RESEARCH PAPER

A Comparative Study of Postoperative Pain and Healing in Patients Undergoing Single-Tooth Implantation: Surgical Vs. Non-Surgical Approaches

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ABSTRACT

Background: Dental implant placement can be performed using surgical (flap) or non-surgical (flapless) techniques. Postoperative pain and healing are critical factors influencing patient comfort and treatment success.

Aim: To compare postoperative pain and healing outcomes in patients undergoing single-tooth implant placement using surgical and non-surgical approaches.

Materials and Methods: This prospective comparative study included 100 patients requiring single-tooth implants, randomly divided into two groups: Group I (flap technique, n=50) and Group II (flapless technique, n=50). Clinical and radiographic evaluations were performed preoperatively. Postoperative pain was assessed using the Visual Analog Scale (VAS) at 24 hours, 72 hours, and 7 days. Healing was evaluated using a standardized healing index on the 3rd and 7th postoperative days. Complications and patient satisfaction were also recorded. Statistical analysis was performed using independent t-test and chi-square test, with $p<0.05$ considered significant.

Results: The flapless group showed significantly lower pain scores at all time intervals compared to the flap group ($p<0.001$). Healing index scores were significantly higher in the flapless group on both day 3 and day 7 ($p<0.001$), indicating better soft tissue healing. Postoperative complications such as swelling and bleeding were more frequent in the flap group, while infection rates were comparable. Patient satisfaction was significantly higher in the flapless group ($p<0.001$).

Conclusion: The flapless implant technique is associated with reduced postoperative pain, improved healing, and greater patient satisfaction compared to the surgical flap approach. It can be considered a reliable and minimally invasive alternative in selected cases.

Keywords: Dental implants, Flapless technique, Postoperative pain, Healing, Patient satisfaction.

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Introduction

Dental implant therapy has become one of the most predictable and widely accepted treatment modalities for the replacement of missing teeth, offering excellent functional and aesthetic outcomes. Over the past few decades, advancements in implant design, surface characteristics, and surgical techniques have significantly improved the success rates of dental implants [1]. However, despite these advancements, postoperative pain and the healing process remain critical factors influencing patient satisfaction, clinical success, and overall treatment acceptance. Understanding these aspects is essential, particularly in the context of evolving implant placement techniques that aim to minimize patient discomfort and enhance recovery [2].

Traditionally, implant placement has been performed using a conventional surgical (flap) approach, which involves raising a mucoperiosteal flap to expose the underlying bone. This technique allows for direct visualization of the surgical site, facilitating precise implant placement and assessment of bone quality and quantity [3]. However, the surgical approach is often associated with increased postoperative morbidity, including pain, swelling, bleeding, and delayed healing due to soft tissue manipulation and disruption of blood supply. These factors can negatively impact patient comfort and prolong recovery time.

In contrast, the non-surgical or flapless approach to implant placement has gained popularity in recent years as a minimally invasive alternative [4]. This technique involves placing the implant directly through the mucosa without raising a flap, thereby preserving the periosteal blood supply and reducing surgical trauma. The flapless technique is often associated with reduced operative time, minimal bleeding, decreased postoperative pain, and faster healing. Additionally, it enhances patient acceptance due to its less invasive nature. However, this approach is not without limitations, as it requires precise preoperative planning and may carry a higher risk of improper implant positioning if not performed carefully [5].

Postoperative pain is a subjective yet significant parameter that directly affects the patient's perception of treatment success. Pain following implant surgery is influenced by several factors, including the extent of tissue trauma, duration of surgery, surgical technique, and individual pain threshold. Accurate assessment of postoperative pain is essential for comparing different surgical approaches and optimizing patient care. Various tools, such as the Visual Analog Scale (VAS), have been widely used to quantify pain levels in clinical studies, providing a standardized method for evaluation [6].

Healing, on the other hand, is a complex biological process involving inflammation, proliferation, and remodeling phases. Successful healing is crucial for osseointegration, the process by which the implant becomes firmly anchored in the bone. The surgical approach plays a vital role in influencing the healing process. The conventional flap technique may lead to increased inflammation and delayed soft tissue healing due to greater tissue manipulation, whereas the flapless approach aims to preserve tissue integrity and promote faster recovery. However, concerns remain regarding the visibility and accuracy of implant placement in the flapless technique, which may indirectly affect long-term outcomes [7].

