ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 07 | July - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

GUIDED FLAPLESS VERSUS CONVENTIONAL FLAPPED DENTAL IMPLANT SURGERY- A COMPARATIVE PROSPECTIVE STUDY

Oral & Maxillofacial Surgery

Balaraj B.V* Assistant Professor, Department of Oral & Maxillofacial Surgery, M.R. Ambedkar Dental College and Hospital, Bengaluru, Karnataka *Corresponding Author

Shruti A Tammannavar Consultant Oral & Maxillofacial Surgeon, Bengaluru, Karnataka

Anuradha V Consultant Oral & Maxillofacial Surgeon, Bengaluru, Karnataka

Vaibhav N Associate Professor, Department of Oral & Maxillofacial Surgery, M.R. Ambedkar Dental College and Hospital, Bengaluru, Karnataka

Sunil S P Associate Professor, Department of Oral & Maxillofacial Surgery, M.R. Ambedkar Dental College and Hospital, Bengaluru, Karnataka

Surbhi Consultant Dental Surgeon

ABSTRACT

Introduction: Guided/Flapless implant procedure aided by surgical stents prepared using CAD-CAM technology results in reproducible implant positions as planned pre-operatively provides better hard and soft tissue status. The high success rate was attributed to the higher precision of implant position and non-destruction of periodontal blood supply of flapless procedure by avoiding incisions. Also immediate loading of implants results in fewer surgical visits, thus reduces the duration of treatment. The purpose of this study is to compare and evaluate guided/flapless versus conventional/flapped placed implants clinically and radiographically. **Method:**In this study 30 medically fit patients of the age group of 18 to 50 years with single or multiple missing teeth are selected. Patients are divided randomly into group A- Guided/flapless procedure & B- conventional/flapped procedure, 15 patients in each group. Follow up was done for all patients at 1st, 3rd and 6th month after placement of implants to assess the amount of crestal bone loss and periodontal status of implant.**Results and Discussion:** Clinical, radiographic and statistical observations show that Guided/flapless procedure has both hard and soft tissue better outcome post-operatively. Thus the risk to benefit ratio must be assessed for each patient and evaluated separately. The results indicated that SURGICAL STENT guided implants placed with a flapless approach had decreased peri-implant bone crestal bone resorption and a milder postsurgical inflammatory reaction compared with implants placed with the conventional flap surgery.

KEYWORDS

Dental Implants, Guided/flapless Procedure, Conventional/flapped Procedure, Crestal Bone, Periodontal Status.

INTRODUCTION

Tooth loss is a burden for many patients as it affects both oral function and esthetics.[1] With advancements in dental science better modalities of tooth replacement came into existence, implant supported dental rehabilitation has become a common treatment option, with favourable survival rates, for replacing missing teeth and improving the quality of life of patients.[2-5] The developments were all concerned with the three primary goals of comfort, function and esthetics.[6-8]

A 2-dimensional periapical radiograph has been the standard in dentistry for aiding clinicians in the diagnosis and treatment planning for various procedures, which provides minimal information. When planning for dental implants, and especially when guided surgical applications are considered, it is essential that the true 3-dimensional anatomic presentation is understood and that all adjacent vital structures be accurately visualized.[9,10]

The advent and acceptance of 3-dimensional Computed Tomography (CT), and Cone Beam Computed Tomography (CBCT) in combination with interactive treatment planning software provides the clinicians with the ability to truly appreciate each patient's anatomic reality.[11-13] The team can now start with the end result, the planned tooth, and then place an implant into the correct position according to the restorative plan. The accurate and predictable placement of implants according to a computer-generated virtual treatment plan is now a reality, taking the virtual plan from the computer to the patient clinically.[14]

The conventional Branemark protocol requires a crestal incision with an extensive surgical flap elevation to assess the shape, and the volume of available jawbone and ensure that anatomical structures can be identified.[8,15-18] Thus implant placement is traumatic, resulting in postoperative inflammation and bone resorption.[19]

The term “guided surgery” in implant dentistry can be defined as a digital workflow that begins with the acquisition of data regarding the future patient prosthesis, continues with the digital processing of this information through virtual planning software, and ends with the production of the stereolithographic template via a prototyping system.[4,10] This techniques that can provide function, aesthetics and comfort with a minimally invasive surgical approach.[20]

As there are limited controlled data available to compare the clinical condition of both hard and soft tissue after flapless implant placement with the flap technique. The objective of the present study was to evaluate the crestal bone loss and periodontal status of implant.

