Original Article

Evaluation of Flapless Approach for Dental Implantation: A Prospective Clinical Study

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Abstract

Objective: The present study aims to evaluate the dental implant flapless technique as a successful treatment option for implant patients by assessing marginal bone loss after 3 months and post-operative pain.

Methods: One hundred and twenty implants were placed in 40 patients. Two parameters were assessed post-operatively: marginal bone loss and pain; the difference in marginal bone loss (MBL) was measured based on an immediate post-operative OPG and another OPG taken three months after the surgery, and pain assessment was achieved using a 10-cm visual analog scale (VAS) post-operatively for five days. Descriptive and inferential statistics were used, and as most of the data were not normally distributed, Mann-Whitney test was used for comparing the groups.

Results: The present study's findings demonstrate that the average marginal bone loss (MBL) around the implant at three months using the flapless technique was 0.2± 0.1 mm. No implants failed to osseointegrate. There was no statistical MBL significance between male and female patients or between upper and lower jaw. This study shows significantly reduced post-operative pain in the flapless implant placement technique.

Conclusions: The flapless approach is predictable when patient selection, meticulous planning, and precise surgical protocols are followed.

Keywords: *Flapless approach, Dental implant, Marginal bone loss, Post-operative pain, Visual analog scale.*

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Introduction

Dentition is an essential component of the stomatognathic system. Teeth play a pivotal role in good phonics, articulation, and facial profile, in addition to their primary function of commencing digestion and ingestion[1].

Loss of teeth compromises the dental arch soundness and oral functions, modifies jaw-line alignment, reduces facial height, and produces unfavorable facial esthetic alterations[1].

One of the primary purposes of dentistry is to regain function, esthetics, and comfort by replacing missing teeth[2].

As a consequence of ongoing alveolar bone resorption, long-term denture use is widely associated with greater discomfort. At the same time, dental implant-supported prostheses (overdentures or bridges) can mitigate conventional dentures' drawbacks. Oral rehabilitation utilizing dental implants has evolved into a highly efficient therapeutic alternative for partially and completely edentulous patients[3].

According to the Branemark dental implant protocol, a mucoperiosteal flap is always elevated, and the underlying bone is revealed to facilitate vision and accessibility of the operative site[4]. However, this increases the odds of post-operative complications such as pain, edema, bleeding, prolonged operational time, and discomfort due to the inability to use the prosthesis[3,5,6]. In addition, flap reflection may result in scarring of the soft tissues[5-7], gingival recession, poor esthetic result, and crestal bone loss (CBL) as a result of a diminished supra periosteal blood flow[3,5-7], as it is documented from the periodontal surgical aspect that any flap elevation is invariably followed by bone resorption and a change in crestal bone height[8]; moreover, flap elevation necessitates suturing and is associated with a modicum of morbidity[5].

Despite the well-acknowledged high success rate of the implant procedure, bone loss is still a problem that sometimes requires complicated surgical interventions[9,10]. Implants may fail after crestal bone loss, necessitating additional operations such as reconstructive[11,12] or regenerative surgery[13,14].

Numerous alterations to implant topography(acid etching and sandblasting)[15], implant geometry (cylindrical and conical fixture)[16], and implant thread alterations (depth, shape, type, and pitches of thread) have been made to avoid subsequent alveolar bone loss and maximize the success rate of dental implants[17].

Because of these problems, new treatment modalities have been introduced. In the last three decades, implant dentistry has developed from a classic flap approach to a highly esthetic-driven approach[18]. The flapless technique, which Ledermann introduced in 1977, entails punching the soft tissue without reflecting a mucoperiosteal flap; this procedure can be done either by motor-driven discoid tissue punch or by utilizing a round bur to pierce the mucosa, while another option to achieve the flapless technique is to use a surgical blade[5].

Flapless implant placement has been proposed for patients with appropriate bone volume in the implantation site to limit post-operative peri-implant tissue loss and address the need for soft-tissue preservation intra and post-operatively[19].

The flapless and flap approach outcomes are similar regarding implant stability and clinical osseointegration; besides, the flapless technique has additional advantages for the patient, such as reduced trauma, fewer visits, shorter appointments, and faster recovery that permits the patient to resume routine dental hygiene immediately after surgery[20,21].

