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Comparative Evaluation of Crestal Bone Changes after Delayed and Immediate Implant Placement

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Abstract

Implants serve as a foundation for prosthetic support. The purpose of this study was to evaluate and compare buccolingual and interproximal crestal bone changes after delayed and immediate platform switched, acid etched implant (SLA), without the use of graft or barrier membrane clinically as well as radio graphically.

Method: 14 implants were included in study and clinical and radiographic parameters i.e. buccolingual bone width (BLW), interproximal crestal bone height (CBH), Keratinized mucosa index score (KMI), Jemt papilla fill index score (PFI), probing attachment levels (PAL) were analyzed at baseline, 3 months and 6 months in immediate and delayed implant group (A,B).

Results: It was observed that mean change in BLW, CBH, PFI, PAL from baseline to 6 months for Group A and Group B was 3.42 ± 0.97 mm and 3.57 ± 0.97 mm, -0.30 ± 0.04 mm and -0.38 ± 0.06 mm, -1.42 ± 0.53 and -1.14 ± 0.37 and-0.78 ± 0.26 mm and -0.64 ± 0.37 mm respectively which was statistically significant in both the groups. There was no change in KMI scores observed at 3, 6 months of observation period in both the groups.

On comparing both the groups there was no significant difference between immediate and delayed implant placement with respect to all parameters recorded in the study.

Conclusion: There was observed significant differences when mean change from baseline to 6 months was compared but there existed a non-significant difference in crestal bone changes observed in immediate and delayed groups.

Keywords: Implants; Crestal bone changes; Platform switched; Acid etched implant

Introduction

Tooth loss reflects the ultimate outcome of oral disease over the course of life. While it is not axiomatic that a missing tooth should always be replaced, there are many occasions where this is desirable to improve appearance, masticatory function or speech.

A number of prosthodontic techniques are available for the rehabilitation of the single-tooth space like fixed and removable partial dentures however they are associated with disadvantages such as loss of tooth substance and a potential loss of tooth vitality, especially in young individuals [1].

The coincidental discovery and work done by Swedish orthopedic surgeon Branemark led to the discovery that commercially pure titanium fixed in place due to close bond that developed between the two, a phenomenon that he later described as osseointegration [2].

Original protocols in implant dentistry advocated a nonloaded healing period for implants of 4 to 6 months as a prerequisite for osseointegration but now it has been modified to shorten treatment time and improve patient comfort. In this context, both the time of implant placement and the initiation of function play decisive roles.

Implants placed immediately after tooth extraction offer several advantages for the patient as well as for the clinician, such as preventing bone loss [3] and finally good asthetics [4-8]. But this method is often associated with residual gap between coronal portion of implants and residual bone walls, increased risk of infections [9] and associated failure if the socket becomes infected. This problem can be tackled by waiting for 6-8 weeks after extraction before placement of implants in order to achieve some soft tissue healing and decrease the risk of infections (Delayed implants) [10].

Another category of efforts aimed at reducing the healing period, has been usage of new titanium surface that shorten and improve osseointegration process like sandblasted and acid-etched (SLA) implant [11-15].

Crestal bone loss has been documented as one of the important factors that affect the long term prognosis of implant supported restoration [16]. It has been demonstrated that following implant surgery, remodeling occurs and is characterized by a reduction in bone dimension, both horizontally and vertically [17]. The concept of "platform switching" refers to the use of a smaller-diameter abutment on a larger-diameter implant collar introduced by Lazzara and Porter [18] which further contributed to reduction of bone loss.

The purpose of this study was to evaluate and compare buccolingual and interproximal crestal bone changes and to compare clinical parameters viz width of attached gingival, Jemt papilla fill index and probing attachment level after delayed and immediate implant placement clinically and radio graphically.

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Materials and Method

Selection of patients

A total of 14 sites in need of single tooth replacement were included in study amongst those patients visiting the Department of Periodontology and Oral Implantology, National Dental College and Hospital, Derabassi.

Criteria for inclusion of patients

- Partially edentulous patients with one or more missing teeth with good oral hygiene and systemic health,
- Sites showing at least 5 mm of bone beyond the root apex, to help insure primary implant stability,
- Patient with healthy, sufficiently sculpted and stable soft tissue architecture,
- Co-operative, motivated and hygiene conscious patients.

Criteria for exclusion of patients

- Patient having systemic diseases such as uncontrolled diabetes mellitus, cardiac illness, urinary tract infection, liver disease that would inhibit the healing process for osseointegration,
- Patients who smoke were excluded from study,
- Patient who are allergic to local anaesthesia, or to any of the material used,
- Having active infection at the site of implant placement.
- Very close proximity of vital anatomic structures to the proposed implant site.

