Effects of Flapless Implant Surgery on Soft Tissue Profiles: A Prospective Clinical Study

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ABSTRACT

Background: Flapless implant surgery has been suggested as a suitable treatment modality for the preservation of soft tissue after implant placement.

Purpose: The purpose of this study was to determine the extent of soft tissue profile changes around implants after flapless implant surgery.

Materials and Methods: A total of 44 patients received 76 implants using a flapless implant procedure. The marginal level of the peri-implant soft tissue was evaluated using dental casts 1 week, 1 month, and 4 months after implant placement.

Results: The mean soft tissue levels around implants showed 0.7 ± 0.3 mm of coronal growth 1 week after surgery. At 1 month, the levels were 0.2 ± 0.2 mm coronal growth and at 4 months, the values were 0.0 ± 0.3 mm. Soft tissue profiles assessed 4 months after flapless implant placement were similar to profiles assessed immediately before implant placement.

Conclusion: Flapless implant surgery is advantageous for preserving mucosal form surrounding dental implants.

KEY WORDS: dental implant, flapless, minimal invasive, peri-implant tissue

INTRODUCTION

Within the context of rapid advances in dental implant therapeutics, current trends are geared toward enhancing esthetics and patient satisfaction. Papilla preservation and predictable soft tissue margins around dental implants are major esthetic concerns, particularly for patients who have high smile lines.[1,2] Postsurgical soft tissue loss can result from flap reflection,[3] implying that flap surgery for implant placement may negatively influence implant esthetic outcomes.

Flapless surgery for implant placement has been gaining popularity among implant surgeons, facilitated by modern radiographic technologies and dental implant treatment planning software that allow clinicians to perform three-dimensional evaluation of potential implant sites.[4–7] Flapless implant surgery has been suggested as a treatment modality to preserve soft tissue.[8–10] Although there have been several reports on clinical outcomes of flapless implant surgery,[11–13] limited controlled data are available to evaluate soft tissue profiles. Therefore, the purpose of this study was to examine soft tissue profile changes around implants after flapless implant surgery.

MATERIALS AND METHODS

Forty-four consecutive patients (24 men and 20 women; age 24–65 years [mean 54 years]) requiring implant placements in partially edentulous jaws were enrolled in this study. All patients were treated at the same Korean university clinic. A total of 20 Astra implants (Astra Tech, Taastrup, Denmark) and 56 Osstem implants (Osstem Implant Co., Seoul, Korea) were inserted in the 44 patients. Twenty implants were inserted in the maxilla and 56 in the mandible. Patients with a history of diabetes or any other debilitating systemic disease, as well as those requiring ridge augmentation with barrier

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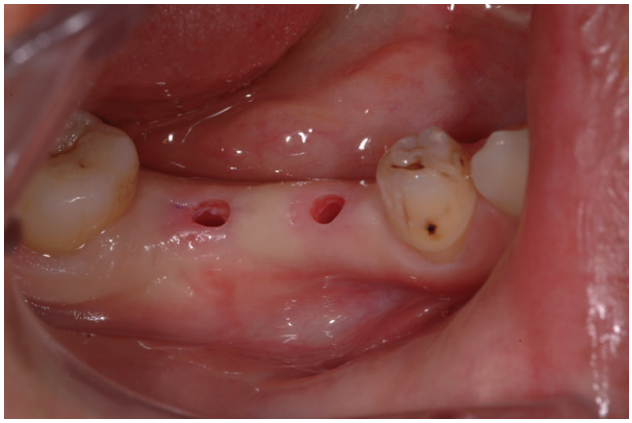

Figure 1 Clinical features after punching the soft tissue at the proposed implant sites with a 3-mm soft tissue punch.

membranes, sinus grafting procedures, or allogenic bone grafting, were excluded from the study. All patients underwent flapless implant surgery.