MATERIALS AND METHODS

Study design

This present comparative prospective study was conducted at the department of oral and maxillofacial surgery from October 2017-October 2019. Before commencement of the study, ethical approval was attained from the Institutional Ethical Committee bearing reference number MRADC/ECIRB/2017-18. Prior informed consent was obtained from the study subjects. A total of 30 patients of either gender between 18 and 50 years with a patient demonstrating good general health/medically fit. Both partial and total edentulous patients having adequate bone for implant placement were included. Patients who fall under American Society of Anaesthesiologists III and IV, immune-compromised patients, patients with malignant conditions, anatomical situations requiring regenerative procedures prior or contemporaneous to the implant surgery were excluded from this study. A random selection of patients into Group A receiving implants with guided flapless surgery and Group B receiving traditional conventional flapped implants was done.

At the point of study, CTRI was not mandatory at the authors institution.

INCLUSION CRITERIA:

1. Patients demonstrating good general health/medically fit.
2. Both partial and total edentulous patients having adequate bone for implant placement are included.
3. No gender bias in the study.
4. Age group: 18-50 years.

EXCLUSION CRITERIA:

1. Immunocompromised patients.

2. Patients with malignant conditions.
3. Anatomical situations requiring regenerative procedures prior or contemporaneous to the implant surgery were excluded.

The radiographs, photographs and clinical evaluation done pre and post-operatively will be compared and evaluated

All procedures performed in the study were conducted in accordance with the ethics standards given in 1964 Declaration of Helsinki, as revised in 2013.

Data collection

Demographic data, including age and gender of the subjects, were recorded. In Group A, guided flapless surgery done after careful analysis of alveolar bone with the help of investigations such as Intra-oral scanner and CBCT of maxillary and mandibular arches. After analysing both intra-oral scan and CBCT both were merged together and surgical guides were produced in a stereolithographic process using digital data, it was also integrated with appropriate sleeves for the implant positioning, implant sizes were also pre-determined by combining the digital information of the bone with the planned restorative solution, the implant position can be adjusted to the best possible angulations, position, and depth over the digital software, thus developed stent used as a guide and implant placement and temporization done (Figure 1-10).

The conventional flapped technique was followed in Group B, followed by inducing respective blocks, incision placed with no.15 stainless steel BP blade extending into mucoperiosteum over the alveolar crest, adjunct vertical reliving incisions placed buccal at both ends of the crestal incision if required, mucoperiosteal flap raised implant placed and flap closure obtained with suturing following with temporization is done(Figure 11-14).

Evaluation of the surrounding investing layers was performed at 1st, 3rd and 6th month post implant placement. Postoperative assessment of the patient for crestal bone height surrounding the implant was done radiographically using IOPAR/RVG following Paralleling technique where 3 consecutive x-rays were taken scanned under 600dpi and measured, from coronal point on implant to the tip of crestal bone for all the 3 x-rays individually and the mean value was taken into consideration. CPITN Index was used for scoring periodontal status during all the 3 visits.

Data obtained was compiled systematically in Microsoft Excel 2016 spreadsheet and a master chart was prepared. Data was proof read and later presented in the form of graphs and tables. Statistical analysis performed using Statistical Package for Social science software (SPSS version 26). Depending upon the data nature, the statistical tests were chosen and tabulated(Table 1-4).