Materials

Implants: 14 endosseous platform switched, sand blasted and acid etched implants (SLA) of required lengths and diameters as per the selected site, supplied in a sterile state with double packing.

Dental Implant Kit (MIS Implants Technologies Ltd, ISRAEL),

1:20 reduction gear hand piece,

Physiodispensor,

Periodontal probe UNC15,

12 UNC Hu-friedy plastic probe,

Bone width gauge.

Method

A detailed history was taken for every patient on a written performa, and the findings of examination were recorded before undertaking the surgical procedure. Selected sites in the patients were divided in two Groups:

Group A: Included 7 sites receiving implants immediately in fresh extraction sockets. (Immediate implants).

Group B: Included 7 sites receiving implants in healed/mature bone sockets (Delayed implants).

Pre-surgical evaluation

Clinical examination: A pre-operative examination was carried out with careful evaluation of the soft and hard tissues. The impressions with alginate were taken and the study casts were made.

Radiographic evaluation: Radiovisiographs (RVG)/periapical-x rays with a radiographic grid of the proposed implant sites were taken prior to surgery.

Blood investigations: Then presurgical blood investigations of all the subjects selected for the study were carried out.

Surgical procedure

The patient was prepared, draped and anesthetized under strict aseptic conditions with local anaesthesia preferably infiltration using 2% lignocaine hydrochloride with 1:200000 adrenaline given buccally and lingually/palatally to achieve anesthesia.

A crestal incision with sulcular releasing incisions at adjacent teeth was given. In case of immediate implants (Group-A) mucoperiosteal flaps were raised to facilitate tooth removal and every effort was made to minimize trauma to crestal bone during extraction and implants were placed. Similarly mucoperiosteal flaps were raised in healed sockets and implants were placed in (Group-B) patients.

All implants were placed within alveoli confines and were ensured to be clinically stable at the time of insertion without the use of grafts and barrier membranes.

Next, the gingival tissue was closed with interrupted sutures using 3-0 silk suture. Immediately after implant placement in each patients in both Groups the following parameters were measured which were used as baseline measurements - The distance from buccal bone to lingual bone using bone width gauge [19].

Crestal height of bone - by radiographs as distance between apical end of first step of implant and most coronal point of interproximal crestal bone height. The baseline value to determine the amount of bone loss was interproximal crestal bone height measured on radiograph taken immediately after implant placement [16].

Width of attached gingiva - by Keratinized mucosa index [20]. The width of keratinized mucosa was measured by UNC-15 periodontal probe.

Jemt papilla fill index to determine the interdental papilla volume using index proposed by Jemt [21]. Probing attachment level - by Hu-friedy plastic probes to record peri-implant loss of attachment [22]. Sutures were removed 7 days after surgery. In both Groups second surgery was performed after 3 months of implant placement to remove the cover screw and to place healing abutment. Clinical and radiographic parameters were repeated after 3 and 6 months of implant placement.

After 6 months when healing had progressed and the final prosthetic stage was initiated. Final impressions were made directly on the abutment, and definitive porcelain-fused-to-metal splinted restorations were delivered.

Statistical analysis

The statistical analysis was carried out using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 15.0 for Windows). The continuous data are represented as Mean ± SD. Normality of quantitative data was checked by measures Kolmogorov Smirnov tests of normality. Data was normally distributed, so t-test was applied for comparison of two groups. For time related variables, Paired t-test was applied. All statistical tests were two-sided and performed at a

significance level of α=0.05. The results of this analysis were tabulated and plotted as graphs.

Results

A total of 14 implants were placed in which Group A consists of implants placed in fresh extraction sockets and Group B consists of implant sites in healed/mature sockets. Implant placement was done as per technical and manufacturer's guidelines.

It was observed that mean differences in buccolingual bone width (mm), interproximal crestal bone height (mm), Jemt papilla fill index score, probing attachment level (mm) at different periods of observations for both Group A and Group B was statistically significant.

There was no statistically significant difference between immediate and delayed implant placement with respect to all parameters i.e. buccal to lingual bone i.e. buccolingual bone width at baseline, 3months and 6 months (BLW1, BLW2, BLW3), interproximal crestal bone height at baseline, 3months and 6 months (CBH1, CBH2, CBH3), Keratinized mucosa index score (KMI) at baseline, 3months and 6 months (KMI1, KMI2, KMI3), Jemt papilla fill index score (PFI) at baseline, 3months and 6 months (PFI1, PFI2, PFI3) probing attachment levels (PAL) at baseline, 3 months and 6months (PAL1, PAL2, PAL3) postoperatively (Table 1).

Discussion

Implant dentistry has improved dramatically in last 20 years providing clinicians with new opportunities for dental rehabilitation that was previously considered unrealistical [10].

