A Comparative Study between Flapped and Flapless Surgical Techniques in Dental Implant Stability According to Resonance Frequency Analysis

Ali F. Hassan, B.D.S. [1]
Thair Abdul-Lateef, B.D.S., H.D.D., F.I.B.M.S. [2]

ABSTRACT

Background: Recent implant surgical approach aims to cause less trauma, invasiveness and pain as much as possible and to reduce patient and surgeon discomfort, time of surgery and time needed for functional implant loading. Flapless surgical techniques considered recently as one of the most popular techniques that may achieve these aims especially enhancing osseointegration and subsequently implant stability within less time than the traditional flapped surgical technique. So this study aimed to make a comparison between flapped and flapless surgical techniques in resulted implant stability according to resonance frequency analysis RFA and in duration of surgical operation.

Materials and methods: A total of 26 patients with 41 implants (one implant in the study group failed so it was excluded from the statistical analysis) were randomized into two groups: control group which involved 20 implants inserted by conventional flapped surgical approach and study group which involved 20 implants inserted by flapless surgical approach. Estimation of alveolar bone was done for study group by bone (ridge) mapping procedure. Duration of surgical operation for each implant, Implant stability was measured at three time intervals (at surgery, two months and three months after surgery).

Results: After three months interval of surgery the mean implant stability of the study (flapless) group achieved significant higher implant stability than control (flapped) group ($P< 0.05$) and the difference in measured implant stability was (5.05) implant stability quotient(ISQ). The time of surgical operation for implants in the study group significantly was less than that of control group ($P< 0.01$).

Conclusions: Implants placed with flapless surgical technique can produce high implant stability in shorter time and consume prominently shorter time for surgical operation compared to those placed with conventional flapped technique.

Key words: Flapless technique, implant stability, resonance frequency analysis, implant stability quotient. (J Bagh Coll Dentistry 2016; 28(2):92-97).

INTRODUCTION

Dental implant is a recent science. This science is continuously developing from its beginning on nineteenth century till now. One aspect of that development was the surgical procedure. When dental implant science saw the light the classical surgical procedure involved the incision of mucosa and reflection of the flap then exposing the bone, finally placing the implant and suturing back the flap [1,2]. This procedure had some disadvantages, one of them crestal bone resoption and this may affect implant future outcome and stability [3]. Reflection of flap was not needed in flapless surgery since the implant placed in bone through mucosa by minimal incision or by making a window through mucosa by tissue punch[4].

Dental implant placement by flapless surgery is becoming more popular among surgeons. It has many benefits as preservation of the original mucosal form around implant [5], decreasing the resoption of bone at the site of operation [6], maintenance of the blood supply around the implant [7],in addition to decrease patient discomfort and decrease the time of operation [8].

(1) Master student. Department of Oral and Maxillofacial Surgery. College of Dentistry, University of Baghdad.
(2) Assistant professor. Department of Oral and Maxillofacial Surgery. College of Dentistry, University of Baghdad.

The flapless procedure is first introduced by Lederman in 1977 [9]. Campelo and Camara in 2002 performed a retrospective study over 10 years, which involved 770 implants placed by flapless procedure. The success rate was 74.1% for cases between 1990 and 2000. Since the changes and technological advancements made in the surface of the various implants used in the procedure as well as the implants shapes, a complete success was achieved after 2000[10].

There are no differences in perforation or dehiscence of the crestal bone by either novice or professional dentists as a study employed in 2006 by Ghent University .This study also showed the flapless technique was more reliable and easy to use and it concluded that the procedural success of implant depend on the good knowledge about the anatomy and structure of bone [11].

One of the most important advantages of flapless procedure is enhancing implant stability. Jeong et al. in 2011 stated that implant stability was not decreasing initially after placement of implant by flapless procedure. They found that stability increased after 2 weeks of placement, while it is normally decreasing at this time for the conventional flapped procedure[12]. Since it is very important to confirm this suggestion and to show the effect of flapless surgery on both initial and

secondary stability of implants, further research should be applied using recent tools for measurement of stability.

A noninvasive and simple method with accurate quantitative measure of implant stability is resonance frequency analysis (RFA) [13]. The development of this device over last years led to production of a device better than other implant stability measurement devices like Periotest[14,15].

Considering the advantages and disadvantages of each type of surgical techniques and the limited number of studies on that field, it would be appropriate to study the effect of two techniques on implant stability for appropriate period of time to conclude which method better in this aspect.