Surgical Procedure

Before surgery, alginate impressions and cast fabrications were carried out for all patients. Under local anesthesia with 2% lidocaine (1:100,000 epinephrine), the soft tissue of the proposed implant site was punched with a 3-mm soft tissue punch (Figure 1). Prior to drilling, soft tissue thickness was measured at the implant site using a periodontal probe. Implant osteotomy and placement were performed following manufacturers' instructions. All patients received endosseous implants, 4 or 4.5 mm in diameter and 10–15 mm in length via flapless surgery. After implant placement, healing abutments – 4.5 or 5.5 mm in diameter and 3 or 5 mm long – were connected immediately to the fixtures, such that the coronal portion of the abutments remained exposed to the oral cavity (Figure 2). All implants were placed by experienced senior authors. A daily, meticulous plaque control procedure was initiated immediately after placement of implants.

Clinical Evaluation

Clinical evaluation was performed 4 months after implant insertion. One clinician performed the clinical evaluation, which involved measuring the probing pocket depth, assessing the Gingival Index (GI), and recording the presence of bleeding on probing (BOP).[14] The presence of keratinized gingiva around implants was also recorded. Pocket depths were measured using probes (PDT Sensor® probes, Zila Inc., AZ, USA) with a probing force of 0.2 N. The mean pocket probing depth for each implant site was obtained from averaging measurements taken at four sites around each implant.

To assess postsurgical changes in the soft tissue level after implant placement, alginate impressions and dental cast fabrications were carried out immediately before implant placement, 1 week, 1 month, and 4 months after implant placement (Figure 3). The casts were sectioned parallel to the implant axis in the mesiodistal plane (Figure 4). They were also sectioned parallel to the implant axis in the buccolingual plane (Figure 5). The sectioned casts were optically digitized. Custom software was used to align and process the digital images. Images from preoperative casts were used as baselines. Each postsurgical image was superimposed onto images from the preoperative cast, and distances between the images were calculated at the mesial, distal, buccal, and lingual aspects of each implant. Changes apical to the baseline soft tissue profile were recorded as negative, whereas a positive value was a change coronal to the baseline.

To assess postsurgical changes in the crestal bone level, conventional dental x-rays were taken immediately and 4 months after implant placement. The images were digitized, and the distance between the fixture shoulder and apical level of the marginal bone in contact with the implant was measured using 8× magnification using implant height (a known measurement) for calibration. Measurements were made at the mesial and distal aspects of each fixture and the mean for each case was calculated. All measurements were performed by two examiners with no knowledge of the methods used in the study; when examiners disagreed, the values were rechecked and discussed until an agreement was reached.

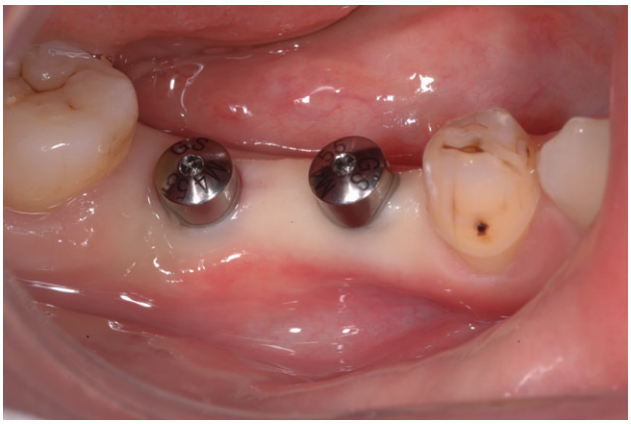

Figure 2 Clinical features after healing abutments are connected to the fixtures.