Standard procedures require a mature healed edentulous alveolar ridge in which to place the implant fixture. One matter of interest has been to investigate whether it is possible to shorten the time period between tooth extraction and placement of the implant, alternatively to insert the implant at the same visit as the removal of the tooth with equally predictable success rates [23].

Crestal bone loss has been documented as one of the important factor that affects the long term prognosis of dental implant. So crestal bone preservation is thought of even before the treatment planning for implant placement. Various approaches have been described in literature one of them is platform switching which is used in present study [24].

The implant surface has also been recognized to be critical factor for the achievement of osseointegration [11]. Sandblasted and acid-etched (SLA) surface demonstrated enhanced bone apposition in histomorphometric studies [25,26], which is used in present study.

A total of 14 implants were placed at the selected sites which were divided in two groups immediate and delayed implant group.

All parameters were recorded at the time of surgery as baseline data, at 3 months and at 6 month post-surgery.

In present study Buccolingual bone width was measured by bone width gauge in order to prevent surgically reopening of that site again [19].

The mean change in buccolingual bone width from baseline to 6 months for Group A and Group B was statistically significant (p value=0.001) for both the groups (Tables 2 and 3).

Intergroup analysis showed a statistical non-significant difference in mean values of buccolingual width at baseline (p value=0.242), 3 months (p value=0.077) and 6 months (p value=0.077) between Group A and Group B (Table 1).

The pattern of coronal bone remodeling, with narrowing of buccolingual bone width was almost similar for both the groups. Delayed group exhibited more marked osseous recontouring that probably begins after tooth extraction and continued through the waiting period prior to implant placement [27]. Similar results have been reported by Covani [10,27], Cornelini and Barone [27] who also observed significant reduction in buccolingual width between first and at the time of second surgery.

The mean change in interproximal crestal bone height from baseline

Clinical Parameter	Mean ± Standard Deviation (GROUP A)	Mean ± Standard Deviation (GROUP B)	P Value	Significance
Buccolingual bone width				
BLW1	9.28 ± 2.05	8.14 ± 1.34	.242	NS
BLW2	7.57 ± 1.90	6.00 ± 1.00	.077	NS
BLW3	5.85 ± 1.21	4.57 ± 1.27	.077	NS
Interproximal Crestal bone height				
CBH1	5.42 ± 0.97	6.42 ± 1.53	.172	NS
CBH2	5.42 ± 0.84	6.62 ± 1.56	.102	NS
CBH3	5.72 ± 0.97	6.81 ± 1.54	.142	NS
Keratinized mucosa index score				
KMI1	2.21 ± 0.26	2.07 ± 0.44	.484	NS
KMI2	2.21 ± 0.26	2.07 ± 0.44	.484	NS
KMI3	2.21 ± 0.26	2.07 ± 0.44	.484	NS
Jemt papilla fill index score				
PFI1	0.00 ± 0.00	0.00 ± 0.00	-	NS
PFI2	0.57 ± 0.53	0.43 ± 0.53	.626	NS
PFI3	1.43 ± 0.53	1.14 ± 0.37	.217	NS
Probing attachment level				
PAL1	0.00 ± 0.00	0.00 ± 0.00	-	NS
PAL2	0.50 ± 0.28	0.50 ± 0.40	1.000	NS
PAL3	0.78 ± 0.26	0.64 ± 0.37	.430	NS

Table 1: Showing mean values of Buccolingual bone width (in mm), Interproximal Crestal bone height (in mm), Keratinized mucosa index score, Jemt papilla fill index score, Probing attachment level (in mm) at different periods of observation in Group A and Group B.

Clinical Parameter	Mean Difference	Standard Deviation	p- value	Significance
Buccolingual bone width				
BLW1-BLW2	1.71	0.48	.001	HS
BLW1-BLW3	3.42	0.97	.001	HS
BLW2-BLW3	1.71	0.75	.001	HS
Interproximal Crestal bone height				
CBH1-CBH2	0.00	0.37	.003	S
CBH1-CBH3	-0.30	0.04	.000	HS
CBH2-CBH3	-0.30	0.37	.003	S
Keratinized mucosa index score				
KMI1-KMI2	0.00	0.00	-	NS
KMI1-KMI3	0.00	0.00	-	NS
KMI2-KMI3	0.00	0.00	-	NS
Jemt papilla fill index score				
PFI1-PFI2	-0.57	0.53	.030	S
PFI1-PFI3	-1.42	0.53	.001	HS
PFI2-PFI3	-0.85	0.69	.017	S
Probing attachment level				
PAL1-PAL2	-0.50	0.28	.004	S
PAL1-PAL3	-0.78	0.26	.001	HS
PAL2-PAL3	-0.28	0.39	1.000	NS

Table 2: Showing comparative analysis of mean differences in Buccolingual bone width (in mm), Interproximal Crestal bone height (in mm), Keratinized mucosa index score, Jemt papilla fill index score, Probing attachment level (mm) at different periods of observations in Group A.

