Original Article

Assessing the Status of Peri-Implant Soft Tissue and Bone Around an Early Loaded Implant for Replacing a Single Missing Tooth: A Clinical and Radiography Study

Vishal Yadav[1]*, Richa Agarwal[2], Jyoti Prakash[1], Jagir Singh[1], Kapil Jhajhariya[3]

[1]Department of Periodontology and Implantology, Daswani Dental College and Hospital, Kota, Rajasthan, India.
[2]Private Practitioner, Six Sigma Health Care Centre, Janakpuri, New Delhi, India.
[3]Private Practitioner, Jhunjhunu, Rajasthan, India.

Abstract

Background: The pre-conditions for peri-implant bone regeneration and the one-stage non-submerged technique, which can achieve success rates comparable to implants placed in a two-stage submerged surgery, have led to increasingly sophisticated conceptions of implant loading. **Materials and Procedures:** This investigation includes 20 sites with just one missing tooth. Over the course of 12 months, clinical indicators such as the sulcus bleeding index (sBI), probing pocket depth (PD), and papilla index (PI), as well as radiographic factors like the crestal bone level, were evaluated. **Results:** The mean value for crestal bone loss ranged from baseline values of 0.25–0.31 at 3 weeks, 0.67 at 3 months, 0.85 at 6 months, and 0.88 at 12 months. Probing PD, the mean value for probing PD at 3 weeks was 1.20 ± 0.83, 3 months 1.60 ± 1.1, at 6 months 1.40 ± 1.14, and at 12 months 1.20 ± 1.0. Mean values for sBI at 3 weeks, 3 months, 6 months, and 12 months were 0.00, 0.00, 0.3, 0.11, and 0.09, 0.25, respectively. With $P = 0.000$, PI demonstrated a substantial difference across points in time. **Conclusion:** At a 12-month follow-up, the dental implants had lost <1 mm of crestal bone, but between the time of implant insertion and 3 months later, there had been clinically substantial marginal bone loss. Following that, there was not much bone loss seen in the area around the implant over the next 9 months. The maturity of the peri-implant soft tissue persisted throughout the investigation.

Keywords: Single stage, Hard and soft tissues, Early loading.

Introduction

Despite the fact that osseointegration is necessary for long-term implant stability, the right soft tissue seal to the titanium surfaces at the most coronal aspect of the implant body is necessary to avoid pathology that could obstruct the process of osseointegration.[1] Dental implants can be divided into different categories based on a variety of factors, including size, material used, type of connection on the implant's top, and the stages of the procedure, with the last one being the most important. One stage: The implant heals without protection of the oral mucosa and is accessible through the mucosa during healing time.[1] The placement of implants in a one-stage procedure has some advantages such as only one surgical intervention is needed,[2] treatment time is short. Two stage: The implant heals under the soft tissue and is, after a healing period, accessed through a second-stage surgery. This constitutes a critical stage in all rapid loading protocols.[3]

Access this article online

Website: www.jrad.co.in

DOI: https://doi.org/10.53064/jrad.2022.13.5.265

Materials and Methods

Twenty patients in total were chosen for the proposed study from the Daswani Dental College and Research Center of Kota, Rajasthan from January 2021 to December 2021 from outpatient Department of Periodontics and Oral Implantology. Both a verbal and written explanation of the advantages and disadvantages of the recommended course of treatment were given to each patient. Before the procedure, they had to sign a consent document. The study comprised patients with a single

Address for correspondence: Vishal Yadav, Department of Periodontology and Implantology, Daswani Dental College and Hospital, Kota, Rajasthan, India.
E-mail: drvishalsinghyadav916@gmail.com

Received: Aug. 12, 2022; **Accepted:** Sep. 15, 2022; **Published:** Oct. 13, 2022

How to cite this article: Yadav V, Agarwal R, Prakash J, Singh J, Jhajhariya K. Assessing the Status of Peri-implant Soft Tissue and Bone Around an Early Loaded Implant for Replacing a Single Missing Tooth: A Clinical and Radiography Study. J Res Adv Dent 2022;13(5):71-74.

