ISSN (O) : 2582-3271
PubMed-National Library of Medicine - ID: 101766917

International Journal of Dental Science and Clinical Research (IJDSCR)

Dr. Angel Vaidic Publication

Available Online at: http://www.ijdscr.org

Volume - 6, Issue – 1, February - 2024, Page No. : 27 – 37

A Clinicoradiographic Evaluation of Crestal Bone Level Changes Following Flapless and Conventional Flap Techniques of Implant Placement

[1]Dr. Akhilesh Sankhyayan, [2]Dr. Anil Sharma, [3]Dr. Shiva Chauhan, [4]Dr. Vikas Jindal

[1]Private Practitioner, Sankhyayan Dental Care and Implant Centre, Shimla, Himachal Pradesh, India

[2]Medical officer (Dental), Health and Family Welfare Department, Himachal Pradesh, India

[3]Reader, Dept. of Periodontics, Himachal Dental College, Sundernagar, Himachal Pradesh, India

[4]HOD, Department of Periodontics, Himachal Dental College, Sundernagar, Himachal Pradesh, India

Citation of this Article: Dr. Akhilesh Sankhyayan, Dr. Anil Sharma, Dr. Shiva Chauhan, Dr. Vikas Jindal, "A Clinicoradiographic Evaluation of Crestal Bone Level Changes Following Flapless and Conventional Flap Techniques of Implant Placement.'' IJDSCR – February – 2024, Vol. – 6, Issue - 1, Page No. 27-37.

Corresponding Author: Dr. Anil Sharma, Medical officer (Dental), Health and Family Welfare Department, Himachal Pradesh, India

Type of Publication: Original Research Article

Conflicts of Interest: Nil

ABSTRACT

Background

To investigate the crestal bone changes following Flapless versus conventional flap technique of implant placement.

Aims and Objective

A clinicoradiographic evaluation of crestal bone level changes following flapless and conventional flap techniques of implant placement

Methods

A prospective randomized comparative study was conducted in thirty edentulous sites of patients with age group of 18 to 50 years, comprising both male and female patients visiting the Out-patient Department of Periodontics, Himachal Dental College, Sundernagar Himachal Pradesh.. Radiographic Assessment (RA) for crestal bone changes and clinical parameters were recorded at baseline (1 month), 3 months and 6 months; clinical parameters included modified plaque index and modified sulcus bleeding index

Results

On intergroup comparison, the mean difference of the crestal bone loss between Group I and Group II showed that Group II had slightly higher bone loss (Table I & II) than Group I during 1st to 3rd month and 3rd to 6th month period and on intergroup

comparison there was an increase in the mean difference value of modified plaque index (Table V) from baseline to 3rd months and the decrease from 3rd month to 6th month in Group I and Group II. Intergroup analysis showed statistically non-significant decrease in modified sulcus bleeding score from baseline, 3month and 6 month between Group I and Group II (Table VIII).

Conclusion

Within the limitation of this study, it can be concluded that there was significantly less crestal bone loss in Group I (Flapless) around dental implant placement in flapless technique at both mesial and distal aspects during 3rd to 6th month observation period . Also slight bone resorption was observed over the time in both the groups but , crestal bone loss is less in case of flapless technique. This study showed that in flapless technique, there is reduced invasiveness of surgery and thus reduced surgical outcomes such as pain , hematoma and edema. However, considering the debate on efficacy of flapless over conventional flap procedure, further studies are required to evaluate the same.

Keywords

Crestal bone loss, delayed implant, osseointegration

INTRODUCTION

Dental implants were designed to eliminate the challenges involved in conventional prosthesis therapy.[i] This significant advancement originated with the late 1960s research efforts of Swedish orthopaedic physician Branemark et al. (1997)[ii] who pioneered the use of machined screw-type commercially pure titanium (cpTi) implants with little surgical trauma. Implant success depends upon how it osteointegrates with the host bone and withstand occlussal forces. To ensure long-term success, the implants must be rigidly fixed within the host bone site. Branemark et al. (1997) described osteo-integration as "a direct structural and functional link between organized live bone and the surface of a load-bearing implant." It is dependent on various aspects, including the metal's biocompatibility, the implant's design and surface condition, the host bed's state, the surgical method employed, and the loading condition imposed. The surgery for implant placement is performed in two stages- Implant placement and prosthetic restoration. Implant placement with flap elevation needs suturing and is related to some degree of morbidity and discomfort[iii]. A previous study has also revealed that flap reflection often results in gingival recession and bone resorption around natural teeth.

