ORIGINAL RESEARCH

The Effect of Dental Implant Placement on the Marginal Bone and Gingiva of the Adjacent Proximal Areas

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ABSTRACT

Introduction: In the past two decades, replacement of missing teeth with implant supported prostheses has become a widely accepted treatment modality for the rehabilitation of partially or fully edentulous patients. Therefore, the aim of the present prospective study was to evaluate dimensional changes of the hard and soft tissues proximal to the implant on the adjacent natural tooth from the time of implant placement to 6-month post placement.

Materials and Methods: A total of 21 single implants were placed in 14 partially edentulous patients (male or female) in an age group of 20–50 years with good oral hygiene and adjacent sound and periodontally healthy teeth present on the mesial and distal side of edentulous space were included in the study.

Results: The study patients were in the range of 20–50 years with a mean age of 34.6 years. It was observed that mean height of mid marginal facial papilla (Baseline: 5.537 ± 3.125, at 6 months: 5.611 ± 3.023), mesial papilla (Baseline: 4.963 ± 2.107, at 6 months: 5.111 ± 2.547), and distal papilla (Baseline: 4.259 ± 1.74, at 6 months: 4.148 ± 1.64), increased from baseline to 6 months after implant placement. Mean plaque scores had significantly ($P \leq 0.05$*) decreased from baseline (0.8889 ± 0.5064) to 6 months (0.2222 ± 0.4237) after implant placement.

Conclusion: It was concluded that there is an increase in the soft tissue height on the facial surface and the mesial papilla of the adjacent teeth from baseline to 6 months follow-up. The frequency of bleeding on probing was low throughout the study period. Statistically significant decrease in plaque score from a mean from baseline to 6 months.

Keywords: Bone, Dental, Gingiva, Implant.

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INTRODUCTION

In the past two decades, replacement of missing teeth with implant-supported prostheses has become a widely accepted treatment modality for the rehabilitation of partially or fully edentulous patients. High clinical success rates with the original implant protocols have given clinicians and researcher's confidence to further develop and refine the osseointegration technique and use of implants in increasingly more challenging situations.[1] The success of implants has been attributed to their firm bone anchorage; referred to as osseointegration or functional ankylosis.[2]

Tissue integration of endosseous implants designed for osseointegration is generally associated with the loss of vertical bone height during the 1st year after placement.[3] The amount of bone loss goes up to 1.6 mm reported during the 1st year. The observation of this additional subsequent bone loss around the implant has to lead to our interest to assess the changes in the bone and to clinically analyze the changes in the gingival tissue around the adjacent natural teeth.[4]

The level of bone support and the soft tissue dimensions around the implant-supported single tooth restoration is factors suggested to be important for the esthetic outcome of implant therapy.[3]

Therefore, the aim of the present prospective study was to evaluate dimensional changes of the hard and soft tissues proximal to the implant on the adjacent natural tooth from the time of implant placement to 6-month post placement.

MATERIALS AND METHODS

A total of 14 patients (20–50 years) with a single missing tooth, good oral hygiene and adjacent sound and periodontally healthy teeth present on the mesial and distal side of edentulous space were included in the study. Patients with insufficient bone quantity as determined by pre-extraction radiographs and clinical inspection before implant placement (e.g., cysts, soft

tissue ulceration, and insufficient healing of previous extraction site) or any active infection at or adjacent to the site of implant placement were excluded from the study. All patients with one or more teeth missing reporting to the outdoor patient department were evaluated for implant insertion.

Clinical Parameters

At the time of implant placement (Baseline) and 3 months and 6 months, the following clinical parameters were recorded.

Soft Tissue Parameters

1. Plaque score. A dichotomous score was given (0 – no visible plaque at the soft tissue margin and 1 – visible plaque at the soft tissue margin) at four sites per tooth adjacent to the implant (mesial, midfacial, distal, and palatal).
2. Probing depth. It was measured at four sites per tooth adjacent to the implant (mesial, mid-facial, distal, and palatal) using a manual probe (15 UNC, Hu-Friedy, Chicago, USA).
3. Bleeding on probing. A dichotomous score was given (0 – no bleeding and 1 – bleeding) at four sites per tooth adjacent to the implant (mesial, mid-facial, distal, and palatal).

