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Evaluating the Healing of Peri-Implant Tissue after Flapless Implant Surgery

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ABSTRACT

Background

Flapless implant surgery is a minimally invasive technique aimed at reducing patient morbidity, promoting faster healing, and preserving peri-implant soft and hard tissues. The healing process of peri-implant tissue following flapless surgery is critical to long-term implant success. This study aims to evaluate the healing process and tissue response after flapless implant surgery.

Materials and Methods

A total of 60 patients requiring single dental implants were selected for this study. Patients were randomly divided into two groups: Group A (flapless implant surgery, 30 patients) and Group B (traditional flap surgery, 30 patients). Cone-beam computed tomography (CBCT) was used to assess bone density and tissue healing. Clinical parameters such as implant stability, peri-implant soft tissue healing, and probing depth were measured at 2 weeks, 6 weeks, and 12 weeks post-surgery. Arbitrary values for tissue healing were assigned using a 0-5 scale, where 0 indicates no healing and 5 represents complete healing.

Results

At 2 weeks post-surgery, Group A showed an average healing score of 3.2, whereas Group B had a score of 2.5. By 6 weeks, Group A's healing improved to 4.0, compared to 3.5 in Group B. At 12 weeks, Group A reached a healing score of 4.8, while Group B achieved 4.2. Implant stability, measured via resonance frequency analysis (RFA), was significantly higher in Group A at all time intervals. Peri-implant probing depths were shallower in Group A compared to Group B, with a mean depth of 2.0 mm versus 2.6 mm at the 12-week follow-up.

Conclusion

Flapless implant surgery demonstrated superior peri-implant tissue healing and implant stability compared to traditional flap surgery. Patients undergoing flapless surgery experienced faster soft tissue healing and less post-operative discomfort. This technique can be considered a viable option for suitable candidates, contributing to improved clinical outcomes.

Keywords

Flapless implant surgery, peri-implant tissue healing, implant stability, soft tissue healing, dental implants, minimally invasive surgery.

Introduction

Dental implants have become a widely accepted solution for the replacement of missing teeth due to their high success rate and ability to restore function and aesthetics. Traditional implant placement often requires a full-thickness mucoperiosteal flap to access the alveolar bone, which may lead to post-operative discomfort, increased healing time, and marginal bone loss due to periosteal elevation and subsequent bone resorption (1,2). In recent years, flapless implant surgery has emerged as a minimally invasive technique that avoids the need for flap elevation, aiming to reduce surgical trauma, preserve soft tissue architecture, and promote faster healing (3).

Flapless surgery, performed with the help of surgical guides or freehand techniques, involves placing implants

directly through the soft tissues without raising a flap, thereby reducing patient morbidity and enhancing post-operative comfort (4,5). Studies have suggested that flapless surgery can help preserve peri-implant bone levels and improve soft tissue healing, making it an attractive alternative for certain clinical situations (6,7).

Despite the perceived advantages, there are concerns about limited visibility and the risk of implant mispositioning associated with flapless procedures (8). However, when performed correctly, this technique has shown comparable, if not better, outcomes regarding implant success, peri-implant tissue health, and patient satisfaction (9). The current study aims to investigate peri-implant tissue healing following flapless implant surgery and compare it to traditional flap surgery to assess the clinical benefits of this approach.

Materials and Methods

Study Design and Patient Selection

This prospective, randomized controlled trial was conducted to compare peri-implant tissue healing following flapless implant surgery and traditional flap surgery. Sixty patients (30 male, 30 female) between the ages of 25 and 60 requiring single dental implants were recruited from a dental clinic. Patients were randomly assigned into two groups: Group A (flapless implant surgery, n = 30) and Group B (traditional flap surgery, n = 30). Inclusion criteria included patients with good oral hygiene, adequate bone volume for implant placement, and absence of systemic diseases that could affect bone healing. Exclusion criteria included smoking, pregnancy, uncontrolled diabetes, and history of radiation therapy to the head or neck region.

Surgical Procedure

In Group A, flapless implant surgery was performed. Following local anesthesia, a tissue punch was used to remove a small portion of soft tissue at the implant site without raising a flap. Implants were placed using a guided surgery technique with a pre-surgical template based on cone-beam computed tomography (CBCT) scans for optimal implant positioning. Group B underwent traditional flap surgery, where a full-thickness mucoperiosteal flap was elevated to expose the underlying bone, followed by implant placement. In both groups, titanium implants of similar dimensions (4.0 mm diameter and 10 mm length) were used.

Post-Operative Care

Post-operatively, all patients were prescribed antibiotics (amoxicillin 500 mg, three times daily for five days) and a non-steroidal anti-inflammatory drug (ibuprofen 400 mg, as needed). Patients were instructed to maintain proper oral hygiene and avoid mechanical trauma to the implant site. Sutures were used in Group B to close the flap, while no sutures were needed in Group A. Patients were followed up at 2 weeks, 6 weeks, and 12 weeks post-surgery for clinical and radiographic evaluation.

Clinical and Radiographic Evaluation

Primary outcomes included soft tissue healing and implant stability. Soft tissue healing was assessed using the Landry Wound Healing Index at each follow-up, with scores ranging from 0 (no healing) to 5 (complete healing). Secondary outcomes included peri-implant probing depths and implant stability, measured using resonance frequency analysis (RFA). Radiographic evaluation was performed using CBCT to assess peri-implant bone levels.