This study aimed to measure the implant stability by means of OsstellTM according to RFA on three months follow up. The working hypothesis is that using flapless technique leads to better implant stability and to calculate the duration of surgical procedure for each implant placement and compare it between flapped and flapless techniques.

MATERIALS AND METHODS

This study was taken place in the implantology unit of the department of Oral and Maxillofacial Surgery, dental college teaching hospital, Baghdad University, Iraq, from December 2013 to December 2014.

Patient sample

It included 26 patients with 41 implants (one implant in study group failed so it is excluded from the statistical analysis except in the analysis of survival and failure rates). There are 10 male patients with 14 implants and 16 female patients with 26 implants. The whole sample was divided into:

1- Flapped group (control): which consisted of 20 implants placed with classical flap procedure, 8 implants placed in 6 male patients and 12 implant placed in 8 female patients.
2- Flapless group (study): which consisted of 20 implants placed with flapless procedure, 6 implants placed in 4 male patients and 14 implants in 8 female patients.

An informed consent was procured from all patients before starting the treatment. Patients were followed up to 3 months after surgery.

Inclusion criteria

1- Good oral hygiene.
2- Implants to be placed at least 6 months after teeth extraction.
3- Presence of at least 2 mm keratinized tissue above the crest of bone in the area receiving the implant, as measured by needle and stopper.
4- Available bone width is at least 5 mm, 3 mm apical to crest measured by bone caliper after measurement of soft tissue above the crest.
5- Patients ≥ the age of 18 years.

Exclusion Criteria

1- Insufficient keratinized tissue above the implant site (less than 2 mm above the ridge crest).
2- Insufficient bone width (less than 5 mm, 3 mm apical to crest).
3- Subantral bone height less than 8 mm.
4- Presence of any pathological condition in or adjacent proposed implant site.
5- Any systemic chronic disease (uncontrolled diabetes, uncontrolled hypertension, osteoporosis or any other conditions have a direct effect on bone healing).
6- Pregnant or lactating females.
7- Any dehiscence or fenestration of alveolar bone happened during the operation of implant placement.

Implant systems:

Two implants systems were utilized in the study (Implantium® / Dentium® / Seoul / Korea) and (Nucleoss®/ Turkey) with a property of surface modified by TiO2-large grit sandblasting and acid etched surface.The diameter of Ø3.4 mm, Ø3.8 mm Ø4.3 mm or Ø4.8 mm and a length of 8mm, 10mm, 12mm or 14mm were used in the study.

Preoperative clinical and radiologicalexamination

Detailed previous medical and dental histories were taken from each patient by a special forma of a case sheet for the implant center and special case sheet for this study. Orthopantomogram OPG view was made for each patient.

Bone Mapping Procedure

This step was done just for patients of the study group, it depended on a bone mapping procedure that help in measuring bucco-lingual dimension and avoiding unnecessary radiation of computed tomography. This procedure was done as following:

1- Localization of certain points in patient mouth. The points were made by copying pencil as shown in (Fig.1).

Fig.1: Localization of points in the patient mouth.

2- An impression is taken to the jaw of the patient that the implants were planned to be placed by alginate and is poured immediately to prevent dimensional changes. The done points were printed exactly to the alginate and then to the cast.

3- Then patient cleaned his mouth by tap water and then local anesthesia was given to the tissue around these points and the measurement procedure of mucosa thickness at these localized points was done by needle and stopper (Fig. 2).

Fig. 2: Measurement of thickness of mucosa.

4- Then the surgical stent was fabricated by using vacuum former.

5- The cast was cut at the site of points about 1 mm away from points using disking burs of 0.6 mm thickness. The resulted end of the ridge was trimmed out according to the measurement of soft tissue that was obtained by needle and stopper and was localized by the points on the ridge (Fig. 3).

Fig. 3: Ridge (bone) mapping on the cast.

6-The exact drilling point was placed on the surgical stent depending on the resulted ridge which represented the direct bone without the covering keratinized tissue.

Surgical procedure

The implant surgery was began for both groups with locally anesthetizing the area to be implanted. For flapped (control) group, extensive flap design was made.

The bony bedwas exposed and prepared using conventional drilling procedure of the associated system in sequence until reaching an appropriate size.The specified dental implant was driven in bone manually in the prepared hole and the stability was measured immediately by RFA test utilizingOsstellTM with its smart pegs.