Before implant surgical procedure and at 3 and 6 months of follow-up, soft tissue dimensions measured were as follows:

1. Papilla levels: The levels were recorded by means of an acrylic stent provided with direction grooves [Figure 1]. A papilla level (mesial papilla level–distal papilla level) is defined as the distance between the top of the groove and the top of the papilla measured to the nearest 0.5 mm using a manual probe (CP 15 UNC, Hu-Friedy).
2. Mid-facial mucosa level: The level of the mucosa at the mid-facial aspect of the tooth adjacent to the implant was measured using the same acrylic stent provided with a central direction groove. The mid-facial level is defined as the distance between the top of the groove and the first contact with the mid marginal mucosa measured to the nearest 0.5 mm using a manual probe (CP 15 UNC, Hu-Friedy).

Modified plaque index[5]

Modified sulcus bleeding index[6]

Hard Tissue Parameters using Radiography

- Intraoral periapical radiographs were taken using the long cone paralleling technique and assessed at the time of implant placement, at 1 month, 2 months, 3 months, and 6 months.
- Orthopantomographys were taken before placement of an implant and after placement of an implant [Figure 2].

Computed tomographic (CT) scan: CT scan was done to assess the quantity as well as the quality of bone around the intended implant site and teeth proximal to it. The

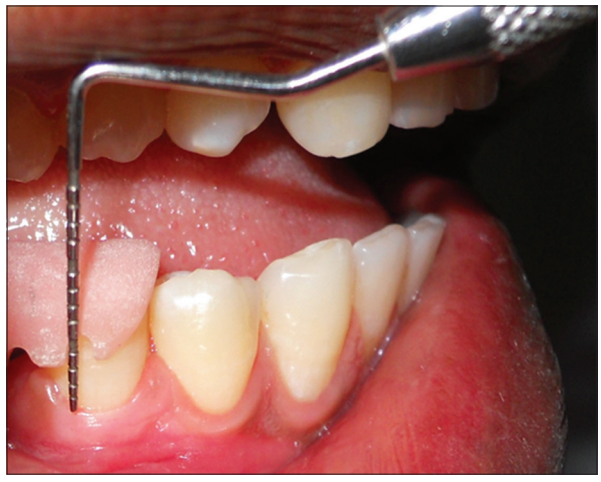

Figure 1: Papilla height measured with UNC-15 probe

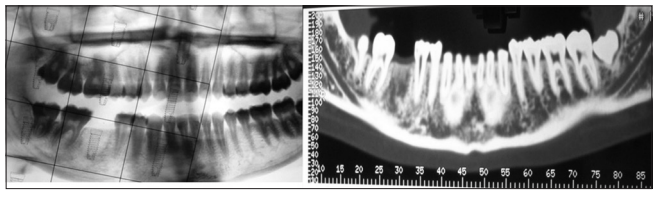

Figure 2: Orthopantomography with radiographic template and Dentascan with measurements

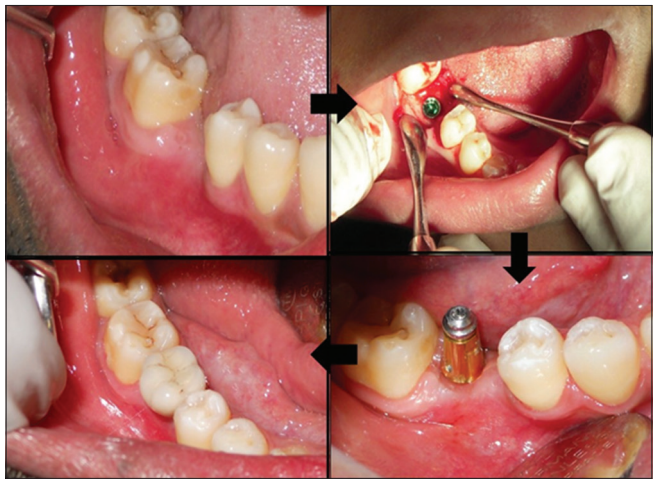

Figure 3: Standard implant placement procedure

Table 1: Distribution of total implants according to age and sex

Age	Male	Female	Total
	n (%)	*n* (%)	*n* (%)
20–30	2 (14.29)	3 (21.43)	5 (35.71)
30–40	3 (21.43)	1 (7.14)	4 (28.57)
40–50	0 (0.00)	5 (35.71)	5 (35.71)
Total	5 (35.71)	9 (64.29)	14 (100.00)

Table 2: Mid-marginal facial papilla height, mesial papilla height, and distal papilla height change from baseline to 6 months

	n	Mid-marginal facial papilla height	Mesial papilla height	Distal papilla height
		Mean±SD	Mean±SD	Mean±SD
Baseline	27	5.537±3.125	4.963±2.107	4.259±1.74
1 month	27	5.37±2.924	4.981±2.444	4.037±1.975
2 months	27	5.537±3.044	5.074±2.483	4.259±1.666
3 months	27	5.426±2.97	5.074±2.556	4.222±1.678
6 months	27	5.611±3.023	5.111±2.547	4.148±1.64
F ratio		1.304	0.419	1.042
P value		0.274	0.795	0.389