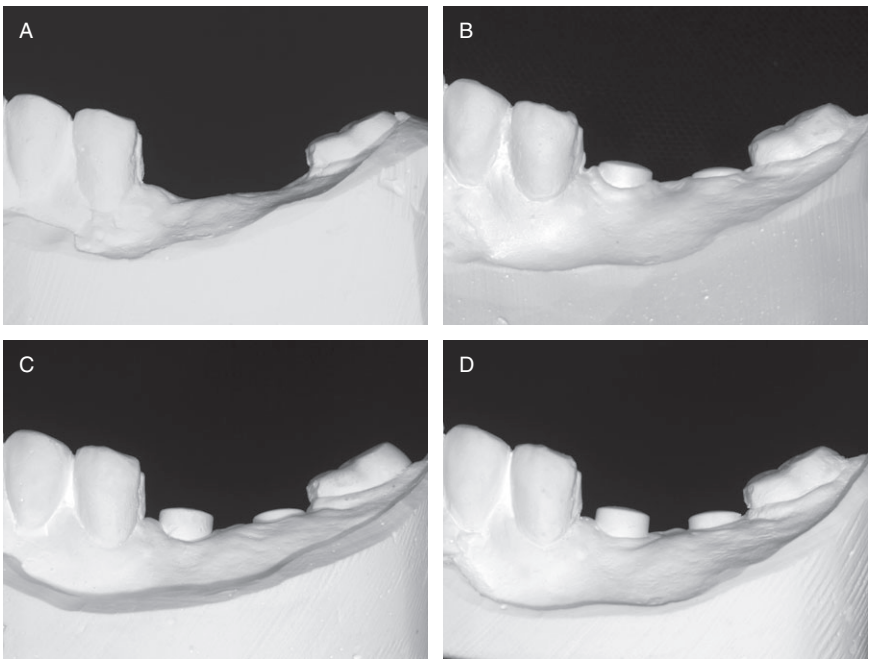

Figure 3 Dental casts immediately before implant placement (A), 1 week (B), 1 month (C), and 4 months (D) after implant placement.

Statistical Analysis

Marginal soft tissue levels were analyzed using the *t*-test for comparison between two groups at a given time point, two different time points and the thick soft tissue (≥3 mm) and the thin soft tissue groups (<3 mm). Analysis of variance was used to calculate significant differences in the soft tissue profile between different time points. A p value <0.05 was considered statistically significant.

RESULTS

All implants were successfully integrated; none required removal. All implants were surrounded by keratinized gingiva throughout the study. Table 1 describes the overall clinical characteristics of implant and related mucosa 4 months after surgery. The mean pocket probing depth was 0.9 ± 0.4 mm. The average GI score was 0 with respect to the peri-implant mucosal health and inflammation (Table 1). The average BOP index was 0. Radiographic evaluations showed a small amount of bone loss during the healing process. The average bone loss was 0.4 ± 0.4 mm 4 months after surgery.

Table 2 shows longitudinal soft tissue measurements taken at three different time points. The mean values of all four sites around the implants showed 0.7 ± 0.3 mm coronal growth 1 week after surgery. The implants showed 0.2 ± 0.2 mm coronal growth at 1 month and 0 ± 0.3 mm at 4 months. Significant changes occurred in the soft tissue profile between 1 week and 4 months; however, there was no significant difference immediately before and 4 months after flapless implant placement.

The relationship of soft tissue thickness to the soft tissue profile was analyzed. The mean soft tissue profiles for the thick (≥3 mm) and thin groups (<3 mm) were 0.0 ± 0.4 and 0.0 ± 0.2, respectively, at 4 months. These results demonstrate that soft tissue thickness did not significantly affect the morphology of soft tissue profiles.