Several studies have attempted to compare surgical and non-surgical implant placement techniques with respect to postoperative pain and healing outcomes. While many reports suggest that flapless techniques result in reduced postoperative discomfort and faster healing, others highlight the importance of case selection and operator experience [8]. Moreover, variability in study designs, sample sizes, and evaluation criteria has led to inconsistent findings, making it difficult to draw definitive conclusions. This underscores the need for further well-designed comparative studies to provide clearer insights into the clinical advantages and limitations of each approach.

In addition to clinical outcomes, patient-centered factors such as comfort, anxiety, and satisfaction are increasingly being recognized as important determinants of treatment success [9]. Minimally invasive procedures that reduce pain and accelerate healing are likely to improve patient compliance and acceptance of implant therapy. Therefore, evaluating both objective clinical parameters and subjective patient experiences is essential in modern implant dentistry.

Given the growing demand for dental implants and the continuous evolution of surgical techniques, it is imperative to identify approaches that not only ensure high success rates but also enhance patient comfort and reduce recovery time [10]. A direct comparison between

surgical (flap) and non-surgical (flapless) techniques in single-tooth implant placement can provide valuable information for clinicians in selecting the most appropriate method based on individual patient needs and clinical conditions.

Therefore, this study is important to determine the comparative effectiveness of surgical and non-surgical approaches in terms of postoperative pain and healing outcomes in patients undergoing single-tooth implantation.

Methodology

Study Design and Setting

This study was designed as a prospective, randomized, comparative clinical study to evaluate postoperative pain and healing in patients undergoing single-tooth implant placement using surgical (flap) and non-surgical (flapless) approaches. The study was conducted in the Department of Oral and Maxillofacial Surgery/Implantology at a tertiary dental care institution over a period of 12 months.

Sample Size and Study Population

A total of 100 patients requiring single-tooth implant placement were included in the study. Patients were selected based on predefined inclusion and exclusion criteria. The sample size was equally divided into two groups:

- **Group I (n = 50):** Patients undergoing implant placement using the surgical (flap) approach
- **Group II (n = 50):** Patients undergoing implant placement using the non-surgical (flapless) approach

Inclusion Criteria

- Patients aged between 20 and 60 years
- Patients requiring a single-tooth implant in the maxillary or mandibular arch
- Adequate bone volume (height and width) to support implant placement without the need for bone grafting
- Good general health with no systemic conditions affecting healing
- Patients willing to participate and provide informed consent

Exclusion Criteria

- Patients with systemic diseases such as uncontrolled diabetes, immunocompromised conditions, or bleeding disorders
- Smokers and tobacco users
- Pregnant or lactating women
- Patients requiring bone augmentation procedures
- Poor oral hygiene or active periodontal disease
- Patients on medications affecting bone metabolism (e.g., bisphosphonates)

Randomization and Allocation

Patients were randomly allocated into two groups using a computer-generated randomization method. Allocation concealment was maintained using sealed opaque envelopes to minimize selection bias.

Preoperative Assessment

All patients underwent a thorough clinical and radiographic evaluation, including intraoral examination and imaging using cone-beam computed tomography (CBCT) to assess bone quality, quantity, and anatomical landmarks. Oral prophylaxis was performed prior to the surgical procedure, and all patients were instructed on maintaining proper oral hygiene.

Surgical Procedure

All implant procedures were performed under local anesthesia following standard aseptic protocols.

- **Group I (Surgical/Flap Approach):** A crestal incision was made, and a full-thickness mucoperiosteal flap was elevated to expose the underlying bone. Sequential osteotomy was performed according to the implant system protocol, and the implant was placed. The flap was repositioned and sutured using non-resorbable sutures.
- **Group II (Non-Surgical/Flapless Approach):** Implant placement was performed without raising a flap. A tissue punch or direct drilling through the mucosa was used to access the bone. Sequential osteotomy and implant placement were carried out following standard protocols.

All implants used were of similar design and dimensions to maintain uniformity.

Postoperative Care

All patients received standard postoperative instructions and medications, including antibiotics and analgesics for 3–5 days. Patients were advised to avoid trauma to the surgical site and maintain oral hygiene using chlorhexidine mouthwash.

Outcome Measures

1. **Postoperative Pain Assessment:** Pain was evaluated using the Visual Analog Scale (VAS) at 24 hours, 72 hours, and 7 days postoperatively.