Over the last three decades there have been multiple modification in treatment modalities[iv], including placement without flap elevation which require greater skill on the part of surgeon to visualize anatomic landmarks and vital structures. Several benefits have contributed to making flapless surgery of dental implants a widely sought-after procedure for both doctors and patients.

- Flapless technique of implant placement causes less morbidity and more patient comfort. All the studies agree that the postoperative period in these cases is much less symptomatic in contrast to conventional surgery.[v,vi,vii,viii,ix]
- Flapless surgery reduces the amount of surgical stress leading to a early recovery with no scar and minimal complications. Absence of sutures adds to the appearance of the surgical region after the procedure.[x]
- The blood supply in flapless surgery is affected little in comparison to procedures which have big flaps as the latter must be constructed broad-based to avoid flap necrosis[14] . The flap reflection causes

a decrease in the blood supply of the supraperiosteum arteries, it will have a negative impact on the bone's own vascularization. In these instances, bone loss is likely when a mucoperiosteum flap reflection is used[xi].

- The absence of a flap has led to considerably decreased blood extravasation, resulting in a cleaner surgical area and shorter post-operative times[18]
- The lack of flap and suturing reduces the amount of time spent in surgery, making it easier for most patients.[12-14]
- Flapless technique of implant placement has high survival rates. In Brodala's systematic revision,[xii] there are fourteen studies, its results show a survival of 98.6% in the flapless implants , and of 95.9% in the retrospectives.

Taking into consideration the various studies mentioned in the literature about the flapless vs flap approach for implant placement, this study was done to coraborate the findings in the literature and to reach to a particular consensus/result for the benefit of public at large.

MATERIAL AND METHODS

A prospective randomized comparative study was conducted in thirty edentulous sites of patients with age group of 18 to 50 years, comprising both male and female patients visiting the Out-patient Department of Periodontics. The patients were randomly allocated for flapless technique and with conventional flap technique for implant placement and each patient was explained the details about the risk and benefits of participation in this study. Only those patients were included in the study that satisfied the following inclusion and exclusion criteria.

Inclusion Criteria

Systemically healthy patients with age group(18-50) years with adequate bone width with fully healed extraction socket, according to pre treatment intraoral radiographs. Patient must have full mouth plaque score < 30% and full mouth bleeding score < 30%

Exclusion Criteria

Patient having poor oral hygiene, non compliant patient, patient having drug or alcohol abuse, smokers, patients having any periapical pathology or pathology at recipient site, patient having irradiation in implant area, pregnant women and lactating mothers.

Patients who satisfied the inclusion criteria were randomly allocated to:

- **In Group I** (test group) :- Delayed implant placement by flapless approach
- **In Group II** (Control group) :- Delayed implant placement by conventional flap technique.

SURGICAL PROCEDURE

All the surgical procedures were performed under local anaesthesia and strict aseptic conditions. Facial skin all around the oral cavity was scrubbed with povidone iodine solution (5%) and the patient was made to rinse with 0.12% Chlorhexidene digluconate mouthrinse for one minute prior to surgery. The area of surgery was anesthetized using 2% lidocaine with adrenaline concentration of 1: 200000

For group I, Tissue punch guide is used to punch out soft tissue with tissue punch. The punch is made with a circumferential rotary blade at low speed (100rpm). Osteotomy was initiated by using a pilot drill of 2 mm to drill the bone according to implant size. Subsequent drilling was done to prepare the site according to the selected implant size, with copious irrigation. Minimum of 35–40 N-cm of torque was achieved which ensured the primary stability of the implant.

After complete insertion of the implant into the bone, the healing cap was tightened to protect central screw hole and suturing was done with 3–0 black silk suture IOPA radiograph was taken after the procedure to confirm complete insertion of the implant.