tooth missing site who were between the ages of 18 and 50, had intact neighboring and opposing teeth, restorations that were both functionally and aesthetically pleasing, and good periodontal and overall systemic health. This study excluded patients who had a history of smoking and were unable to complete basic oral hygiene tasks, patients who had psychosis, a dental history of bruxism, or patients who had parafunctional behaviors and were not candidates for periodontal surgery. A thorough medical and dental history, a periodontal assessment using clinical parameters, a diagnostic cast, periapical and panoramic radiographs, clinical photographs, surgical templates, and the identification of anatomic landmarks in relation to the implant site are all part of the pre-treatment process.

The chosen patients were educated in detail about the nature and surgical procedure, the goal of the study, and were required to sign an informed consent as part of protocol requirements after being subjected to the inclusion and exclusion criteria. The surgical procedure was performed aseptically. Amoxicillin 500 mg was given 3 times daily for 5 days as part of the antimicrobial prophylaxis, beginning 1 h before surgery. Ibuprofen 400 mg twice daily was given as post-operative pain medication for 3 days. The surgical site was inspected, one surgeon performed all implant placements, all patients received local anesthetic, and each patient's implant length and diameter were chosen based on their particular clinical requirements. After elevating the mucoperiosteal flap and making a crestal incision on a healed site, a first pilot drill was pushed through the surgical stent to a depth matching to the length of the implant that was selected. The osteotomy was then expanded using intermediate drills that were the diameter and length of the implant. The correct angulation of the implant was then confirmed using paralleling pins. When resistance is encountered and the implant is inserted into its ultimate location, it was gently digitally pressed into the prepared site with its cover screw connected. The surgical flap was repositioned and it was then stitched up. Using osstell, the implant's stability was evaluated. After 7 days, the sutures were taken out and left undone for 3 weeks. With the use of an Osstell ISQ resonance frequency analyzer, another reading of the ISQ was taken at the end of the 3rd week. The prosthesis was then given once an imprint had been taken. With porcelain occlusals and porcelain fused to metal crowns, all implants were repaired. The crowns were secured with zinc polycarboxylate cement. Clinical and radiographic data were used to evaluate the soft tissue and bone levels, and statistical analysis was performed.

Clinical parameters evaluated: Following the prosthesis, the condition of the peri-implant soft tissue was evaluated at 3 weeks, 3 months, 6 months, and 12 months. The following criteria were used to evaluate all of the patients.

1. Mombelli's sulcus bleeding index (sBI) (1987)[4]
2. Four locations around the implant were examined for probing pocket depth (PD) (mesial, distal, buccal, and lingual)[5]
3. Jemt's papilla index (PI) (1997).[6]

Evaluated radiographic parameters.

Long cone paralleling radiographs were collected and evaluated at various intervals, including baseline, 3 weeks, 3 months, 6 months, and 9 months.

To evaluate bone changes around each implant, all the radiographs collected at various intervals were submitted to this testing. Crestal bone level (CBL) is the distance, measured in the distal and mesial aspects of each implant, between the implant abutment junction and the bone's most coronal point. This parameter was assessed at baseline, after loading for 3 weeks, and then again after 3 months, 6 months, and 12 months. Using a paralleling approach and a specialized film holder, standardized intraoral periapical radiographs of the implant sites were acquired. A holder attached to the paralleling device was used to hold the intraoral periapical radiograph and grid in place while the appropriate exposure was made. The occlusal platform made it possible to do an occlusal registration, maintaining the distances from the source to the object and the object to the film. The exposure period and film development were both standardized, and the same holders were used throughout. The CBL was then evaluated using these radiographs for any alterations.[7,8]

Results

Statistical Package for the Social Sciences version 16.0 was the program utilized for the statistical analysis (IBM, USA). The values were shown as a numeric value (n), a percentage (%), and a mean (m). ANOVA is a statistical test used to compare the variance between more than two mean values. When P=0.05 (P=0.05) and a 95% confidence interval were used, the P value was deemed significant.