RESULT

Of the 30 patients enrolled for the study, there were 5 males and 10 females in Group A and 9 males and 6 females in Group B. The mean age of the patient in Group A and B was 34.67 years and 25.12 years, respectively. Most reported missing teeth were molars (Group A -.8 patients; Group B -.10 patients) followed by incisors (Group A -.4; Group B -.4), and premolars (Group A-.3; Group B -1).

The variable factors like implant position in the arch, pts. Age, habits history and medical conditions of the patients were evaluated for the control of possible confounding factors that could influence responses regarding the variables studied.

The mean vertical bone loss on both mesial and distal aspect of the implant during 1st month was comparably less and non-significant in both the groups. However, during 3rd and 6thmonth follow-up, the vertical bone loss became statistically significant and highly significant respectively, with more amount of bone loss especially on the distal aspect of the implant.

Whereas the soft tissue status analysed based on mean CPITN index score had a significant change during the 1st month follow-up which progressed to become highly significant between both the groups during consequent follow-ups at 3rd and 6th month. The mean scores of both the groups for both the parameters were subjected for Student t-test, to obtain P value.

Table 1: Measurement of Vertical crestal bone Mesial (mm) & Distal (mm) of conventional and guided surgery patient groups at 1st month, 3rd month and 6th month respectively

Statistics

Conventional vs Guided implant			1st month Vertical crestal bone loss: Mesial (mm)	3rd Month Vertical crestal bone loss: Mesial (mm)	6th Month Vertical crestal bone loss: Mesial (mm)	1st Month Vertical crestal bone loss: Distal (mm)	3rd Month Vertical crestal bone loss: Distal (mm)	6th Month Vertical crestal bone loss: Distal (mm)
Conventional Surgery	N	Valid	15	15	15	15	15	15
		Missing	0	0	0	0	0	0
	Mean		.0800	.2733	.3867	.0867	.3133	.5067
	Std. Deviation		.09411	.12799	.15976	.09155	.13020	.17099
	Minimum		.00	.10	.10	.00	.00	.20
	Maximum		.30	.50	.60	.20	.50	.80
Guided Surgery	N	Valid	14	14	14	14	14	14
		Missing	1	1	1	1	1	1
	Mean		.0286	.1071	.2286	.0429	.1071	.2286
	Std. Deviation		.06112	.08287	.06112	.05136	.07300	.08254
	Minimum		.00	.00	.10	.00	.00	.10
	Maximum		.20	.20	.30	.10	.20	.40

Table 2: Comparison of vertical crestal bone measurement between conventional and guided surgery: Mesial (mm)

Month	Conventional surgery Mean (SD)	Guided surgery Mean (SD)	P value †
1 month	.08 (.09)	.02 (.06)	0.095
3 month	.27 (.12)	.10 (.08)	<0.001**
6 month	.38 (.15)	.22 (.06)	0.002*

- P≤0.05 significant * p < 0.001 highly significant ** † Student t-test

Table 3: Comparison of vertical crestal bone measurement between conventional and guided surgery: Distal (mm)

Month	Conventional surgery Mean (SD)	Guided surgery Mean (SD)	P value †
1 month	.08 (.09)	.04 (.05)	0.127
3 month	.31 (.13)	.10 (.07)	<0.001**
6 month	.50 (.17)	.22 (.08)	<0.001**

- P≤0.05 significant * p < 0.001 highly significant ** † Student t-test

Table 4: Comparison of Soft tissue status between conventional and guided surgery using CPITN index

Month	Conventional surgery Mean (SD)	Guided surgery Mean (SD)	P value †
1 month	0.40 (.63)	0 (0)	0.028*
3 month	0.87 (.74)	.26 (.45)	<0.007**
6 month	1.46 (.99)	.60 (.63)	<0.002**

- P≤0.05 significant * p < 0.001 highly significant ** † Student t-test

DISCUSSION

The significant advantages and increasing popularity of flapless implantation resulted in a considerable number of clinical studies providing very less insight. The goal of the present prospective randomized clinical trial was to compare the placement of flapped vs. flapless dental implants utilizing custom clinical and radiographic findings to elicit the outcomes of crestal bone height and periodontal status.