DISCUSSION

Previous studies have documented that gingival recession is a common outcome following flap implant surgery.[15–17] Most gingival recession occurs early (3 months) after implant placement. In the results of a study by Small and Tarnow,[15] the mean gingival recession at the buccal site was 0.8 mm and 0.6 mm at the proximal site within 3 months of implant placement, and maintained at that level. In contrast, our patients experienced no gingival recession after implant placement using a flapless implant procedure. The soft tissue level around the implants in our sample increased by 0.7 mm at 1 week, 0.2 mm at 1 month, and resolved to

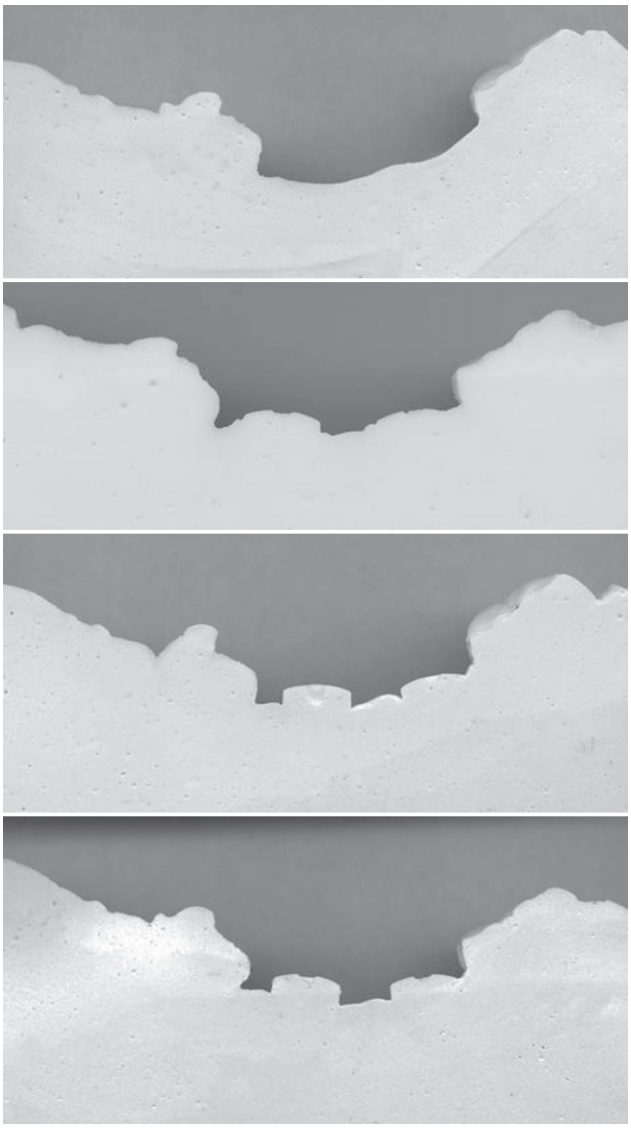

Figure 4 Casts sectioned parallel to the implant axis in the mesiodistal plane.

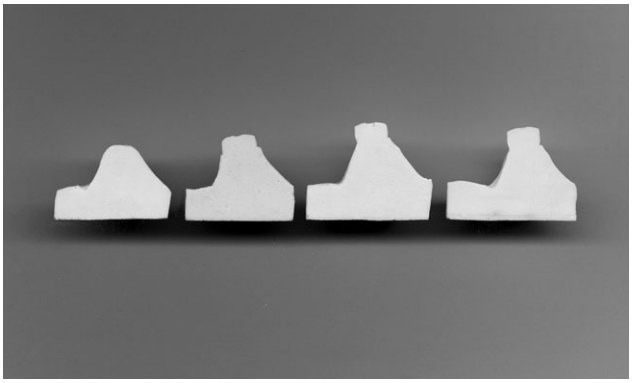

Figure 5 Casts sectioned parallel to the implant axis in the buccolingual plane.

0 mm by 4 months, indicating that the adjacent mucosa thickens a little, following the surgery but returns to baseline. These results suggest that flapless procedures are advantageous for maintaining the original mucosal form surrounding dental implants. Flapless implant surgery is indicated for the anterior esthetic zone to optimize esthetic results. It is noteworthy that soft tissue levels increased by 0.7 mm 1 week after implant placement. This initial increase is most likely due to postoperative edema. Clinically, healing abutments can be selected based on this soft tissue level. A permucosal healing abutment should extend at least 0.7 mm above the adjacent mucosa to help prevent tissue overgrowth during healing.