For group II, a sub-crestal incision was given to reflect the mucoperiosteal flap. The osteotomy was initiated using a pilot drill of 2 mm followed by sequential drilling to prepare the site according to the selected implant size. Copious irrigation with saline was done during the surgical procedure. The implant was inserted with the help of insertion tool and a torque wrench. Minimum of 35–40 N-cm of torque was achieved which ensured the primary stability of the implant. After complete insertion of the implant into the bone, the healing cap was tightened to protect central screw hole and suturing was done with 3–0 black silk suture. IOPA radiograph was taken after the procedure to confirm complete insertion of the implant.

POST SURGICAL

Patients were prescribed antibiotic and anti-inflammatory course comprising of Amoxicillin and Clavulanic acid (625) thrice daily for 5 days and Ibubrofen (400mg) thrice daily for 5 days and were instructed to maintain a relatively cold diet for 24 hours and soft diet for first few days and gradually return to normal diet. Patient were advised to avoid brushing on the operated site for 10 days. Patients were advised 0.12% Chlorhexidene digluconate mouth rinse for 1 minute three times daily for 14 days, one day after the day of surgey.

RADIOGRAPHIC ASSESSMENT

Standardized intraoral peri-apical radiograph with Radio Visual Graph (R.V.G.) was obtained for each implant site at baseline, 3rd and 6th month after placement of the implant. The X-ray unit with long cone paralleling technique was used. The level of crestal bone was measured on the mesial and distal aspect of each implant. The reference point was from implant shoulder to the crest of interproximal alveolar bone. To assess the changes in bone hieght, the distance between the implant shoulder and the first visible bone implant contact (DIB) was determined by measuring the squares on radiograph and expressed in millimeters.

CLINICAL PARAMETERS ASSESSED

The periodontal status was evaluated at baseline (1 month), 3rd and 6th month according to the following indices from the day of implant placement.

1. **Modified Plaque index (mPI) by Mombelli et al :**Mombelli and coworkers modified Silness and Loe's original Plaque Index to assess Biofilm development in the marginal area around Implants. The parameters were assessd at 1 month, 3 month and six month after implant placement. MPI was measured around implant using following scale: 0 no plaque, 1 : plaque on probing, 2: visible plaque and 3, abundant plaque. One plaque value was obtained based on the average of obtained plaque value.
2. **Modified sulcus bleeding index by Mombeli et al (1987)**

   Modified sulcus bleeding index [mSBI] was measured at four surfaces around implant. mSBI was scored as 0 : no bleeding when aperiodontal probe is passed along the mucosal margin adjacent to implant, 1: Isolated bleeding space visible, 2: Blood forms a confluent red line in the mucosal margin, 3:Heavy or profuse bleeding. For each implant, one mSBI value was calculated based on the average of four obtained values.

RESULTS

The periodontal status was clinically and radiographically evaluated at baseline (1 month after implant placement) 3rd and 6th month according to the following indices from the day of implant placement.

I. RADIOGRAPHIC ASSESSMENT (RA)

i. CRESTAL BONE LOSS (CBL) Mesial

Intragroup analysis of mean Crestal Bone Loss (mesial) value in **Group I and Group II** at baseline, **3 months** and 6 months is shown in **Table 1 and Graph 1 .**

Intergroup analysis showed a statistically non-significant difference in mean values of CBL in both Group I and Group II at **baseline** (p value 0.240),**3 months** (p value 1.000) **and** the analysis of **6 months** is statically significant (p value 0.006), at different time periods as shown in **Table 2** and **Graph 2**.

Table 1: Intragroup Comparison of Mesial Crestal Bone Loss in Group I and Group II at Different Time Intervals

		Values at designated intervals		Change from baseline		Significance of Difference Using Wilcoxon Signed Ranks Test		
		Mean	S.D.	Mean	S.D.	Z	P value	Sig
GROUP I (Test)	Baseline	0.49	0.08	-	-	-	-	-
	3month	0.60	0.05	-0.11	0.08	-3.017	0.003	S
	6month	0.65	0.05	-0.17	0.08	-3.345	0.001	S
GROUP II (Control)	Baseline	0.52	0.07	-	-	-	-	-
	3month	0.60	0.08	-0.08	0.08	-2.652	0.008	S
	6month	0.71	0.05	-0.19	0.09	-3.370	0.001	S