The above and several other advantages of flapless procedures, such as reduced morbidity[22], bleeding reduction[23], and the avoidance of sutures and scars, have made the flapless technique highly coveted and utilized in Implantology, both in traditional dental implant surgery and guided-implant surgery[24].

This characteristic of minimally invasive surgery makes it particularly appropriate for senior individuals with specific illnesses (immunodeficiency, diabetes) for whom it is vital to cause the least amount of harm and complete the procedure swiftly, in the least amount of time[24]. In addition, given the trend in hematological protocols to not suppress anticoagulants and antiplatelet medicines before surgery, the flapless procedure is safer for these patients, eliminating the danger of moderate or protracted bleeding[24].

Despite the previously mentioned advantages, there are some claims about hurdles, mainly that it is a blind technique that is restricted to sites with adequate bone height and width and there is possibility of heat damage due to restricted access to external irrigation[25,26].

Patients and methods

A total of 120 implants were placed between September 2021 and February of the following year; data collection continued until the end of June 2022. Forty patients were selected from the Outpatient Clinic at the Oral and Maxillofacial Surgery Department of the College of

Dentistry at Sulaimani University. Most cases (85%) had missing teeth for over three months, while a few cases (15%) were immediately implanted.

One-piece compressive implants (ROOTT implant system, TRATE AG, Switzerland) were used; these implants' characteristics include manufacture from grade 5 titanium alloy, blasted surface with hydroxyapatite (HA) and tricalcium phosphate(TCP), and acid-etching. Also, they have the unique feature of being able to be bent up to 15 degrees at the neck after implant placement. The implants were 3-5.5 mm in diameter and 8-14mm in length.

Healthy patients over 18 who had adequate bone width at a minimum of 4.5 mm and keratinized tissue of 5 mm and more, as assessed using a Williams probe, were included in the research. Meanwhile, patients with systemic diseases such as diabetes and hypertension and patients with inadequate bone width and insufficient keratinized tissue were excluded.

Pre-surgical phase

Before the dental implant installation, thorough clinical and radiographical assessments were done. Then, all of the selected patients were provided with an informed consent form to sign after discussing with them the whole surgical procedure, any potential complications, risk factors, benefits, alternative treatment modalities, and the proposed study criteria.

A pre-operative CBCT and an Orthopantomogram (OPG) were taken to provide the essential information about the available bone and the distance between important structures before surgery; another OPG was taken to measure the level of crestal bone after three months.

Surgical phase

Before the procedure, all patients were asked to rinse their mouths for 30 seconds with 0.12% chlorhexidine gluconate mouthwash. Then, the surgical field was prepared, and the implant site was anesthetized with 2% lidocaine with 1:80,000 epinephrine, using the infiltration technique.

The steps of implant placement were carried out according to the instructions of the implant manufacturer; external irrigation with sterile saline was utilized to prepare the implant site. First, the initial drill (1.5 mm) was used to perforate the cortical bone to prevent the pilot drill from slipping; then, the pilot drill was used to produce a hole of 2 mm diameter and obtain the intended depth. The direction indicator and depth gauge were utilized to verify the implant's parallelism and measure the depth of the osteotomy site. Incremental drills were then performed until the appropriate diameter was obtained. Once the osteotomy was finished, the implant was placed inside the bone; the minimum torque was 43 Ncm, while the maximum torque was 52 Ncm (Figure 1).

The investigator filled out a questionnaire form at the implant installation visit (covering the area of the dental implant, any intra-operative or post-operative complications, operation time, the time of the next visit, etc.).

Postsurgical Assessment

Digital OPGs were taken post-operatively. In addition, all the patients were given amoxiclav 625 mg thrice daily for five days. They were told to take Paracetamol 500 mg only if needed, to facilitate assessment of the severity of post-operative pain.

Follow up phase

The patients were followed-up post-operatively for five days to assess the severity of post-operative pain; all patients were asked to rank the pain on a 10-cm VAS ranging from zero (no pain) to ten (unbearable pain)[2](Figure 2).

Patients were instructed that scale 0 represents no pain: VAS= 0, Scale 1 represents mild pain: $O < VAS \leq 3.5$, Scale 2 represents moderate pain; $3.5 < VAS \leq 7$, and Scale 3: represents severe pain; $VAS > 7$.