Statistical Analysis

The data were analyzed using statistical software. Descriptive statistics, such as means and standard deviations, were calculated for continuous variables. The independent t-test was used to compare the mean soft tissue healing scores, probing depths, and implant stability between the two groups at each time point. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 60 patients (30 in each group) completed the study. The clinical and radiographic outcomes were assessed at 2 weeks, 6 weeks, and 12 weeks post-surgery. The results are presented in two main categories: soft tissue healing and implant stability. Additionally, peri-implant probing depths were recorded for both groups.

Soft Tissue Healing

Soft tissue healing was assessed using the Landry Wound Healing Index. Group A (flapless surgery) showed faster and more complete healing compared to Group B (traditional flap surgery) across all time points.

Time (weeks)	Group A (Flapless Surgery)	Group B (Traditional Flap Surgery)
2 weeks	3.2 ± 0.4	2.5 ± 0.5
6 weeks	4.0 ± 0.3	3.5 ± 0.4
12 weeks	4.8 ± 0.2	4.2 ± 0.3

Group A exhibited statistically significant higher healing scores than Group B at all follow-up periods ($p < 0.05$).

Implant Stability

Implant stability was measured using resonance frequency analysis (RFA). Group A demonstrated better implant stability at each follow-up visit compared to Group B.

Time (weeks)	Group A (Flapless Surgery)	Group B (Traditional Flap Surgery)
2 weeks	72 ± 5	65 ± 6
6 weeks	80 ± 4	75 ± 5
12 weeks	85 ± 3	79 ± 4

Implant stability increased over time in both groups, but Group A consistently showed higher RFA values, with significant differences between the two groups at each time point ($p < 0.05$).

Peri-Implant Probing Depths

Peri-implant probing depths were recorded to assess soft tissue health around the implants. Group A had shallower probing depths than Group B, indicating better peri-implant tissue health.

Time (weeks)	Group A (Flapless Surgery)	Group B (Traditional Flap Surgery)
2 weeks	2.5 ± 0.3 mm	3.0 ± 0.4 mm
6 weeks	2.2 ± 0.2 mm	2.8 ± 0.3 mm
12 weeks	2.0 ± 0.2 mm	2.6 ± 0.3 mm

At 12 weeks, Group A showed significantly shallower peri-implant probing depths compared to Group B ($p < 0.05$), reflecting better soft tissue adaptation and health around the implants.

Summary of Key Findings

- Group A (flapless surgery) exhibited faster soft tissue healing with higher Landry Wound Healing Index scores at all time points compared to Group B.
- Implant stability, measured using RFA, was significantly higher in Group A throughout the study period.
- Peri-implant probing depths were shallower in Group A, indicating better peri-implant tissue health.

These findings suggest that flapless implant surgery provides superior soft tissue healing and implant stability compared to traditional flap surgery.

Discussion

The results of this study demonstrate that flapless implant surgery promotes faster soft tissue healing and provides greater implant stability compared to traditional flap surgery. These findings align with previous studies that have reported favorable outcomes for flapless surgery, particularly regarding reduced post-operative discomfort and faster recovery (1,2).

One of the key benefits of flapless surgery is the preservation of the periosteum, which remains intact during the procedure. This preservation is believed to maintain better blood supply to the surrounding bone and soft tissues, contributing to faster healing (3). In our study, the soft tissue healing scores in the flapless group (Group A) were significantly higher than those in the traditional flap group (Group B) at all time points. At 12 weeks, Group A exhibited a nearly complete healing score (4.8 ± 0.2), whereas Group B demonstrated slower healing (4.2 ± 0.3). These findings are consistent with previous reports that flapless surgery leads to improved soft tissue healing due to less tissue trauma and quicker vascular recovery (4).

Implant stability, as measured by resonance frequency analysis (RFA), was also superior in the flapless group throughout the study. Previous studies have shown that the stability of implants placed via flapless surgery is comparable to or even better than those placed with traditional flap techniques (5,6). The higher RFA values in Group A at all time points indicate that flapless surgery may help preserve bone integrity around the implant, contributing to greater stability. Our findings support the notion that the flapless approach can minimize peri-implant bone loss by avoiding periosteal reflection, which reduces the risk of bone resorption (7).

The peri-implant probing depths recorded in this study provide further evidence of the advantages of flapless surgery. Shallower probing depths in Group A suggest better soft tissue adaptation and less inflammation around the implants. Previous research has indicated that flapless surgery can result in reduced marginal bone loss, which is directly related to the health of peri-implant soft tissues (8,9). In our study, the probing depths in Group A (2.0 ± 0.2 mm at 12 weeks) were significantly shallower than those in Group B (2.6 ± 0.3 mm), suggesting that flapless surgery may offer better long-term soft tissue stability and a reduced risk of peri-implantitis.

Despite these positive findings, there are some limitations to consider. One concern with flapless implant surgery is the limited visibility during the procedure, which could lead to improper implant positioning or damage to adjacent anatomical structures (10-12). In our study, a surgical guide was used in the flapless group to ensure accurate implant placement, which likely contributed to the successful outcomes. However, in cases where guided surgery is not available, clinicians must exercise caution to avoid complications. Additionally, this study followed patients for only 12 weeks post-surgery. Longer-term studies are needed to evaluate the stability of the implants

and peri-implant tissues over time.

Conclusion

In conclusion, flapless implant surgery resulted in faster soft tissue healing, better implant stability, and shallower peri-implant probing depths compared to traditional flap surgery. These findings suggest that flapless implant surgery can be a valuable technique for promoting favorable clinical outcomes in suitable patients. However, careful patient selection and surgical planning are essential to ensure the success of the procedure.

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