The stability of soft tissue profiles observed at flapless implant sites in the present study likely results from slight peri-implant bone loss. Several authors have reported that flapless implant surgery minimizes bone resorption.[12,18–21] Our results indicate an average bone loss of 0.4 mm 4 months after implant placement. The stability of soft tissue profiles may also reflect a lower degree of soft tissue injury than that incurred after flap implant surgery. The degree of soft tissue injury is known to influence the speed and quality of healing.[21–23] Small, clean, closed wounds heal quickly with little scar formation, whereas large, open wounds heal slowly and with significant scarring. This principle holds for wounds around the implants. Following flapless procedures, the surrounding mucosa has smaller, cleaner, less open wounds than following flap procedures. Cleaner wound may improve peri-implant mucosal healing. According to our results, flapless implant surgery yields reduced sulcus depth around implants, with a mean pocket probing depth of 0.9 mm, 4 months after flapless implant surgery in contrast to pocket depths around flap implants ranging from 2 to 2.6 mm at postoperative weeks 4–12.[24] In addition, we observed excellent

TABLE 1 Probing Depth, Gingival Index, Bleeding on Probing, and Crestal Bone Loss when Implants were Placed without a Flap

	Four months
Probing depth (mm)	0.9 ± 0.4
Gingival index	0
Bleeding on probing	0
Crestal bone loss	0.4 ± 0.4

TABLE 2 Marginal Levels of Peri-implant Soft Tissue

	Buccal	Lingual	Mesial	Distal	Mean
1 week	0.6 ± 0.2	0.8 ± 0.3	0.7 ± 0.3	0.7 ± 0.3	0.7 ± 0.3
1 month	0.1 ± 0.2	0.3 ± 0.3	0.2 ± 0.2	0.2 ± 0.2	0.2 ± 0.2
4 months	0.0 ± 0.2	0.0 ± 0.3	0.0 ± 0.2	0.0 ± 0.3	0.0 ± 0.3

peri-implant mucosal helath in our sample after flapless implant surgery, as confirmed by low GI scores and BOP index. The maintenance of good healing conditions in soft tissue adjacent to flapless implants may contribute to the resulting stable soft tissue profiles.

Bengazi and colleagues[25] documented greater recession at flap implant sites without keratinized mucosa than sites with keratinized mucosa. We observed 100% keratinized mucosa around implants in our sample. These data are not suitable for comparative analysis of the role of keratinized mucosa in implant surgery outcomes, as all of the sites we observed were surrounded with keratinized mucosa. Soft tissue thickness did not sifnificantly affect soft tissue levels. Mean soft tissue levels were similar for the thick (≥3 mm) and thin groups (<3 mm) at 4 months.

We did not observe any differences in soft tissue profiles immediately before and 4 months after flapless implant placement in our patients. Our results indicate that the flapless procedure is superior to flap implant procedures for maintaining original mucosal form surrounding implants. Our findings support the clinical use of flapless implant surgery in the anterior esthetic zone to optimize esthetic results.