Marginal bone loss was determined by monitoring the interproximal bone level, characterized as the interval between the apical terminal of the first implant thread and the most coronal spot of the interproximal alveolar bone[20](Figure 3). All radiographs taken were digital OPG radiographs. In addition, the EasyDent V4 Viewer (PRO) was used. A digital measuring tool was used to obtain the length of each implant's marginal bone loss at baseline (immediately after implantation) and three months afterward.

Results

In this study, the 40 patients who participated were followed up for three months post-surgically.

Among the total patients, 25 were females, and 15 were males.

The mean age of the patients was about 48 ±12.1 years, ranging from 18 to 70 years. The total number of dental implants was 120 implants, 50% of which were placed in the mandible, while 50% were placed in the maxilla. All implants were placed between September 2021 and February 2022; data were recorded until June 2022.

The marginal bone of the 120 flapless dental implants was analyzed at the end of the third month; the mean marginal bone loss (MBL) was 0.2± 0.1 mm after three months. The MBL was 0.2± 0.14 for males and 0.2± 0.12 for females (p= 0.881), and MBL was 0.25±0.13 for the upper arch and 0.23± 0.13 for the lower arch (p=0.642).

The statistics show that gender and jaw differences are not statistically significant (Table 1). However, there is a weak positive correlation between MBL and increasing age in females, as the p-value was 0.01 (Statistically significant at $p \leq 0.05$) (Table 3).

Most participants reported mild pain during the post-operative period, whereas just a few patients experienced moderate pain. The average pain scores dropped from 2.42 ± 1.12 in the first 24 hours following surgery to 1.10 ± 0.89 on the second day, then declined significantly to 0.32 ± 0.52 on the third day, and there was no pain at all on the fourth and fifth days(Table 2). Regarding the pain scores distribution, 5% of patients experienced no pain on the 1st day of flapless surgery; 77.5% experienced mild pain (1 to 3 score); 17.5% experienced moderate pain (4 to 6 score); while nobody reported severe pain (7 to 10 score).

In the first 24 hours post-surgically, the average pain scores were significantly higher in women (Table 2).

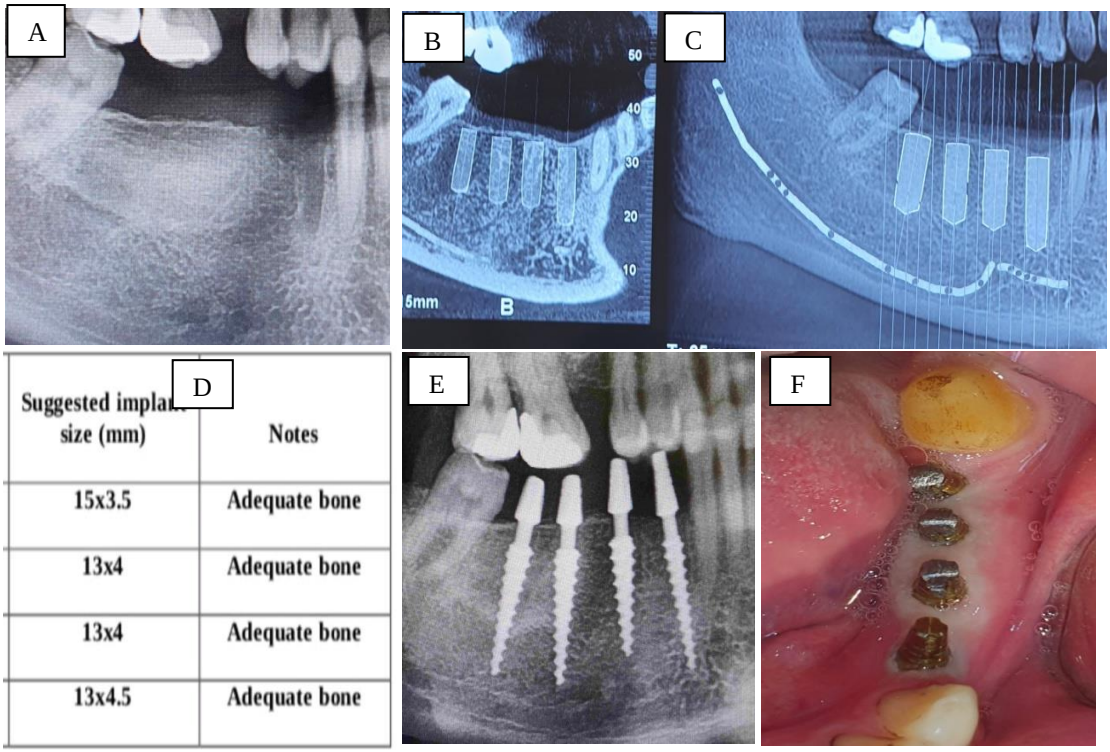

Figure 3: Flapless implantation case: A: Pre-surgical OPG, B, C, D: Pre-operative radiographical assessment and planning, E: Immediate post-operative OPG, and F: Post-operative clinical picture of the flapless dental implant.