Graph 1: Intragroup Comparison of Mesial Cretsal Bone Loss at Different Time Intervals

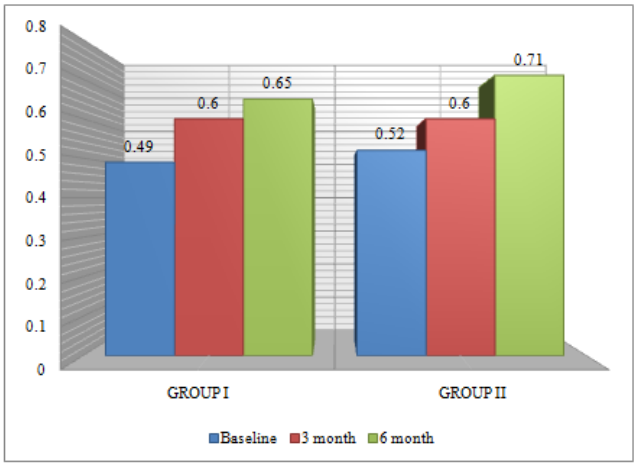
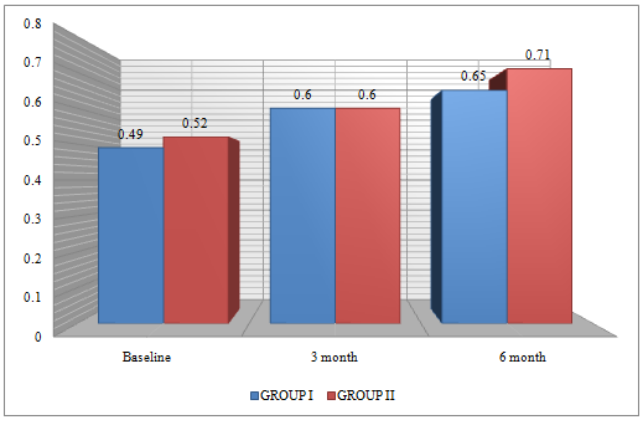


Table 2: Intergroup Comparison Of Mesial Crestal Bone Loss Between Group I And Group II At Different Time Intervals

	GROUP I (Test)		GROUP II (Control)		Comparison done using Mann-Whitney U Test		
	Mean	SD	Mean	SD	Z-value	P-value	Sig.
Baseline	0.49	0.08	0.52	0.07	-1.176	0.240	NS
3months	0.60	0.05	0.60	0.08	0.000	1.000	NS
6months	0.65	0.05	0.71	0.05	-2.773	0.006	S

Graph 2: Intergroup Comparison of Mesial Crestal Bone Loss at Different Time Intervals



ii. CRESTAL BONE LOSS (CBL) Distal

Intragroup analysis of mean Crestal Bone Loss (distal) value in **Group I and Group II** at baseline, 3 months and 6 months is shown in **Table 3 and Graph 3.**

Intergroup analysis showed a statistically non-significant difference in mean values of CBL in both

Group I and Group II at **baseline** (p value 0.924),**3 months** (p value 0.073) **and** the analysis of **6 months** is statically significant(p value 0.001), at different time periods as shown in **Table 4** and **Graph 4**.

Table 3: Intragroup Comparison of Distal Crestal Bone Loss in Group I And Group II At Different Time Intervals

		Values at designated intervals		Change from baseline		Significance of Difference Using Wilcox on Signed Ranks Test		
		Mean	S.D.	Mean	S.D.	Z	P value	Sig
GROUP I (Test)	Baseline	0.51	0.05	-	-	-	-	-
	3month	0.61	0.05	-0.09	0.02	-3.742	<0.001	S
	6month	0.69	0.05	-0.18	0.06	-3.482	<0.001	S
GROUP II (Control)	Baseline	0.51	0.07	-	-	-	-	-
	3month	0.64	0.05	-0.13	0.05	-3.416	0.001	S
	6month	0.74	0.05	-0.23	0.09	-3.438	0.001	S

Graph 3: Intragroup Comparison of Distal Crestal Bone Loss at Different Time Intervals