After implant insertion, tissue repair requires the development of a vascular system at the site of injury for the delivery of oxygen and nutrients and the removal of cell debris for a complete healing process. Furthermore, after healing, blood vessels are important components for the formation and maintenance of healthy tissue. Berglundh et al and Moon et al reported that in implants that were placed with flap elevation procedures, the connective tissue located between the barrier epithelium and the marginal bone was poorly vascularized. Ericsson et al reported that the lack of blood vessels in the peri-implant mucosa may, in part, explain the more extensive progression of plaque-associated inflammation that occurred in the peri-implant mucosa than in the gingival tissue of the beagle dog.[21-23]

The flapless approach avoids elevation of mucoperiosteal flaps, the marginal bone level (MBL) might be maintained. The periosteum and supra-periosteal plexus provide osteogenic potential and blood supply to the underlying alveolar bone (lin2014) Engelke & Capobianco (2005) have described flapless sinus floor augmentation in combination with 3D planning based on CT. A less invasive trans-alveolar technique for sinus floor elevation with immediate implant placement was first suggested by Tatum (1986) and later developed as an osteotome technique by Summers in 1994 (Tatum 1986; Summers 1994).[24-26]

Studies have also shown that a flapless procedure during implant placement has a positive effect on alveolar bone remodelling process. However, controversial results have also been reported. In the studies by Froum et al. and De Bruyn et al. Crestal Bone Loss (CBL) around implants placed in healed sites using flapped and flapless surgery were

comparable.[27-29]

Peri-implant bone loss is a crucial parameter affecting implant success (Hermann et al. 1997). An often-underestimated factor affecting bone loss around implants is flap design. In the present study, flap elevation resulted in an average mesial vertical crestal bone resorption of 0.08, 0.27 and 0.38 mm at 1st, 3rd and 6th month and in flapless group was 0.02, 0.1 and 0.22 during the same period (TABLE 2). Whereas on distal aspect vertical crestal bone loss of 0.08, 0.31 and 0.50 mm noticed in flapped procedure and bone loss of 0.04, 0.1 and 0.22 mm was noticed during the same period (TABLE 3). The main attributing factor for bone loss in case of flapless technique was mainly due to improper oral hygiene maintenance and immediate loading. In a canine model, similarly reported mean bone resorption of 0.2 ± 0.3 mm in the flapped group 3 months after implant placement and no bone loss in the flapless group.[15] In a case series with 76 flapless implants placed in 44 patients, radiographic evaluation showed a small amount of bone loss during the 4-month healing process (Lee et al. in press). Similar resorption patterns were reported by Job et al. in a related small-scale comparative study (Job et al. 2008). More specifically, the radiographic evaluation 3 months after implant placement indicated 0.4-mm bone loss in the flapped group and 0.06 mm in the flapless group. Jeong et al placed 286 implants with a two-stage surgical protocol in 129 patients, 142 using the conventional flap approach and 144 using a mini-flap.[30] The radiographic evaluation, 3-4 months after implant placement, showed an average bone loss of 0.26 mm in the conventional flap group and 0.20 mm in the mini-flap group. The results of the flapped group are within the magnitude of the findings reported in the present study, while bone loss in the test group may be explained by the elevation of the mini-flap. In a case series involving flapless insertion and immediate loading of 51 implants in first mandibular molar region, the 3-month postoperative readings revealed an average bone resorption of 0.75 mm (Rao & Benzi 2007).[31,32] However, the investigators attributed the observed amount of bone loss to the immediate loading of the implants.

Based on the findings of the present prospective randomized controlled clinical trial and the existing relevant literature, bone loss is apparently minimal or even non-existent around flapless implants during the first preloading period of 3–6 months after implant placement. Other studies on flapless implants with longer follow-up periods indicate that there is no significant additional bone loss after implant loading.[30,31]

The mean values of the investigated clinical periodontal parameters were higher in the flapped compared with the flapless group at follow-up evaluations, with statistically significant differences in 1st month. In 3rd and 6th postoperative month periodontal parameters being statistically highly significant (TABLE 4). In agreement with these findings, You et al. (2009) in an experimental study showed that the flapped group had higher GI and bleeding on probing (BOP) compared with the flapless group (GI: 0.9 ± 0.5 and BOP: 0.7 ± 0.4 in the flapped group and zero values for both parameters in the flapless group), 3 months after implant placement.