P≤0.05*, SD: Standard deviation

corono-apical, mesio-distal, and labio-lingual dimension of the site indicated for implant placement were measured using CT scan. The height of the alveolar bone mesial and distal to the implant site and proximal to the adjacent teeth was measured using the CT scan [Figure 2]. Selection of the width and length of the implant was done according to these CT scan measurements. An informed and signed consent was obtained from the patient for dental procedures and to participate in the study and to attend regular follow-up. Preparation for surgery was made according to standard protocols. Implants were placed in the patients by following standard procedure. The patient was called for the post-operative checkup after 24 h. The sutures were removed 10 days after the surgery. The patients were then followed-up post-operatively at 1st day, 1st week, 1 month, 2 months, 3 months, and 6 months and thereon any other required investigation was done whenever needed. After completion of the requisite period of 4–6 months for bone implant integration, the implant had to be localized and exposed to remove the cover screw and for the placement of abutment head to carry out suitable prosthodontic rehabilitation [Figure 3].

Statistical Analysis

Change in mid marginal facial papilla in various age groups, mesial and distal papilla height, change in alveolar bone height among various age groups analyzed by applying ANOVA test. Change in alveolar bone height in maxilla and mandible was analyzed using Unpaired "*t*" test.

RESULTS

Table 1 shows that the study patients were in the range of 20–50 years with a mean age of 34.6 years. Maximum patients are females in 40–50 years age group.

Table 2 shows the effect of implant placement on the bone level from baseline to 6 months. It was observed that mean height of mid marginal facial papilla (Baseline: 5.537± 3.125, at 6 months: 5.611±3.023), mesial papilla (Baseline: 4.963± 2.107, at 6 months: 5.111 ± 2.547), and distal papilla (Baseline: 4.259 ± 1.74, at 6 months: 4.148 ± 1.64), increased from baseline to 6 months after implant placement. However, all the three results were statistically non-significant as $P > 0.05$.

Table 3: Change in plaque score from baseline to 6 months

	n	Mean±SD	Median	"*P*" value*
Baseline	27	0.8889±0.5064	1	0.000*
1 month	27	0.8148±0.8787	1	
2 months	27	0.6667±0.7338	1	
3 months	27	0.2963±0.5417	0	
6 months	27	0.2222±0.4237	0	

P≤0.05*, SD: Standard deviation

Table 4: Change in bleeding on probing from baseline to 6 months

	Present	Absent	Chi-square	"*P*" value
	n (%)	*n* (%)		
Baseline	11 (40.74)	16 (59.26)	18.011 4 DF	0.001
1 month	8 (29.63)	19 (70.37)		
2 months	7 (25.93)	20 (74.07)		
3 months	2 (7.41)	25 (92.59)		
6 months	0 (0.00)	27 (100.00)		

P≤0.05*, SD: Standard deviation

Table 3 shows the effect of implant placement on mean plaque score from baseline to 6 months; it has been observed that mean plaque scores had significantly ($P \leq 0.05$*) decreased from baseline (0.8889 ± 0.5064) to 6 months (0.2222 ± 0.4237) after implant placement.

Table 4 shows the effect of implant placement on bleeding on probing from baseline to 6 months. It was reported that the number of teeth with bleeding present was significantly ($P \leq 0.05$*) decreased from baseline (11, 40.74%) teeth to 6 months (0, 0.00%).

Table 5 shows changes in probing pocket depth according to the various age groups, sex, jaw, site, diameter of implant placed, and time duration. It was observed that probing depth significantly ($P \leq 0.05$*) decreases with the site of implant anterior to posterior and from baseline to 6 months.