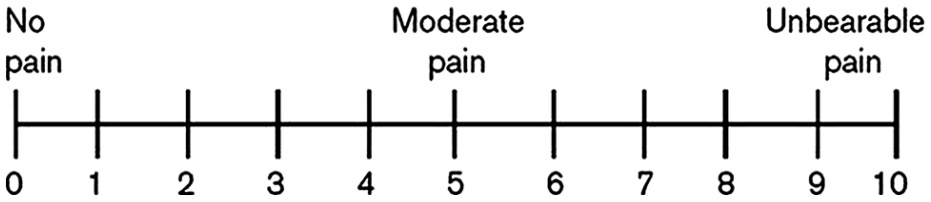

Figure 2: VAS assessment[2].

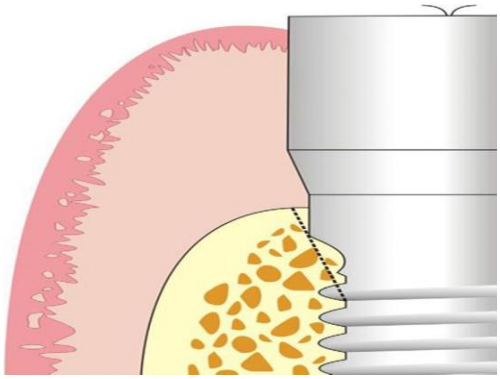

Figure 3: Marginal bone loss measurement.

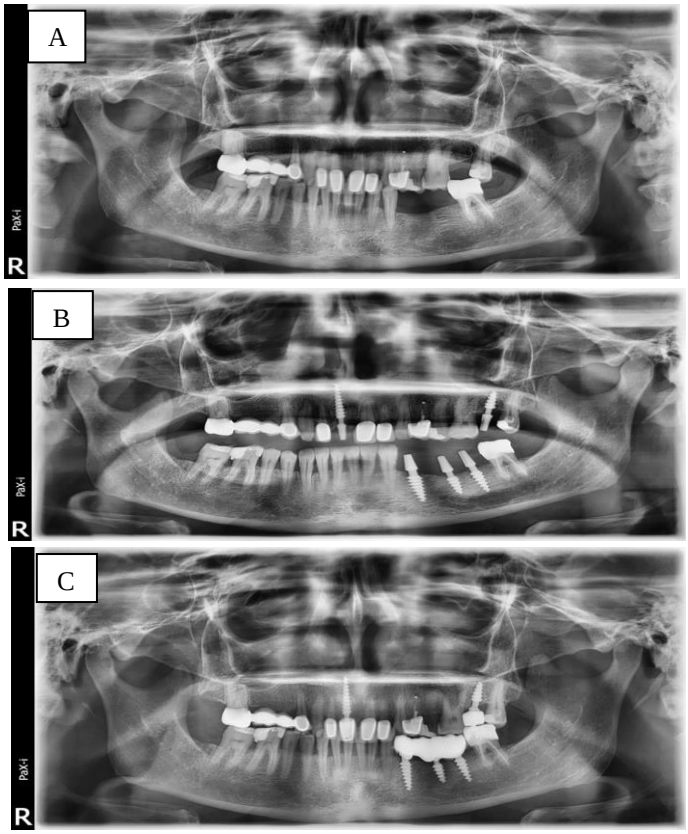

Figure 4: Panoramic radiograph of flapless implantation case: A: Pre-operative OPG, B: Immediate post-operative OPG, and C: Three months post-operative OPG.

Table 1: MBL by gender and arch.