According to radiographic data, crestal bone loss (mesial) had a mean value at baseline of 0.25, 0.31, 0.67, 0.85, and 0.88 after 3 weeks, 6 months, and 9 months. For the purpose of comparing mean crestal bone loss over time, repeated ANOVA was performed. $P = 0.000$ indicated a significant change in the means of crestal bone loss over time (Table 1). Mean values for crestal bone loss (distal) at baseline were 0.25, 0.31, 0.71, 0.76, and 0.75, respectively. These values were statistically very highly significant (0.000) (Table 2).

Clinical parameters

Mean values for probing PD were 1.20 0.83 at 3 weeks, 1.60 1.1 at 3 months, 1.40 1.14 at 6 months, and 1.20 1.0 at 12 months. For the purpose of comparing the mean probing PD at various intervals, repeated ANOVA was performed. $P = 0.5$ indicated that there was no statistically significant difference in the means of probing PD at various stages in time. sBI, mean value for sBI at 3 weeks was 0.00 0.00, at 3 months, it was 0.3 0.11, at 6 months, it was 0.09 0.25, and at 12 months, it was 0.08 0.24 (Table 3). The mean sBI at various intervals was compared using repeated-measures ANOVA. With $P = 0.3$, the difference between the means of the sBI at various times was not statistically significant.

Table 1: *Post hoc* tests – Bonferroni multiple comparisons

Interval	Interval	Mean Difference	*P*
Baseline	3 weeks	–0.25	1.00
	3 months	–0.55	0.00
	6 months	–0.35	0.000
	12 months	–0.65	0.000
3 weeks	Baseline	0.35	1.000
	3 months	–0.20	0.000
	6 months	–0.09	0.000
	12 months	-0.30	0.000
3 months	Baseline	0.55	0.000
	3 weeks	0.80	0.000
	6 months	–0.80	0.000
	12 months	–0.10	0.000
6 months	Baseline	0.65	0.000
	3 weeks	0.70	0.000
	3 months	0.80	0.000
	12 months	–0.30	1.000

Table 2: *Post hoc* tests – Bonferroni multiple comparisons

Interval	Interval	Mean difference	*P*
Baseline	3 weeks	–0.10	0.75
	3 months	–0.30	0.0
	6 months	-0.80	0.00
	12 months	–0.50	0.0
3 weeks	Baseline	0.20	0.75
	3 months	–0.20	0.0
	6 months	–0.70	0.00
	12 months	–0.60	0.0
3 months	Baseline	0.30	0.00
	3 weeks	0.20	0.0
	6 months	–0.10	0.0
	12 months	–0.40	1.000
6 months	Baseline	0.60	0.000
	3 weeks	0.70	0.000
	3 months	0.50	0.000
	12 months	0.10	0.005

Table 3: Mean and SD of sBI at different time intervals

Interval	Number	Mean	SD	*P*
3 weeks	20	000	00	0.37
3 months	20	002	01	
6 months	20	008	05	
12 months	20	007	02	

sBI: Sulcus Bleeding Index

The proportion of PI at various intervals was compared using Pearson Chi-square tests. Score 1 at 3 weeks was achieved in 75% of instances, Score 2 at 3 months in 60% of cases, and Score 3 at 6 and 12 months in 90% of cases. There was a significant difference in the proportion of PI at various times in time, with $P = 0.000$.When comparing the proportion of PI at various stages in time using Pearson Chi-square, there was a significant difference with $P = 0.000$, with Score 1 at 3 weeks in 65% of cases, Score 2 at 3 months in 55% of cases, and Score 3 at 6 and 12 months in 90% of cases.