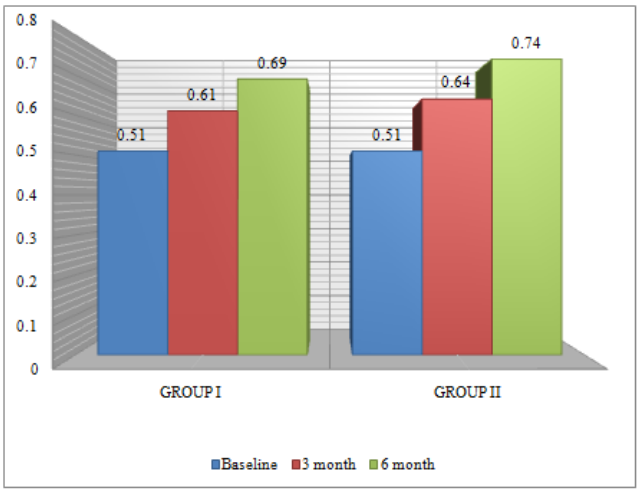
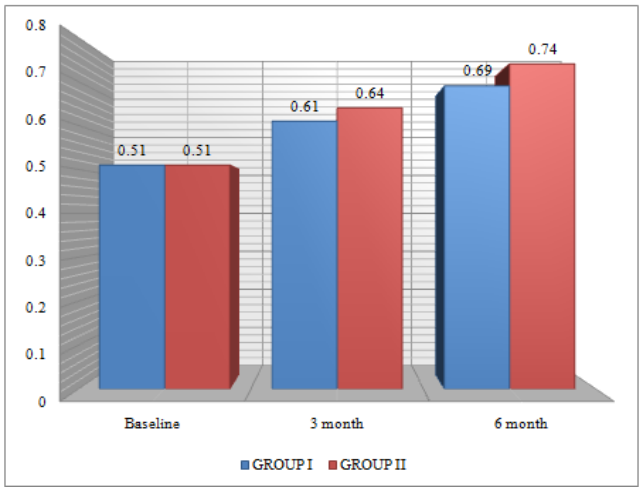


Table 4: Intergroup Comparison of Distal Crestal Bone Loss between Group I and Group Ii At Different Time Intervals

	GROUP I (Test)		GROUP II (Control)		Comparison done using Mann-Whitney U Test		
	Mean	SD	Mean	SD	Z-value	P-value	Sig.
Baseline	0.51	0.05	0.51	0.07	-0.095	0.924	NS
3months	0.61	0.05	0.64	0.05	-1.791	0.073	NS
6months	0.69	0.05	0.74	0.05	-2.659	0.001	S

Graph 4: Intergroup Comparison of Distal Crestal Bone Loss at Different Time Intervals



II. CLINICAL PARAMETERS

i. MODIFIED PLAQUE INDEX (mPI)

Intragroup analysis of mean modified plaque index (mPI) value in **Group I and Group II** at baseline, 3 months and 6 months is shown in **Table 5 and Graph 5.**

Intergroup analysis showed a statistically non-significant difference in mean values of plaque index in both **Group I and Group II** at **Baseline** (p value 0.710), **3 months** (p value 0.777) **and 6 months** (p value 0.753), at different time periods as shown in **Table 6 and Graph 6**.

Table 5: Intragroup Comparison of Modified Plaque Index in the Test and Control Group at Different Time Intervals

		Values at designated intervals		Change from baseline		Significance of Difference Using Wilcoxon Signed Ranks Test		
		Mean	S.D.	Mean	S.D.	Z	P value	Sig
GROUP I (Test)	Baseline	0.31	0.15	-	-	-	-	-
	3month	1.19	0.36	-0.89	0.33	-3.436	0.001	S
	6month	0.69	0.16	-0.39	0.19	-3.349	0.001	S
GROUP II (Control)	Baseline	0.32	0.15	-	-	-	-	-
	3month	1.21	0.21	-0.89	0.25	-3.422	0.001	S
	6month	0.70	0.15	-0.38	0.18	-3.354	0.001	S

Graph 5: Intragroup Comparison of Modified Plaque Index in Group I and Group II at Different Time Intervals