Even though flapless surgery is “blind" procedure for the surgeon, the development of three-dimensional imaging techniques and computer-guided implantology have improved the accuracy in the preparation of dental implant site (Azari & Nikzad 2008; Van Assche et al. 2010; Verhamme et al. 2013). Flapless implant placement using soft tissue punch has various advantages, including the preservation of circulation, soft tissue architecture, and hard tissue volume at the site, decreased surgical time, improved patient comfort, and accelerated recuperation (Sclar 2007). The main limitation of soft tissue punch technique is surgeon's inability to submerge implants with inadequate primary stability, which increases the risk of implant micro-motion during the healing period and subsequent early implant failure.[19,21]

Even though the small number of participants may represent a limiting factor to the ability of the present randomized controlled clinical trial, flapless implant placement yielded improved clinical and radiographical outcomes to flapped implantation. However, although flapless implant placement exhibits significant advantages over conventional implant surgery, it is actually a “blind” procedure.

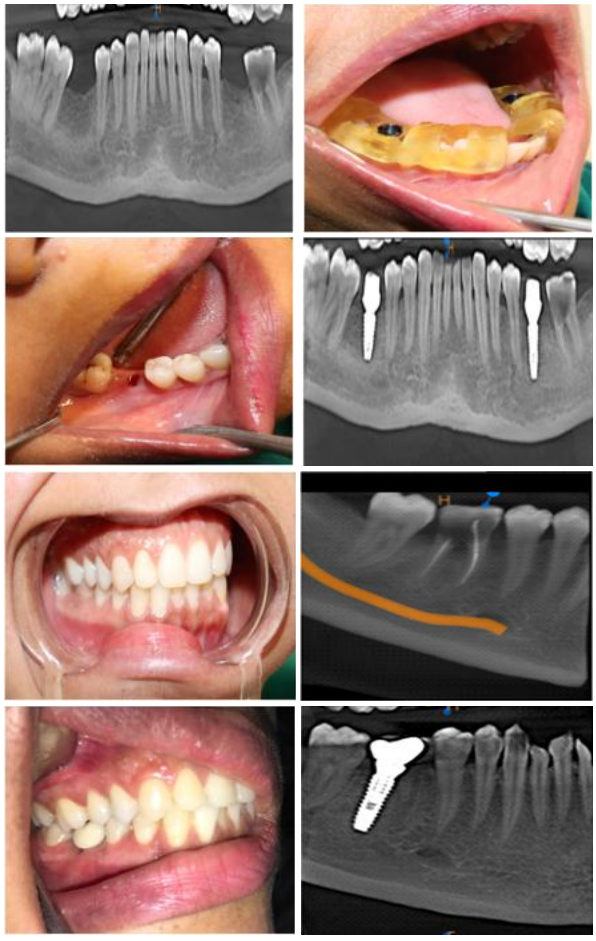
Therefore, both careful case selection without anatomic restrictions and adequate surgical experience is required for the flapless implantation approach.

CONCLUSION

The present comparative clinical trial compared flapped vs. flapless dental implantation procedures utilizing clinical and radiographic findings. The results indicated that SURGICAL STENT guided implants placed with a flapless approach had decreased peri-implant bone crestal bone resorption and a milder postsurgical inflammatory reaction compared with implants placed with the conventional flap surgery. Indicating its better outcome. More studies with larger sample sizes may further validate our findings.