Discussion

A number of authors have reported that early or immediate loaded implants show a greater percentage of bone-to-implant contact and more mature cortical bone than delayed loaded controls, contrary to the Branemark protocol's historical preference for a protracted healing period to allow stabilization of the bone interface before the clinical function. Bone quality, quantity, surgical technique, and implant design are all aspects that relate to implant stability and may have an impact on the time of loading depending on the circumstances. Even with such high success rates, problems and failures still happen. It has been suggested that mechanical component strength and biologic tissue reaction (soft tissue and bone) are both important for implant success (implant components and superstructure). Bone loss around implants has both been linked to the susceptibility of the soft tissue to bacterial invasion and the susceptibility of the bone to stress.[2] As a result, comparisons of the changes in the hard and soft tissues around early-loaded implants in single-stage delayed implant placement over a follow-up period of 9 months were made in this study. The majority of studies only provide short-term results and several authors have emphasized the need for longer studies with at least a 5-year follow-up. The study's 5-year findings revealed that early loading of implants with a fluoride-treated, grit-blasted surface is feasible in the posterior mandible with a high degree of predictability in terms of survival rate, maintenance of marginal bone level, and condition of peri-implant soft tissue.[3] The crestal bone loss over the course of the follow-up period in this study was well controlled, with mean values ranging from baseline 0.25 0.11–0.31 0.08 at 3 weeks, to 0.67 0.13 at 3 months, to 0.85 0.09 at 6 months, and to 0.88 0.12 at 12 months. This is comparable to one of the studies, in which the mean crestal bone loss at 6 months was found to be 1.2 mm (For one stage of an implant, Turkyilmaz[1] observed an average marginal bone loss of 0.7 mm at 1-year recall. When edentulous individuals had implants put in the maxilla rather than the mandible, there was statistically significant ($P = 0.05$) bone loss surrounding the implants, according to Schwartz-Arad *et al*. The fact that all the implants were positioned in the maxillary anterior region may be the cause of the higher mean marginal bone loss on the mesial and distal surfaces. The authors demonstrated that a significant portion of the early bone loss in one stage implants occurred within the 1st month. Bone loss happens mostly in the 1st year following surgery. An instant restoration did not appear to increase the average amount of bone loss after the 1st year of function.

When baseline and 3 weeks (the period of loading) were compared in the present study, there was no discernible bone loss; however, when baseline and 3 months were compared, the mean value was discernible.

This discrepancy may have been caused by patient-related variables such the mandibular bone's quality, excessive chewing pressures, and patient oral hygiene condition. When implants had to be put in an uneven bone surface or when the location of the rough/smooth implant border was not aligned with the lowest bone level of the bone crest, initial crestal bone loss (between baseline and early healing) may also have happened. In addition, it has been shown that the host reacts with an inflammatory reaction in response to the microgap/interface at the link to the superstructure, which may have led to tissue remodeling. It has been suggested that bacteria may create a reservoir in such microgaps (interfaces).[1] Becker, *et al*. observed that increased periodontal PD (PPD) was a significant predictor, indicating a high risk of infection developing in the implant mucosa.[10] PPD did not significantly rise during the course of the trial from 1.20 0.83 at 3 weeks to 1.60 11.10 at 3 months, 1.40 1.14 at 6 months, and 1.20 1.06 at 12 months, showing that the implant mucosa was maintained in a healthy state from the outset. One early sign of peri-implantitis is bleeding from the junctional epithelium of the implant. Luterbacher *et al*.[12] found that BOP had statistically greater diagnostic values for implants than for teeth, while Jepsen *et al*.[11] revealed that BOP had a strong negative predictive value for monitoring peri-implant health for implants. According to Ericsson and Lindhe, the dogs healthy implant sites scored higher BOP values than the dog's healthy natural dentition.[13] In the present study, 87% of implant sites display healthy gingiva despite the post-operative usage of chlorhexidine mouthwash being suggested for non-periodontitis patients with adequate overall hygiene. In this investigation, sBI over the follow-up was well-controlled, with mean values ranging from 0.00 at 3 weeks–0.03 0.11 at 3 months, 0.09 0.25 at 6 months, and 0.08 0.24 at 12 months.[14] During the follow-up period in the present study, a substantial rise in PI (mesial) was shown with Score 1 at 3 weeks, Score 2 at 3 months, and Score 3 at 6 and 12 months. During the follow-up period in this trial, a substantial rise in PI (distal) was shown with Score 1 at 3 weeks, to Score 2 at 3 months, and to Score 3 at 6 and 12 months. Only when the Jemt PI is scored according to the actual distance between the crestal bone and the contact point does it become apparent that the papillae can demonstrate a wide range of thicknesses within the scoring categories, for example. Score 3, a complete fill of the interproximal triangle, was evident for papillae ranging from b in relation to the Jemt PI score, the vertical distance between the contact point and the natural tooth's crest of bone.[9]

