reveals that flapless surgery apparently has no influence on bone remodeling.¹ Conversely, two clinical studies with three and four-year follow-ups, respectively, report a reduction in marginal bone resorption after flapless surgery.^{17,18}

Nevertheless, the present research found greater remodeling in the buccal bone wall when flap elevation was performed. Group 1 was statistically superior in terms of BIC and buccal bone area of implants when compared to group 2. Conversely, on the lingual surface, both groups yielded similar results, which might be attributed to the fact that buccal wall is thinner and, therefore, normally presents with a greater resorption rate than the lingual wall. Thus, preserving the periosteum seems to have positively influenced this result.

Another factor associated with remodeling is peri-implant esthetics, that is, the impact of bone remodeling on soft tissues. A retrospective study conducted with 85 patients undergoing immediate implant placement in maxillary central and lateral incisors region without flap elevation concluded that implant immediately placed without flap elevation can be associated with visually perceptible marginal mucosal recession.¹⁹ On the other hand, a study conducted with dogs reported that clinical evaluation performed three months after healing revealed less gingival recession in

patients who underwent flapless surgery, with significant differences when compared to full-thickness flap elevation.³

A previous clinical study found no changes in the soft tissue profile of patients undergoing dental implant placement by means of the flapless technique. The study suggests this technique is better than flap surgery, particularly for maintenance of the original peri-implant mucosa, encouraging the use of this technique especially in esthetic regions.²⁰ Nevertheless, disadvantages and/or limitations are also present, although the authors always indicate prior planning based on CT scans, which allows visualization of patient's anatomy and its real dimensions. Trans-surgical bone fenestration may be missed by flapless surgery; however, it can be prevented not only by immediate implant placement performed by means of the palatal approach, but also based on professional experience: should the clinician not feel safe, he should always hold the flap and perform the conventionally technique.

CONCLUSION

Thus, it is concluded that flapless immediate implant placement provides higher BIC and bone formation rates when compared to full-thickness flap procedures.

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