DISCUSSION

The goal of modern dentistry is to restore normal contour, function, comfort, aesthetics, speech, and health,

Table 5: Changes in probing pocket depth according to various age groups, sex, jaw, site, diameter of implant placed, and time duration

	Age group			Jaw		Site		Change with duration of time (month)				
	20–30	30–40	40–50	Max	Mand	Ant	Post	Baseline	1	2	3	6
n	10	7	10	12	15	18	9	27	27	27	27	27
Mean±Standard deviation	−0.33±0.69	−0.29±0.30	−0.20±0.51	−0.44±0.60	−0.13±0.43	−0.44±0.53	0.08±0.31	2.05±0.62	2.03±0.60	1.95±0.46	1.83±0.37	1.78±0.35
P value		0.874		0.140		0.011*				0.008*		
F		0.136								3.671		

P≤0.05

regardless of the atrophy, disease, or injury of the stomatognathic system.[7] However, one of the most common problems in implant dentistry is bone atrophy after tooth loss that, in some cases, prevents implant placement or requires additional surgical intervention to re-establish bone volume.[8,9]

Osseointegration has been defined as a direct structural connection at the light microscopic level between bone and the surface of a load-carrying implant. No soft connective tissue or periodontal ligament-like interface is detectable between the bone and the implant, and the osseointegrated implant functions without mobility.[2]

In the present study, the mesial papilla height increased from 4.96 ± 2.10 mm at baseline to 5.11 ± 2.54 mm at 6 months follow-up [Table 2], which is comparable to the study done by Moontaek Chang and Wennström[10] in 2010, in which significantly increased height of proximal soft tissue around the implant with a mean of 1.1mm observed. In the same study, at the facial aspect of the implants, the soft tissue margin receded on an average 0.6 mm from implant placement to 2 months, while virtually no further change was observed during the subsequent period of follow-up.

In the present study, the plaque score remains low throughout the study period decreasing significantly from 22% at baseline to 7% at 6 months [Table 3]. These findings are similar to the findings observed by Chou *et al*.[11]

Bleeding on probing is an objective sign of inflammation in the gingival connective tissue. An increased bleeding incidence shows disease activity in the adjoining site. The frequency of bleeding on probing was low throughout the study period as 11 sites (44%) showed bleeding on probing at baseline which decreased to 8, 7, 2, and 0 sites at 1, 2, 3, and 6 months, respectively, and this decrease in bleeding on probing shows a statistically significant difference ($P = 0.001$) from baseline to 6 months [Table 4]. These findings were similar to the findings of Chang and Wennstrom[10] who observed 40% bleeding sites at the start of the study and reduced to 12% as the study terminates.

Probing pocket depth is an important parameter to assess the soft tissue condition around the implant and adjacent teeth. In this present study, mean probing pocket depth reduced from 2.04±0.61mm at baseline to 1.77±0.34mm at 6 months, which is statistically significant [Table 5].

De Rouck *et al*.,[12] 2008, observed the decreasing trend in probing depth between 1 month of follow-up (3.90 mm) and study termination (3.46 mm) at 1 year. Their study had a mean reduction of 0.44 mm which is in much agreement with the present study having 0.27 mm reduction. Similar pocket shrinkage was reported by Proussaefs *et al*.,[13] 2002, from 3.6 mm at

3 months to 3.2 mm at 12 months of follow-up and Apse *et al*.,[14] 1991.

The findings in the present study regarding soft tissue alterations are contradictory to observations made in a prospective study by Small and Tarnow,[15] 2000, in which a mean recession of 0.5–0.8 mm at proximal sites 6 months after implant placement/abutment connection surgery was reported. However, the studies are difficult to compare because in the study by Small and Tarnow,[15] 2000, adjacent teeth soft tissue parameters were not analyzed separately and patients with fixed as well as removable prostheses were included.

The frequency of bleeding on probing was low throughout the study period as 11 sites (44%) showed bleeding on probing at baseline which decreased to 8, 7, 2, and 0 sites at 1, 2, 3, and 6 months, respectively, and this decrease in bleeding on probing shows a statistically significant difference ($P = 0.001$) from baseline to 6 months. These findings were similar to the study done by Chang and Wennstrom,[10] 2010, in which they observed 40% bleeding sites at the start of the study and reduced to 12% as the study terminates.

CONCLUSION

From above observations, it was concluded that there is an increase in in the soft tissue height on the facial surface and the mesial papilla of the adjacent teeth from baseline to 6 months follow up. The frequency of bleeding on probing was low throughout the study period. Statistically significant decrease in mean plaque score from baseline to 6 months. When different age groups are compared for changes in facial soft tissue height, distal papilla height, and mesial papilla height on the adjacent teeth, no significant differences noted among them; however, the plaque score shows statistically significant decrease among three groups. The pocket probing depth decreases from baseline to 6 months post-implant placement at all sites on adjacent teeth, and this difference is found to be statistically significant. When comparing the jaws and sites of implant placement, statistically significant differences are seen in changes in pocket probing depth in anterior segments which showed more reduction irrespective of the jaw involved as compared to posterior segments which showed slight increase in pocket probing depth.

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