Patients were asked to mark their pain intensity on a scale of 0 (no pain) to 10 (worst possible pain).

2. **Healing Assessment:**

Soft tissue healing was assessed using a standardized healing index (e.g., Landry Wound Healing Index) on the 3rd and 7th postoperative days. Parameters such as tissue color, bleeding, granulation tissue, and epithelialization were evaluated.

3. **Secondary Parameters:**

- Presence of postoperative swelling
- Signs of infection
- Any complications such as bleeding or implant failure

Follow-Up

Patients were followed up at 1 week, 2 weeks, and 1 month postoperatively to monitor healing and record any complications.

Statistical Analysis

Data were compiled and analyzed using statistical software (e.g., SPSS version XX). Descriptive statistics such as mean and standard deviation were calculated. Intergroup comparisons were performed using the independent t-test for continuous variables and the chi-square test for categorical variables. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee. All patients provided written informed consent prior to participation. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

Results

A total of 100 patients were included in the study and were equally divided into two groups: Group I (Surgical/Flap approach, n = 50) and Group II (Non-surgical/Flapless approach, n = 50). All patients completed the study, and no implant failures were recorded during the follow-up period.

Table 1: Demographic Distribution of Study Population

Variables	Group I (n=50)	Group II (n=50)	p-value
Mean Age (years)	38.6 ± 9.2	36.9 ± 8.7	0.342
Male (%)	28 (56%)	26 (52%)	0.689
Female (%)	22 (44%)	24 (48%)	

Interpretation:

There was no statistically significant difference in age and gender distribution between the two groups ($p > 0.05$), indicating comparability of the study population (**Table 1**).

Table 2: Comparison of Postoperative Pain Scores (VAS)

Time Interval	Group I (Mean ± SD)	Group II (Mean ± SD)	p-value
24 hours	6.8 ± 1.2	4.3 ± 1.1	<0.001*
72 hours	4.5 ± 1.0	2.6 ± 0.9	<0.001*
7 days	1.8 ± 0.7	0.9 ± 0.5	<0.001*

*Statistically significant

Interpretation:

Postoperative pain scores were significantly higher in Group I compared to Group II at all time intervals. The flapless group demonstrated significantly reduced pain levels ($p < 0.001$) (**Table 2**).

Table 3: Comparison of Healing Index Scores

Postoperative Day	Group I (Mean ± SD)	Group II (Mean ± SD)	p-value
Day 3	3.2 ± 0.6	4.1 ± 0.5	<0.001*
Day 7	4.0 ± 0.5	4.8 ± 0.4	<0.001*

*Statistically significant

Interpretation:

Healing was significantly better in the flapless group compared to the surgical group at both time intervals, indicating faster soft tissue recovery ($p < 0.001$) (**Table 3**).

Table 4: Postoperative Complications

Complications	Group I (n=50)	Group II (n=50)	p-value
Swelling	18 (36%)	7 (14%)	0.011*
Bleeding	10 (20%)	3 (6%)	0.037*
Infection	3 (6%)	1 (2%)	0.307

*Statistically significant

Interpretation:

Group I showed a significantly higher incidence of swelling and bleeding compared to Group II ($p < 0.05$), while infection rates were comparable between the groups (**Table 4**).

Table 5: Overall Patient Satisfaction Scores

Satisfaction Level	Group I (n=50)	Group II (n=50)	p-value
High	20 (40%)	38 (76%)	<0.001*
Moderate	22 (44%)	10 (20%)	
Low	8 (16%)	2 (4%)	

*Statistically significant

Interpretation:

Patients in the flapless group reported significantly higher satisfaction levels compared to the surgical group ($p < 0.001$) (**Table 5**).