Group	N	MBL	SD	Mean Rank	Z	Z	P-value
Male	51	0.2441	0.14270	59.96	1732.000	-.149	0.881
Female	69	0.2442	0.12935	60.90			
Upper	60	0.2508	0.13670	61.94	1713.500	-.464	0.642
Lower	60	0.2375	0.13328	59.06			

Table 2: VAS by gender.

Gender		Mean	SD	Rank	U	Z	p-Value
VAS1	Male	2.00	1.265	16.28			0.051*
	Female	2.71	0.955	23.31			
VAS2	Male	1.063	0.9287	20.19	187.000	-0.147	0.883
	Female	1.125	0.8877	20.71			
VAS3	Male	0.19	0.403	18.16	154.500	-1.298	0.194
	Female	0.42	0.584	22.06			
VAS4	Male	0	0	0	0	0	0
VAS5	Female	0	0	0	0	0	0

Table 3: Correlation between MBL and age of males and females.

		Male age	Female age
MBL	Pearson correlation	-0.030	0.307
	Sig(2-tailed)	0.835	0.010*
	N	51	69

*: Statistically significant at $p \leq 0.05$

Discussion

In this research, one-piece compressive implants (ROOTT implant system) were used to increase the prosthesis's strength and stability by eliminating the weakest point of the two-piece implant (the implant-abutment connection). The outcomes of this study are minimum marginal bone loss and post-operative pain with dental implants placed using the flapless approach, as the periosteum is left unscathed on the lingual and buccal surfaces of the ridge, preserving an adequate blood supply at the recipient site[27]. Hence reducing post-operative pain and lowering the risk of peri-implant bone resorption[7,28], especially in the marginal bone region, which has been regarded as a key biomarker of implant health[5], because it endures the maximum stress around the implant[29].

In this study, the mean MBL from baseline to the third month was at minimum, 0.24 ± 0.13 mm, and no implants showed bone loss of more than 0.5mm or failed to osseointegrate. These low rates of subsequent bone loss and implant failures concur with earlier studies' findings[29]. Also, recent research indicated that early MBL >0.44 mm in the first few months after prosthetic loading is a significant predictor for the progress of peri-implant bone loss[30]. Seung-MiJeong et al.'s study, indicated a 100% success rate for the flapless procedure[31]; early MBL has been regarded as a significant predictive indicator of long-term implant survival rate[32].

Jeong et al. reported mean marginal bone loss, using a flapless approach, ranging from 0.0 to 1.1 mm in a one-year follow-up[6]. Furthermore, the observed MBL in this study is significantly associated with increasing age in women. Our mean age was 52± 11, corresponding to a previous study that revealed that alveolar bone resorption in females peaks in the 40s and 50s age groups[33].

One of the most frequently mentioned concerns related to dental treatment is the fear of pain. In addition, patients have noted that surgical treatments, particularly dental implants, are among the most painful and anxiety-inducing dental procedures[2].

VAS, the most often used pain evaluation method in many institutions, was utilized in the present research to assess the level of pain experienced by the participants[2].

According to the findings of the present investigation, during the surgical process, no patient reported

discomfort, and the majority of the patients had mild VAS scores. On the first day after surgery, only 18% of patients reported moderate pain; by the second day the proportion had declined to 3%; by the third day this moderate pain was resolved, and there were no complaints of severe pain at all.

Fortin et al. also discovered that the flapless procedure resulted in a greater proportion of patients reporting no pain and that pain subsided more quickly; they asserted that one of the goals of the flapless treatment is to lessen the invasiveness of surgery and, consequently, surgical complications such as discomfort, edema, and hematoma[21]. In addition, females were much more likely to express the pain in the first 24 hours (Table 3); as mentioned in a previous study, after periodontal surgery, females had higher pain scores and greater pain memory[27,34,35].

Pre-operative planning is essential for the successful placement of implants utilizing the flapless technique, requiring a thorough examination and diagnosis of the implantation site, with radiographic evaluation[36]. In addition to computer tomography and advanced diagnostic software, pre-operative preparation may also involve the creation of a surgical template with a drilling guide for each implant[2].

Good case selection, operator experience, meticulous planning, and systematic surgical protocols are crucial factors for the success of the flapless approach of dental implant placement[2].

Conclusions

Within the constraints of this study, it is possible to conclude that flapless implant surgery results in minimal marginal bone loss and reduces patient suffering, assuming that requirements such as operator experience, correct patient selection, meticulous planning, and precise surgical protocols are followed.

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