Finally the cover screw was placed and suturing was done by 3/0 braided black silk suture (Fig. 4).The time of procedure calculated from the incision to the end of the last suture and the time of measuring stability was subtracted from the original time

Fig. 4: Placement of the cover screws on dental implants.

For flapless (study) group same surgical procedure was done except tissue punch was used to expose bony bed and finally stability was

measured by RFA test utilizing OsstellTM then healing abutment (gingival former) was placed and no need for sutures Fig. (5). The time of procedure was calculated from the application of the punch to the end of placing the gingival former, time of measuring stability was subtracted from the original time.

Fig. 5: Implants placed with flapless technique with their gingival formers.

Data Collection and Follow up

Data were collected first at the day of operation immediately after implant placement by measuring the stability from two directions of implant (buccolingually and mesiodistally). After that all patients were informed to come back for follow up after two and three months respectively. After two months for control group (flap procedure) surgical exposure for the implant was done for each implant by using tissue punch (Dentium, Korea) and gingival former placed while for the study group just releasing the gingival former was enough for each one.

Statistical Analysis

Statistical analysis was performed in this study using SPSS (Statistical Package for Social Science; Version 17) program. Independent t-test was used to estimate differences between two groups in continuous variables. Also Paired t-test was used to assess the statistical significance of change in mean after each successive interval of time compared to a previous time station in same patients.

RESULTS

For thecontrol group all implants survived with rate 100% while one implant failed in the study group with survival rate 95.23% with statistically insignificant difference (P> 0.05).

According to RFA analysis the result showed:

For baseline interval (at surgery) there was no significant difference between both groups(P> 0.05) with slight difference in mean about (0.53) implant stability quotient (ISQ) and further Cohen's effect measured and showed small difference (0.085).

For the next interval (after two months) the difference increase between two groups with higher values for flapless (study) group but still insignificance (P> 0.05), again Cohen's effect applied and showed moderate difference between both groups (0.45) with ISQ difference in mean about (3.47) ISQ.

Finally in the third interval (after three months) the difference became significant (P< 0.05) with large Cohen's effect (0.95) and about (5.05) ISQ flapless group higher than flapped one. These results illustrated in Fig. (6).

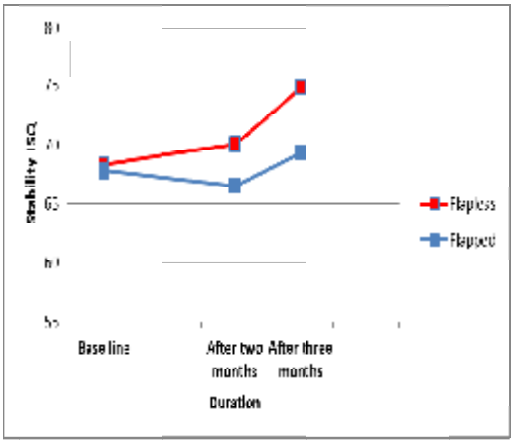
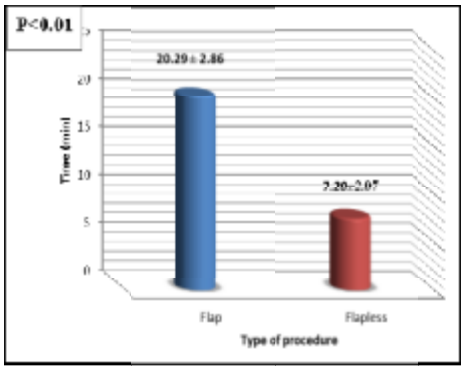


Fig. 6: The mean stability of the dental implants for both control and study groups.

According to the duration of surgical operation time there was high significance difference between the time consumed in flapless and flapped groups (P< 0.01). the difference between the mean of these two groups were (13.09) min and this was illustrating that flapless procedure consumed much less time than flapped procedure as shown in fig (7).



Values are expressed in mean ± SD

Fig.7: Time of surgical operation for both groups.

DISCUSSION

Some studies as this presented study depended on resonance frequency analysis concluded implant stability after implant placement with flapless surgical technique has significant advantages over the flapped technique [16]. In contrast other authors preferred conventional procedure due to blindness of flapless one and some risky of hemorrhage and failure due to miss position of implant placed by flapless technique[17].

According to this study, there was no significant difference between early success rate between control and study groups. The depended criteria in this study was presence or absence of mobility (observed clinically). This criteria considered one of the determinant of failure of dental implants as mentioned by Albrektsson et al. in 1986 and Zarb and Albrektsson in 1998[18,19]. Depending on this there was one implant failed in the study group and there were no implants failed in control group.