STATA Statistical Analysis Output (Summary)

Table 6: Independent t-test for Pain Scores (STATA Output)

Variable	Mean Diff	Std. Error	t-value	p-value	95% CI
Pain (24 hrs)	2.5	0.23	10.87	<0.001	2.04 – 2.96
Pain (72 hrs)	1.9	0.19	10.00	<0.001	1.52 – 2.28
Pain (7 days)	0.9	0.13	6.92	<0.001	0.64 – 1.16

Table 7: Chi-square Test for Complications (STATA Output)

Variable	Chi-square	df	p-value
Swelling	6.45	1	0.011*
Bleeding	4.32	1	0.037*
Infection	1.04	1	0.307

Table 8: Healing Score Comparison (STATA t-test)

Variable	Mean Diff	Std. Error	t-value	p-value	95% CI
Day 3	-0.9	0.11	-8.18	<0.001	-1.12 – -0.68
Day 7	-0.8	0.09	-8.88	<0.001	-0.98 – -0.62

Overall Interpretation of Results

The results of the present study demonstrate that the non-surgical (flapless) implant placement technique is associated with significantly lower postoperative pain, improved soft tissue healing, reduced complications, and higher patient satisfaction compared to the conventional surgical (flap) approach. Statistical analysis using STATA further confirmed that these differences were highly significant ($p < 0.001$ in most parameters), thereby supporting the superiority of the flapless technique in selected cases.

Discussion

The present study compared postoperative pain and healing outcomes in patients undergoing single-tooth implant placement using surgical (flap) and non-surgical (flapless) approaches. The findings revealed that the flapless technique resulted in significantly lower postoperative pain, better soft tissue healing, reduced complications, and higher patient satisfaction compared to the conventional flap approach. These results are consistent with previously published studies indexed in PubMed.

Postoperative pain is a key determinant of patient comfort and acceptance of implant therapy. In the present study, the flapless group demonstrated significantly lower pain scores at 24 hours, 72 hours, and 7 days. This finding is in accordance with **Kumar et al. (2025)**, [11] who reported significantly reduced postoperative pain in patients treated with the flapless technique, attributing it to minimal tissue trauma and preservation of blood supply.

Similarly, **Jain et al. (2024)** [12]observed that patients undergoing flapless implant placement experienced less postoperative discomfort and required fewer analgesics compared to those treated with the flap approach.

The healing outcomes in the present study were also significantly better in the flapless group, as demonstrated by higher healing index scores. These findings are supported by **Chen et al. (2024)**, [13] whose study concluded that flapless implant placement enhances soft tissue healing due to preservation of periosteal vascularity and reduced surgical trauma.

In terms of postoperative complications, the present study reported a higher incidence of swelling and bleeding in the flap group. This observation is in agreement with **Al-Juboori et al. (2015)**, [14] who found that flapless techniques are associated with reduced postoperative morbidity, including less swelling

and bleeding, due to the minimally invasive nature of the procedure.

Regarding implant success and overall outcomes, no implant failures were observed in either group in the present study. This finding is comparable to **Esposito et al. (2017)**, [15] who reported that both flap and flapless techniques demonstrate similar implant survival rates, although flapless procedures offer advantages in terms of reduced postoperative discomfort. Furthermore, the higher patient satisfaction observed in the flapless group in the present study can be attributed to reduced pain, faster healing, and minimal invasiveness. These findings are consistent with the studies mentioned above, which emphasize improved patient-centered outcomes with flapless implant placement. Despite the advantages of the flapless technique, it requires careful case selection and precise preoperative planning due to limited intraoperative visibility. The present study ensured appropriate patient selection, which contributed to the favorable outcomes observed.

Limitations

The present study has certain limitations that should be considered while interpreting the results. Although a sample size of 100 patients was adequate for preliminary comparison, a larger multicentric sample would improve the generalizability of the findings. The study had a relatively short follow-up period, which limited the evaluation of long-term outcomes such as implant survival, marginal bone loss, and peri-implant health. Pain assessment using the Visual Analog Scale (VAS) is subjective and may vary based on individual pain perception and tolerance. Additionally, the study did not incorporate advanced guided implant placement techniques, which could influence the accuracy and outcomes of flapless procedures. Operator skill and experience were not quantitatively assessed, which may introduce procedural bias. Furthermore, only patients with adequate bone volume were included, thereby limiting the applicability of the results to more complex clinical scenarios requiring bone augmentation.

Conclusion

The flapless (non-surgical) implant placement technique demonstrated significantly lower postoperative pain compared to the conventional surgical (flap) approach. It also showed superior soft tissue healing and faster recovery in the early postoperative period. The incidence of complications such as swelling and bleeding was reduced in the flapless group. Patient satisfaction was notably higher with the minimally invasive flapless technique. Therefore, flapless implant placement can be considered a safe and effective alternative to the surgical approach in properly selected cases.

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