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REFERENCES

1. Choquet V, Hermans M, Adriaenssens P, Daelemans P, Tarnow DP, Malevez C. Clinical and radiographic evaluation of the papilla level adjacent to single-tooth dental implants: a retrospective study in the maxillary anterior region. J Periodontol 2001; 72:1364–1371.
2. Grossberg DE. Interimplant papilla reconstruction: assessment of soft tissue changes and results of 12 consecutive cases. J Periodontol 2001; 72:958–962.
3. Van der Zee E, Oosterveld P, Van Waas MA. Effect of GBR and fixture installation on gingiva and bone levels at adjacent teeth. Clin Oral Implants Res 2004; 15:62–65.
4. Elian N, Jalbout ZN, Classi AJ, Wexler A, Sarment D, Tarnow DP. Precision of flapless implant placement using real-time surgical navigation: a case series. Int J Oral Maxillofac Implants 2008; 23:1123–1127.
5. Becker W, Goldstein M, Becker BE, Sennerby L, Kois D, Hujoel P. Minimally invasive flapless implant placement: follow-up results from a multicenter study. J Periodontol 2009; 80:347–352.
6. Merli M, Bernardelli F, Esposito M. Immediate versus early nonocclusal loading of dental implants placed with a flapless procedure in partially edentulous patients: preliminary results from a randomized controlled clinical trial. Int J Periodontics Restorative Dent 2008; 28:453–459.
7. Papaspyridakos P, Lal K. Flapless implant placement: a technique to eliminate the need for a removable interim prosthesis. J Prosthet Dent 2008; 100:232–235.
8. Auty C, Siddiqui A. Punch technique for preservation of interdental papillae at nonsubmerged implant placement. Implant Dent 1999; 8:160–166.
9. Salinas TJ. Soft tissue punch technique for aesthetic implant dentistry. Pract Periodontics Aesthet Dent 1998; 10:434.
10. Oh TJ, Shotwell JL, Billy EJ, Wang HL. Effect of flapless implant surgery on soft tissue profile: a randomized controlled clinical trial. J Periodontol 2006; 77:874–882.
11. Ericsson I, Nilson H, Lindh T, Rankow K. Immediate functional loading of Branemark single tooth implants: an 18 months' clinical pilot follow-up study. Clin Oral Implants Res 2000; 11:26–33.
12. Campelo LD, Camara JRD. Flapless implant surgery: a 10-year clinical retrospective analysis. Int J Oral Maxillofac Implants 2002; 17:271–276.
13. Anderson E, Haanaes HR, Knutsen BM. Immediate loading of single-tooth ITI implants in the anterior maxilla: a prospective 5-year pilot study. Clin Oral Implants Res 2002; 13:282–287.
14. Löe H. The gingival index, the plaque index and the retention index systems. J Periodontol 1967; 38:610–616.
15. Small PN, Tarnow DP. Gingival recession around implants: a 1-year longitudinal prospective study. Int J Oral Maxillofac Implants 2000; 15:527–532.

16. Van der Zee E, Oosterveld P, Van Waas MA. Effect of GBR and fixture installation on gingiva and bone levels at adjacent teeth. Clin Oral Implants Res 2004; 15:62–65.
17. Oates TW, West J, Jones J, Kaiser D, Cochran DL. Long-term changes in soft tissue height on the facial surface of dental implants. Implant Dent 2002; 11:272–279.
18. Becker W, Goldstein M, Becker BE, Sennerby L. Minimally invasive flapless implant surgery: a prospective multicenter study. Clin Implant Dent Relat Res 2005; 7(Suppl 1):S21–S27.
19. Jeong SM, Choi BH, Li J, et al. Falpless implant surgery: an experimental study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007; 104:24–28.
20. Jeong SM, Choi BH, Li J, et al. Bone healing around implants following flap and mini-flap surgeries: a radiographic evaluation between stage I and stage II surgery. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008; 105:293–296.
21. Homans J. A textbook of surgery. Springfield, IL: Charles C Thomas, 1945:1–30.
22. Sabiston DC, Lyerly HK. Textbook of surgery. The biological basis of modern surgical practice. Philadelphia, PA: WB Saunders Company, 1997:207–220.
23. Mathes SJ. Plastic surgery. Philadelphia, PA: Saunders Elsevier Company, 2006:209–234.
24. DeAngelo SJ. Early soft tissue healing around one-stage dental implants: clinical and microbiologic parameters. J Periodontol 2007; 78:1878–1886.
25. Bengazi F, Wennstrom JL, Lekholm U. Recession of the soft tissue margin at oral implants. a 2-year longitudinal prospective study. Clin Oral Implants Res 1996; 7:303–310.