These findings coincided with previous studies were done on flapless technique which found no statistical significance difference between survival rate of flapless and flapped procedure for different intervals of time[20,21,22]. Also they concluded that flapless procedure was viable and predictable procedure.

According to RFA analysis that done in this study implant placed by flapless technique expressed better stability than that placed by flapped one in three months period after surgery. results of this study could be explained by elevation of full thickness flap would be more traumatic on underlying bone causing postsurgical effect and may have an adverse reaction on the process of bone remodeling (this opinion confirmed also by Glauser et al. in 2004[23]). Also there were many experimental studies on animal done to evaluate the peri-implant tissues reaction to both flapless and flapped methods. A study was done in 2007 by Jeong et al. on female mongrel dogs, who investigated the bone to implant contact (BIC) and bone resorptionhistomorphometrically for both procedures. They found 60% BIC and bone height 10 mm in implants placed with flapless procedure compared to 70% BIC and bone height 9 mm in implants placed with flapped procedure[6]. Another study concluded that a flapless surgical method may preserve vasculature of the peri-implant tissue more better than flapped surgical method with more distant appeared to be empty from any signs of inflammation [7]. In addition to previous mentioned studies, a histological analysis of flapless implants revealed the junctional epithelium was situated 1-mm more cervical than flapped implants due to reduced crestal bone resorption around flapless implants [5].

These result come in coordination with Jeong et al. in 2011 who found better ISQ values for next 8 weeks after surgery between flap and flapless group in mongrel dogs[12]. Also Vlahovic et al. in 2013 agreed with this study in comparison between both groups and found significant difference between both groups after three months periods[16].

Finally according to duration of surgical operation, it was obvious in this study the time for one implant placed with flapless procedure consumed less than that placed by flapped one.This resultmay be returned to the following reasons:

- There was no flap elevation in flapless surgical procedure (this reduce time of incision, flap elevation and reflection during the whole time of surgery).
- There was no need for suturing in flapless surgical procedure.
- The flapless procedure was less invasive than the flapped one so there was less trauma to the soft and hard tissue and that was leading to less bleeding in the surgical field that resulted rationally in faster and more comfortable work (less time required for blood suction and dryness of the surgical field).

These results coincided with previous studies [24,25]. Although there was another study established in 2010 by Lindeboom and Wijk that disagree with the results of this study, as they found that there was no significant difference in the time of surgical operation between flapless and flapped procedure. They concluded these results either real findings or due to lack of statistical power due to low number of samples used in their study[26].

Concerning the results and taking in consideration the limitations of this study, flapless surgical technique achieves implant stability significantly higher than traditional flapped technique with the period of three months after the surgery.Also flapless surgical technique can result in predictable survival rate within three months interval if good preoperative assessment and examination was done and the time of operation that flapless implant surgery consuming is very shorter than that of traditional flapped surgical one.