Conclusion

At a 12-month follow-up, the dental implants had less crestal bone loss than is typical of implants that are loaded later. This was most likely caused by the implant collar's solid soft tissue seal, which guarded the crestal bone, as well as stable bone attachment and epithelial attachment.

According to these results, the clinically significant marginal bone loss often took place between the time of implant implantation and 3 months afterward. The maturity of the peri-implant soft tissue persisted throughout the investigation. Single stage implants that are loaded early are a desired and justifiable therapeutic option, despite certain drawbacks including a brief follow-up time and clear clinical difficulties.

References

1. Turkyilmaz I. Clinical and radiological results of patients treated with two loading protocols for mandibular overdentures on Brånemark implants. J Clin Periodontol 2006;33:233-8.
2. Ostman PO. Immediate/early loading of dental implants. Clinical documentation and presentation of a treatment concept. Periodontol 2000 2008;47:90-112.
3. Schliephake H, Rödiger M, Phillips K, McGlumphy EA, Chacon GE, Larsen P. Early loading of surface modified implants in the posterior mandible-5 year results of an open prospective non-controlled study. J Clin Periodontol 2012;39:188-95.
4. Fischer K, Stenberg T. Early loading of ITI implants supporting a maxillary full-arch prosthesis: 1-year data of a prospective, randomized study. Int J Oral Maxillofac Implants 2004;19:374-81.
5. Galindo-Moreno P, Nilsson P, King P, Becktor J, Speroni S, Schramm A, *et al*. Clinical and radiographic evaluation of early loaded narrow diameter implants-1-year follow-up. Clin Oral Implants Res 2012;23:609-16.
6. Zetu L, Wang HL. Management of inter-dental/inter-implant papilla. J Clin Periodontol 2005;32:831-9.
7. Joly JC, De Lima AF, Da Silva RC. Clinical and radiographic evaluation of soft and hard tissue changes around implants: A pilot study. J Periodontol 2003;74:1097-103.
8. Cardaropoli G, Lekholm U, Wennström JL. Tissue alterations at implant-supported single-tooth replacements: A 1-year prospective clinical study. Clin Oral Implants Res 2006;17:165-71.
9. Schwartz-Arad D, Herzberg R, Levin L. Evaluation of long-term implant success. J Periodontol 2005;76:1623-8.
10. Becker W, Becker BE, Newman MG, Nyman S. Clinical and microbiologic findings that may contribute to dental implant failure. Int J Oral Maxillofac Implants 1990;5:31-8.
11. Jepsen S, Rühling A, Jepsen K, Ohlenbusch B, Albers HK. Progressive peri-implantitis. Incidence and prediction of peri-implant attachment loss. Clin Oral Implants Res 1996;7:133-42.
12. Luterbacher S, Mayfield L, Brägger U, Lang NP. Diagnostic characteristics of clinical and microbiological tests for monitoring periodontal and peri-implant mucosal tissue conditions during supportive periodontal therapy (SPT). Clin Oral Implants Res 2000;11:521-9.
13. Ericsson I, Lindhe J. Probing depth at implants and teeth. An experimental study in the dog. J Clin Periodontol 1993;20:623-7.
14. Choquet V, Hermans M, Adriaenssens P, Daelemans P, Tarnow DP, Malevez C. Clinical and radiographic evaluation of the papilla level adjacent to single-tooth dental implants. A retrospective study in the maxillary anterior region. J Periodontol 2001;72:1364-71.