Clinical Parameter	Mean Difference	Standard Deviation	p-value	Significance
Buccolingual bone width				
BLW1-BLW2	2.14	0.90	.001	HS
BLW1-BLW3	3.57	0.97	.001	HS
BLW2-BLW3	1.42	0.53	.001	HS
Interproximal Crestal bone height				
CBH1-CBH2	-0.19	0.06	.000	HS
CBH1-CBH3	-0.38	0.06	.000	HS
CBH2-CBH3	-0.19	0.05	.000	HS
Keratinized mucosa index score				
KMI1-KMI2	0.00	0.00	-	NS
KMI1-KMI3	0.00	0.00	-	NS
KMI2-KMI3	0.00	0.00	-	NS
Jemt papilla fill index score				
PFI1-PFI2	-0.42	0.53	.038	S
PFI1-PFI3	-1.14	0.37	.001	HS
PFI2-PFI3	-0.71	0.48	.008	HS
Probing attachment level				
PAL1-PAL2	-0.50	0.40	.018	S
PAL1-PAL3	-0.64	0.37	.004	HS
PAL2-PAL3	-0.14	0.37	1.000	NS

Table 3: Showing comparative analysis of mean differences in Buccolingual bone width (mm), Interproximal Crestal bone height (mm), Keratinized mucosa index score, Jemt papilla fill index score, Probing attachment level (mm) at different periods of observations in Group B.

to 6 months for Group A and Group B was statistically significant (p value=0.000) for both the groups (Tables 2 and 3).

On comparing group A and B statistical non-significant difference in mean values of interproximal crestal bone height at baseline (p value=0.172), 3 months (p value=0.102) and 6 months (p value=0.142) was observed (Table 1).

Standardized radiographs were taken using IOPAs with paralleling cone technique to locate implant position. The crestal bone height was defined as the measured distance (in mm) between apical end of first step of implant and the most coronal point of interproximal crestal bone height.

Similar results was reported by Heinemann et al. [28,29] who concluded that there was no significant difference between immediate and delayed implants in approximal bone level changes during first year. Very less bone resorption was seen in immediate and delayed implant group in present study which can be due implant design provides high primary stability in cortical bone and the smaller abutment diameter compared with implant diameter which lead to better maintenance of peri-implant bone [30-32].

The present study revealed very less bone loss at different observation periods. Similar findings was reported by Canullo [30], Cappiello [33], Prosper et al [34], Fickl [35], Trammell [36], Vigolo

and Givani [37], also reported significantly less bone loss in platform switched group as compared to non-platform switched group.

There was no change in keratinized mucosa index score [21] observed at 3, 6 months of observation period in both Group A (Tables 1 and 3) and Group B (Tables 2 and 3).

Similar results have been reported by Cox [20], Sanivarapu [38], Anand [39] who also reported that width of keratinized gingiva remain constant throughout the study.

The mean change in Jemt papilla fill index score [21] value from baseline to 6 months for Group A and for Group B which was statistically significant for Group A (p value=0.030) (Table 2) and Group B (p value=0.001) (Table 3).

Similar finding was reported by Evans CDJ, Chen ST [40], Jemt [21], Priest [41], observed spontaneous papilla regeneration to occur irrespective of use of provisional restoration.

Intergroup analysis showed a statistical non-significant difference in mean values of Jemt papilla fill index score at baseline (p value=0.00), 3 months (p value=0.626) and 6 months (p value=0.217) between Group A and Group B (Table 1).

Delayed implants exibit delay in regeneration of papilla at 6 months observation period. Similar findings observed by Schropp [42], who concluded that the risk of presenting no papilla or a negative papilla was seven times greater at baseline for delayed cases than for early cases.

When the mean change in probing attachment level for Group A and Group B from baseline to 6 months which was statistically significant (p value=0.001) (Table 2) and (p value=0.004) (Table 3) respectively.

Zafiropoulos [22] who observed increase in probing attachment level from baseline to 3 year observation period. The results are in accordance with study done by Marwa [43].

Intergroup analysis showed a statistical non-significant difference in mean values of probing attachment level at baseline (p value=0.00), 3 months (p value=1.000) and 6 months (p value=0.430) between Group A and Group B (Table 1). Similar finding have been reported by Anand [39].

Summary and Conclusion

Within limitations of the study it can be concluded that there is significant reduction in buccolingual width and interproximal crestal bone loss from baseline to 6 months observation period. There was significant increase in Jemt papilla fill index score and probing attachment level when observed at 6 months observation period. Keratinized mucosa index score remains constant throughout the study in both immediate and delayed implant placement procedure.

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