REFERENCES

1. Takie HH, Carranza FA, Kennedy EB,Lekovic. Flap technique for periodontal bone implants: papilla

preservation technique. J Periodontol 1985; 56: 204-10
2. Jones AA, Cochran DL. Consequences of implant designs. Dent Clin N Am 2006; 50 (3): 339-60.
3. Roman GG. Influence of flap design on peri implant interproximal crestal bone loss around single tooth implants. Int J Oral Maxillofac Implants 2001; 16: 61-67.
4. Choi BH, Jeong SM, Kim J, Engelke W. Flapless implantology. 1st ed. Germany, Nuremberg: Quintessence Publishing Co; 2010.pp. 2-81.
5. You TM, Choi BH, Li J, Xuan F, Jeong SM, Jang SO. Morphogenesis of the peri- implant mucosa: a comparison between flap and flapless procedures in the canine mandible. Oral Surg Oral Med Oral Pathol Oral RadiolEndod 2009; 107(1): 66-70.
6. Jeong SM, Choi BH, Li J, Kim HS, Ko CY, Jung JH. Flapless implant surgery: an experimental study. Oral Surg Oral Med Oral Pathol Oral RadiolEndod2007; 104: 24-8.
7. Kim JI, Choi BH, Li J, Xuan F, Jeong SM. Blood vessels of the peri-implant mucosa: a comparasion between the flap and flapless procedures. Oral Surg Oral Med Oral Pathol Oral RadiolEndod2009; 107 (4): 508-12.
8. Sclar AG. Guidelines for flapless surgery. J Oral MaxillofacSurg 2007; 65:20-32.
9. Bayounis AM, Alzoman HA, Jansen JA, Babay N. Healing of peri-implant tissues after flapless and flapped implant installation. J ClinPeriodontol. 2011; 38(8): 754-61
10. Campelo LD, Camara JR. Flapless implant surgery: a 10-year clinical retrospective analysis. Int J Oral Maxillofac Implants 2002; 17(2): 271–6.
11. Van de Velde T, Glor F, De Bruyn H. A model study on flapless implant placement by clinicians with a different experience level in implant surgery. Clin. Oral Impl Res 2008; 19: 66–72
12. Jeong SM, Choi BH, Kim J, Lee DH, Xuan F, Mo DU, Lee DH. Comparison of flap and flapless procedures for the stability of chemically modified SLA titanium implants: an experimental study in a canine model. Oral Surg Oral Med Oral Pathol Oral RadiolEndod 2011; 111: 170-3.
13. Meredith N, Alleyne D, Cawley P. Quantitative determination of the stability of the implant-tissue interface using resonance frequency analysis. Clin Oral Implants Res 1996; 7: 261-7.
14. Zix J, Hug S, Kessler-Liechti G, Mericske-Stern R. Measurement of dental implant stability by resonance frequency analysis and damping capacity assessment: comparison of both techniques in a clinical trial. Int J Oral Maxillofac Implants 2008; 23: 525-30.
15. Atsumi M, Park SH, Wang HL. Methods used to assess implant stability: current status. Int J Oral Maxillofac Implants. 2007; 22 (5): 743-54.
16. Vlahovic Z, Mihailovic B, Lazic Z, Golubovic M. Comparative radiographic and resonance frequency analyses of the peri-implant tissue after dental implants placement using flap and flapless techniques: An experimental study on domestic pigs. Vojnosanit Pregl 2013; 70(6): 586–94
17. Kim JH, Park HK, Kim MK, Kang SH. Life-threatening airway obstruction after flapless implant placement in the anterior mandible. J Korean Assoc Oral MaxillofacSurg 2012; 38: 310-3.
18. Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: A review and proposed criteria of success. Int J Oral Maxillofac Implants 1986; 1(1): 11-25.
19. Zarb GA, Albrektsson T. Consensus report: towards optimized treatment outcomes for dental implants. J Prosthet Dent 1998; 80(6): 641.
20. Becker W, Wikesjo UM, Sennerby L, Qahash M, HujoelP, Goldstein M, Turkyilmaz I. Histologic evaluation of implants following flapless and flapped surgery:a study incanines. J Periodontol 2006; 77 (10): 1717-22.
21. Cannizzaro G, Leone M, Consolo U, Ferri V,Esposito M. Immediate functional loading of implants placed with flapless surgery versus conventional implants in partially edentulous patients: a 3-year randomized controlled clinical trial. Int J Oral Maxillofac Implants. 2008; 23(5): 867-75.
22. Berdougo M, Fortin T, Blanchet E, Isidori M,Bosson JL. Flapless implant surgery using an image-guided system. A 1- to 4-year retrospective multicenter comparative clinical study. Clin Implant Dent Relat Res 2010; 12(2): 142-52.
23. Glauser R, Sennerby L, Meredith N, Re´e A, Lundgren A, Gottlow J,Hammerle CH. Resonance frequency analysis of implants subjected to immediate or early functional occlusal loading. Successful vs. failing implants. Clin Oral Implants Res2004; 15(4): 428-34.
24. Arisan V, Karabuda CZ, Ozdemir T. Implant surgery using bone- and mucosa-supported stereolithographic guides in totally edentulous jaws: surgical and post-operative outcomes of computer-aided vs. standard techniques. Clin Oral Implants Res 2010; 21(9): 980-8.
25. Cannizzaro G, Felice P, Leone M, Checchi V, Esposito M. Flapless versus open flap implant surgery in partially edentulous patients subjected to immediate loading: 1-year results from a split-mouth randomised controlled trial. Eur J Oral Implantol 2011; 4 (3): 177-88.
26. Lindeboom JA, van Wijk AJ. A comparison of two implant techniques on patientbased outcome measures: a report of flapless vs. conventional flapped implant placement. Clin Oral Implants Res 2010; 21(4): 366-70.