LEGENDS

- **Figure 1 - Guided Surgery Pre-op X-ray**
- **Figure 2 - Surgical Stent Intra-Orally**
- **Figure 3 - Punch Cut**
- **Figure 4 - Guided Surgery Post-op X-ray**
- **Figure 5 - Coventional Implant Surgery Pre-op clinical pic**
- **Figure 6 - Coventional Implant Surgery Pre-op X-ray**
- **Figure 7 - Coventional Implant Surgery Prosthesis**
- **Figure 8 - Coventional Implant Surgery Post-op X-ray**



REFERENCES

1. Naeini EN, Atashkadeh M, De Bruyn H, D'Haese J. Narrative review regarding the applicability, accuracy, and clinical outcome of flapless implant surgery with or without computer guidance. Clinical Implant Dentistry and Related Research. 2020 Aug;22(4):454-67.
2. Greenberg AM. Digital technologies for dental implant treatment planning and guided surgery. Oral and Maxillofacial Surgery Clinics. 2015 May 1;27(2):319-40.
3. Bover-Ramos F, Viña-Almunia J, Cervera-Ballester J, Peñarrocha-Diago M, García-Mira B. Accuracy of Implant Placement with Computer-Guided Surgery: A Systematic Review and Meta-Analysis Comparing Cadaver, Clinical, and In Vitro Studies. International Journal of Oral & Maxillofacial Implants. 2018 Jan 1;33(1).
4. Tsoukaki M, Kalpidis CD, Sakellari D, Tsalikis L, Mikrogiorgis G, Konstantinidis A. Clinical, radiographic, microbiological, and immunological outcomes of flapped vs. flapless dental implants: a prospective randomized controlled clinical trial. Clinical oral implants research. 2013 Sep;24(9):969-76.
5. Kim JI, Choi BH, Li J, Xuan F, Jeong SM. Blood vessels of the peri-implant mucosa: a comparison between flap and flapless procedures. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2009 Apr 1;107(4):508-12.
6. Naeini EN, Dierens M, Atashkadeh M, De Bruyn H. Long term clinical outcome of single implants inserted flaplessly or conventionally. Clinical Implant Dentistry and Related Research. 2018 Oct;20(5):829-37.
7. Smitkarn P, Subbalekha K, Mattheos N, Pimkhaokham A. The accuracy of single tooth implants placed using fully digital guided surgery and freehand implant surgery. Journal of Clinical Periodontology. 2019 Sep;46(9):949-57.
8. Xu L, Wang X, Zhang Q, Yang W, Zhu W, Zhao K. Immediate versus early loading of flapless placed dental implants: a systematic review. The Journal of prosthetic dentistry. 2014 Oct 1;112(4):760-9.