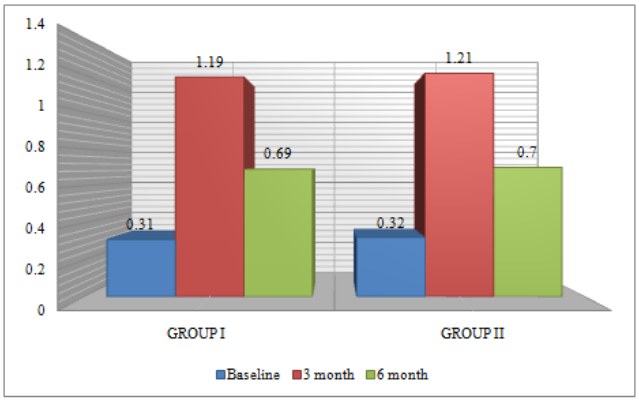
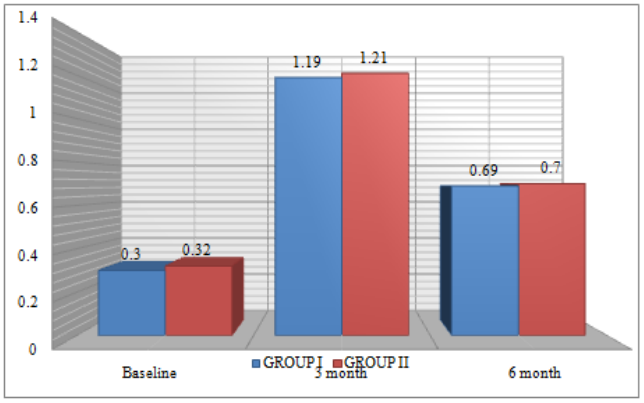


Table 6: Intergroup Comparison of Modified Plaque Index between Group I and Group II At Different Time Intervals

	GROUP I (Test)		GROUP II (Control)		Comparison done using Mann-Whitney U Test		
	Mean	SD	Mean	SD	Z-value	P-value	Sig.
Baseline	0.30	0.15	0.32	0.15	-0.372	0.710	NS
3months	1.19	0.36	1.21	0.19	-0.283	0.777	NS
6months	0.69	0.16	0.70	0.12	-0.315	0.753	NS

Graph 6: Intergroup Comparison of Modified Plaque Index between Group I and Group II at Different Time Intervals



ii. MODIFIED SULCUS BLEEDING INDEX (mSBI)

Intragroup analysis of mean modified Sulcus Bleeding Index (mSBI) value in **Group I and Group II** at baseline, 3 months and 6 months is shown in **Table 7 and Graph 7.**

Intergroup analysis showed a statistically non-significant difference in mean values of gingival index in both Group I and Group II at **baseline** (p value 0.464),**3 months** (p value 0.417) **and 6 months** (p value 0.674), at different time periods as shown in **Table 8** and **Graph 8**.

Table 7: Intragroup Comparison of Modified Sulcus Bleeding Index In Group I And Group II At Different Time Intervals

		Values at designated intervals		Change from baseline		Significance of Difference Using Wilcoxon Signed Ranks Test		
		Mean	S.D.	Mean	S.D.	Z	P value	Sig
GROUP I (Test)	**Baseline**	0.34	0.15	-	-	-	-	-
	3month	0.97	0.19	-0.63	0.27	-3.429	0.001	S
	6month	0.68	0.12	-0.34	0.21	-3.217	0.001	S
GROUP II (Control)	**Baseline**	0.30	0.15	-	-	-	-	-
	3month	1.03	0.24	-0.73	0.24	-3.432	0.001	S
	6month	0.68	0.19	-0.38	0.23	-3.211	0.001	S

Graph 7: Intragroup Comparison of Modified Sulcus Bleeding Index in Group I and Group II at Different Time Intervals