9. Laverty DP, Buglass J, Patel A. Flapless dental implant surgery and use of cone beam computer tomography guided surgery. British dental journal. 2018 Apr;224(8):591-602.
10. Divakar TK, GideanArularasan S, Baskaran M, Packiaraj I, Dhineksh Kumar N. Clinical evaluation of placement of implant by flapless technique over conventional flap technique. Journal of maxillofacial and oral surgery. 2020 Mar;19(1):74-84.
11. Ganz SD. Three-dimensional imaging and guided surgery for dental implants. Dental Clinics. 2015 Apr 1;59(2):265-90.
12. Raico Gallardo YN, da Silva Olivio IR, Mukai E, Morimoto S, Sesma N, Cordaro L. Accuracy comparison of guided surgery for dental implants according to the tissue of support: a systematic review and meta analysis. Clinical Oral Implants Research. 2017 May;28(5):602-12.
13. Choi W, Nguyen BC, Doan A, Girod S, Gaudilliere B, Gaudilliere D. Freehand versus guided surgery: factors influencing accuracy of dental implant placement. Implant dentistry. 2017 Aug 1;26(4):500-9.
14. Jeong SM, Choi BH, Kim J, Xuan F, Lee DH, Mo DY, Lee CU. A 1-year prospective clinical study of soft tissue conditions and marginal bone changes around dental implants after flapless implant surgery. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2011 Jan 1;111(1):41-6.
15. Spector L. Computer-aided dental implant planning. Dental Clinics of North America. 2008 Oct 1;52(4):761-75.
16. Marlière DA, Demétrio MS, Picinini LS, De Oliveira RG, Netto HD. Accuracy of computer-guided surgery for dental implant placement in fully edentulous patients: A systematic review. European Journal of Dentistry. 2018 Jan;12(01):153-60.
17. D'haese J, Ackhurst J, Wismeijer D, De Bruyn H, Tahmaseb A. Current state of the art of computer guided implant surgery. Periodontology 2000. 2017 Feb;73(1):121-33.
18. Al-Ekrish AA. Radiology of Implant Dentistry. Radiologic Clinics of North America. 2017 Oct 16;56(1):141-56.
19. Vlahovic Z, Markovic A, Golubovic M, Scepanovic M, Kalanovic M, Djinic A. Histopathological comparative analysis of peri implant soft tissue response after dental implant placement with flap and flapless surgical technique. Experimental study in pigs. Clinical oral implants research. 2015 Nov;26(11):1309-14.
20. Orentlicher G, Abboud M. Guided surgery for implant therapy. Oral and Maxillofacial Surgery Clinics. 2011 May 1;23(2):239-56.
21. Fornell J, Johansson LÅ, Bolin A, Isaksson S, Sennerby L. Flapless, CBCT guided osteotome sinus floor elevation with simultaneous implant installation. I: radiographic examination and surgical technique. A prospective 1 year follow up. Clinical oral implants research. 2012 Jan;23(1):28-34.
22. 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 Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2009 Jan 1;107(1):66-70.
23. Maier FM. Initial Crestal Bone Loss After Implant Placement with Flapped or Flapless Surgery--A Prospective Cohort Study. International Journal of Oral & Maxillofacial Implants. 2016 Jul 1;31(4).
24. Jeong SM, Yoo JH, Fang Y, Choi BH, Son JS, Oh JH. The effect of guided flapless implant procedure on heat generation from implant drilling. Journal of Cranio-Maxillofacial Surgery. 2014 Sep 1;42(6):725-9.
25. Bencharit S, Staffen A, Yeung M, Whitley III D, Laskin DM, Deeb GR. In vivo tooth-supported implant surgical guides fabricated with desktop stereolithographic printers: fully guided surgery is more accurate than partially guided surgery. Journal of Oral and Maxillofacial Surgery. 2018 Jul 1;76(7):1431-9.
26. Monaco C, Arena A, Corsaletti L, Santomauro V, Venezia P, Cavalcanti R, Di Fiore A, Zucchelli G. 2D/3D accuracies of implant position after guided surgery using different surgical protocols: a retrospective study. Journal of Prosthodontic Research. 2020;64(4):424-30.
27. Vohra F, Al Kheraif AA, Almas K, Javed F. Comparison of crestal bone loss around dental implants placed in healed sites using flapped and flapless techniques: a systematic review. Journal of periodontology. 2015 Feb 1;86(2):185-91.
28. Seo C, Juodzbalys G. Accuracy of guided surgery via stereolithographic mucosa-supported surgical guide in implant surgery for edentulous patient: a systematic review. Journal of Oral & Maxillofacial Research. 2018 Jan;9(1).
29. Shamsan YA, Eldibany RM, El Halawani GN, Fahmy RA. Flapless versus conventional flap approch for dental implant placement in the maxillary esthetic zone. Alexandria Dental Journal. 2018 Aug 1;43(2):80-5.
30. Becker W, Goldstein M, Becker BE, Sennerby L, Kois D, Hujoel P. Minimally invasive flapless implant placement: follow up results from a multicenter study. Journal of periodontology. 2009 Feb;80(2):347-52.
31. Jeong SM, Choi BH, Li J, et al. Flapless Implant Surgery: An experimental study.Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;104:24-28.
32. Zhou W, Liu Z, Song L, Kuo CL, Shafer DM. Clinical factors affecting the accuracy of guided implant surgery—a systematic review and meta-analysis. Journal of Evidence Based Dental Practice. 2018 Mar 1;18(1):28-40.