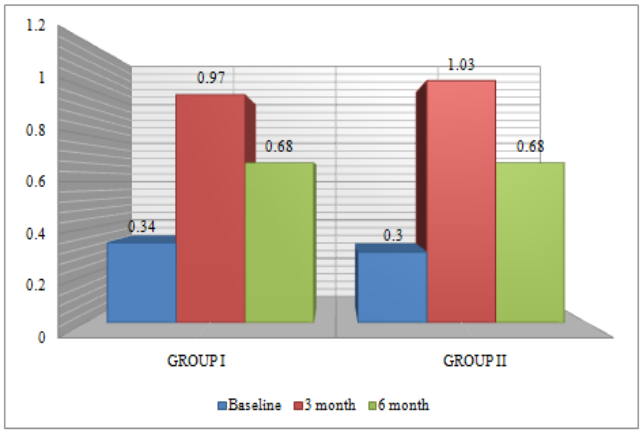
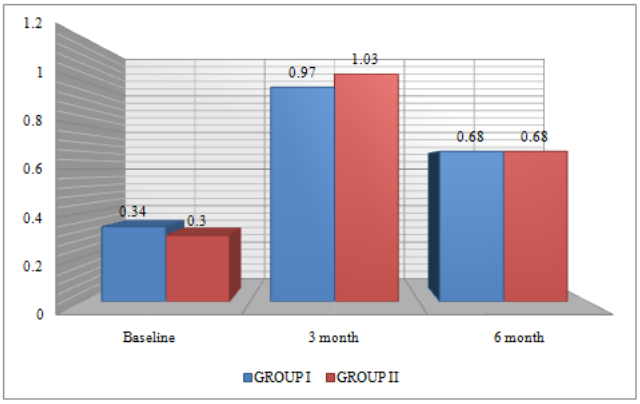


Table 8: Intergroup Comparison of Modified Sulcus Bleeding Index In Between Group I and Group II at Different Time Intervals

	GROUP I (Test)		GROUP II (Control)		Comparison done using Mann-Whitney U Test		
	Mean	SD	Mean	SD	Z-value	P-value	Sig.
Baseline	0.34	0.15	0.30	0.15	-0.733	0.464	NS
3months	0.97	0.19	1.03	0.24	-0.811	0.417	NS
6months	0.68	0.12	0.68	0.19	-0.420	0.674	NS

Graph 8: Intergroup Comparison of Modified Sulcus Bleeding Index In Between Group I and Group II at Different Time Intervals



DISCUSSION

Standardized intraoral peri-apical radiograph were obtained for each implant site at baseline, 3rd and 6th month after placement of the implant. The X-ray unit with long cone paralleling device was used. The level of bone was measured on the mesial and distal aspect of each implant. The reference point was taken from implant shoulder to the crest of interproximal alveolar bone. To assess the crestal bone loss, the distance between implant shoulder and the first visible bone-implant contact (FBIC) was determined by measuring the squares on radiograph and expressed in millimetres. Clinical parameters i.e. modified Plaque index (mPI), modified Sulcus Bleeding Index (mSBI) were measured at baseline (1 month after implant placement), 3 months and 6 months.

I. RADIOGRAPHIC ASSESSMENT

CRESTAL BONE LOSS (MESIAL & DISTAL)

Radiographic interpretation of alveolar bone loss has been proven to be one of the most valuable means to elucidate implant success as stated by **Dehlin C, et al. (1988)**.[xiii]The mean crestal bone loss on both mersial and distal sides in both the groups, increased from baseline, 3 months and 6 months at different time intervals .

The results were similar with the study done by **Esposito M (2009)**[xiv]who stated that peri-implant bone loss is more accentuated in the first 6 months after surgery**.** In the present study the bone loss after the placement of prosthesis was less than 1.5 mm, which was in accordance with the established criteria for the assessment of marginal bone level change that should be less than 1.5 mm for first year post loading of the prosthesis and less than 0.2 mm of additional loss for each following year. **Albrektson T, et al. (1986),**[8] **Smith DE (1989).**[xv] **Warren, et al. (2002),**[xvi]reported that crestal bone loss of between 1.0 and 1.5 mm may occur after second stage implant surgery and after prosthesis loading. After second stage implant surgery, post surgical bone loss occurs due to the mucoperiosteal flap reflection. This process starts with accelerated resorptive activity and, in humans begins within a few days post surgery. It typically peaks at 1 to 2 months and may take more than 6 months to subside, **Yaffe A, et al. (1994).**[xvii]**Cardaropoli G (2003),**[xviii] suggested that the bulk of bone resorption, following implant surgery, occurs within the first few months, or even weeks, post implantation. This may be due to bone remodeling, which is very active after 8 weeks of healing and presents a diverse degree of bone maturation

CLINICAL PARAMETERS

i. MODIFIED PLAQUE INDEX (mPI)

Plaque control is essential to minimize the influence of excessive plaque accumulation on long term stability outcomes. Clinical outcome of various forms of surgical interventions are influenced by general level of oral hygiene. In both **Group I** and **Group II,** the mean plaque score at different time periods from baseline to 3 months were slightly increased as shown in **Table 5** and **Graph 5**. On intergroup comparison there was an increase in the mean difference value of **modified plaque index** from **baseline to 3 months** and the decrease from **3rd month to 6th month** in **Group I (Test)** and **Group II (Control)** . The score was statistically non significant at all the time intervals in both groups. On Intragroup comparison of mean difference of plaque index in different time intervals from baseline to 3 months and baseline to 6 months, were statistically significant as shown in **Table 5** and **Graph 5.**

The increased results in different time periods were in accordance to the studies done by **Weber, et al. (2000),[xix]Renvert, et al. (2009),[xx]SasiKumar, et al. (2013),[xxi]Sekar, et al. (2019),[xxii]** these studies yielded the same results that due to lack of oral hygiene maintenance plaque score slightly increased after the placement of prosthesis. But repeated oral hygiene instructions given to patients throughout the follow up study period could be the reason of improved plaque score from 3 to 6 months. The reduction in plaque index score were in accordance with the studies done by**Fengwang etal. (2016)[67], Anjani Kumar Pathak et al. (2021)[76], NidhiMehrotra etal. (2021)[76],** who stated that repeated oral hygiene instructions given to the patients throughout the follow up study period and regular practicing of brushing by the patient from 3 to 6 month lead to reduction in plaque accumulation. In a study done by **Fengwang et al. (2016)[1]**there were changes in mPI for both groups in the first 4 weeks post-surgery.At 2-week post-surgical appointment, therewas a trend for a decrease mPI score ingroup with flap surgery, compared to 1-week post-surgery,which had statistical significant differences.By 3 months after crown delivery, group with flap surgeryhad statistically significantly better mPI scores compared to 1 week post-surgeryand were sustained stable through 24 months.

ii. MODIFIED SULCUS BLEEDING INDEX (mSBI)

In the present study modified sulcus bleeding index was assessed using index given by **Mombelli in 1987** for the purpose of assessing the severity of gingivitis and examining the qualitative changes of the gingival soft tissue. On intra-group comparison of Modified sulcus bleeding index score from baseline to 3 month increased in both **Group I** and **Group II**, and then decreased from 3 month to 6 month, the results were found to be statistically significant in both the groups as shown in **Table 7, Graph 7**. This can be attributed to the fact that after loading the implant hygiene could not be well maintained in the subgingival regions, but later when the repeated reinforcements of oral hygiene measures were given to the patient the inflammation subsided and so did bleeding on probing.

Intergroup analysis showed statistically non-significant decrease in modified sulcus bleeding score from baseline, 3month and 6 month between **Group I** and **Group II** as shown in **Table 8 and Graph 8**. But the results were better in the flapless group, in accordance with **Fengwangetal.[67],** who stated that, by 3 months after crown delivery, flap surgery group had statistically significantly better mSBI scores compared

to 1 week post-surgery and were sustained stable through 24 months.

CONCLUSION

Within the limitation of this study, it can be concluded that there was significantlly less crestal bone loss in **GROUP I (TEST)** around dental implant placement in flapless technique at both mesial and distal aspects during **3rd to 6th month** observation period . Also slight bone resorption was observed over the time in both the groups but , crestal bone loss is less in case of flapless technique. This study showed that in flapless technique, there is reduced invasiveness of surgery and thus reduced surgical outcomes such as pain , hematoma and edema. This study show that flapless technique, may offer advantage in terms of both soft and hard tissue changes when compared with the conventional technique in spite of almost comparable results reported for flapless and conventional techniques, it is very important to understand the risk factors to each procedure, to have careful case selection and to closely follow the surgical and prosthetic protocols. However, considering the debate on efficacy of flapless over conventional flap procedure, further studies are required to evaluate the same.

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