

Evaluation of Success Rate of Early Loading Versus Delayed Loading Single-Tooth Implants – Results after 2 Years of Clinical Function

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ABSTRACT


Background: Success in implant therapy for replacement of one or more missing teeth has been well documented. The original surgical protocol considered a healing period of 3–6 months free from functional loading as optimal to achieve a successful osseointegration. The current scientific literature supports the concept that implants can be loaded early or immediately. **Aims and Objectives:** The aim of the present retrospective study was to compare early loading (within 1–2 weeks) with delayed loading (4–5 months) single-tooth implant, results after 2 years in terms of success rate by assessing peri-implant changes using clinical parameters, radiographic marginal bone level, and implant stability. **Materials and Methods:** A total of 20 patients (mean age = 31.15 years) treated by the implants for the rehabilitation of a single missing tooth in either jaw were examined. The test group was treated by early loading implants while the control group by delayed loading implants. Clinical and radiographic measurements were recorded around each implant. **Results:** At 2 years, the survival rate of implants in the control group (delayed loading implants) was 100% at 5-year follow-up while in the test group (early loading implants), it was 90%. **Conclusion:** It can be concluded that single-tooth implant may be loaded with predictable outcome as early as 2 weeks after installation.

Key words: Delayed loading, dental implants, early loading

INTRODUCTION

Success in implant therapy for replacement of one or more missing teeth has been well documented for more than three decades.^[1] They have been successful largely due to the development of design and implantation procedures that result in direct bone-implant interface without detectable intervening fibrous tissue.^[2] The original surgical protocol proposed by Adell *et al.* and Brånemark *et al.* considered a healing period of 3–6 months

free from functional loading as optimal to achieve a successful osteointegration.^[3,4] The other reasons for using this approach were to prevent apical down growth of mucosal epithelium and to minimize the risk of infection due to early loading during the initial healing period. Only on completion of this healing period, mucosa piercing abutments are placed and the supra connections connected.^[5] A reanalysis of this original experimental design has questioned the necessity for a long implant healing period.^[6] Implant that is loaded after healing period (delayed loading) has high biologic stability, but it also has the disadvantage of prolonged treatment time.^[7] The current scientific literature supports the concept that implants can be loaded early or immediately. A study conducted by Muthukumar *et al.* showed that immediate loading has higher failure rate compared to early loading.^[8]

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With advances in biomaterial technology and continuous clinical research have provided clinicians with improved protocols to provide more advanced treatment options to satisfy continuously increasing patient's expectation of reduced treatment time, improved esthetics, and increased comfort. Rocuzzo *et al.* assessed peri-implant conditions of early loading implants in a prospective split-mouth controlled study and suggested that implant may very well suitable for early loading at 6 weeks.^[9] Cochran *et al.* in a prospective multicenter cohort study involving 133 patients with 383 implants found that implants could be successfully restored after 6 weeks of loading and yielded a success rate >99%, 2 years after prosthetic restoration.^[10]

Considerable outcome variations on immediate or early implant loading for single-tooth replacement, Ericsson *et al.*, 2000, have shown the results and crestal bone changes to be equivalent to those with an established conventional protocol.^[11] The early loading of implant supporting a full-arch prosthesis in the edentulous mouth has also been studied.^[12] However, only few studies regarding early loading of implants supported single-tooth crowns with long-term follow-up are available in literature. Therefore, the aim of the present retrospective study was to compare early loading (within 1–2 weeks) with delayed loading (4–5 months) single-tooth implant, results after 2 years in terms of success rate by assessing peri-implant changes using clinical parameters, radiographic marginal bone level, and implant stability.

MATERIALS AND METHODS

Study Population

A total of 20 systemically healthy patients (mean age = 31.15 ± 7.28 years) who were treated by the implants for the rehabilitation of a single missing tooth in either jaw in the SGT Dental College Hospital and Research Institute, Gurgaon, were examined for the present study. The test group was treated by early loading implants while the control group by delayed loading implants. Before initiating this study, the purpose and design of this clinical trial were explained to the patients and informed consent was signed by every patient. The study protocol was first approved by the ethical committee of SGT Dental College Hospital and Research Institute, Gurgaon.

Clinical Measurements

Patient oral hygiene status was evaluated by the plaque index (PI) as an expression of the level of full-mouth supragingival plaque accumulation. Gingival inflammation was assessed by papillary bleeding index (PBI).

Measurements around Implant

Clinical measurement

Clinical measurements recorded around each implants were modified PI, modified gingival index, probing measurements, and Clinical Implant Mobility Scale (CIMS). Furthermore, the width of the keratinized peri-implant mucosa was assessed on midbuccal aspect of each implant.

Radiographic measurement

Bone level was measured using standardized intraoral periapical radiograph. Radiograph was obtained at baseline and 2 years recall visit. To assess the changes at the interproximal alveolar crestal bone height, the distance from the implant shoulder to the most coronal bone-to-implant contact (DIB) was determined both at the mesial and distal aspect of each implant and was expressed in mm [Figure 1].

Statistical Analysis

The means and standard deviation (Mean \pm SD) values were calculated for all clinical parameters including probing pocket depth (PPD), clinical attachment level (CAL), gingival recession, PI, PBI, and radiographic marginal bone loss. The mean data were analyzed for the statistical significance by standard statistical method.

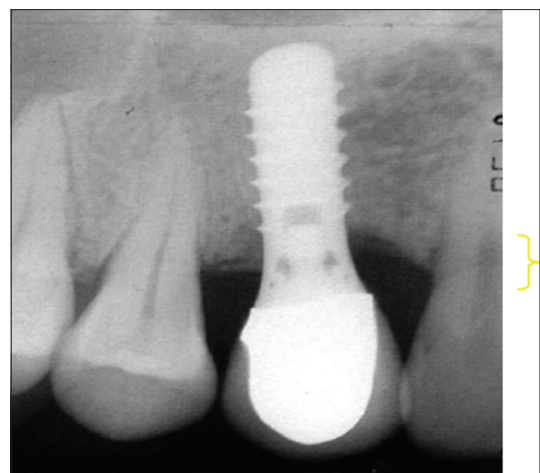


Figure 1: IOPA radiograph showing bone level at the interproximal alveolar crestal bone

RESULTS

Twenty systemically healthy patients, 12 males and 8 females, with a mean age of 31.15 ± 7.28 years who were treated for single missing tooth either in maxilla/mandible with early loading (test group) or delayed loading (control group) single-tooth implant were included in the present study. The test group had four maxillary central incisor missing and six mandibular molar missing, which were replaced by 10 Hi-Tech implants (V-TPS) by early loading protocols, while the control group had 10 mandibular molar missing, which were replaced by 10 Pitt-Easy implants (SLA) by delayed loading protocols [Table 1]. The sizes of implants in the test group were of 2.8 mm \times 10 mm in three patients, 2.8 mm \times 13 mm in one patient, and 3.7 mm \times 10 mm in one patient, 3.7 mm \times 13 mm in five patients, while sizes of implant in the control group were of 3.25 mm \times 10 mm in four patients, 3.25 mm \times 12 mm in one patient, 3.7 mm \times 10 mm in two patients, and 3.7 mm \times 13 mm in five patients [Table 2].

During the course of the study, no implants had to be removed. None of the selected patients had dropped out before the termination of the study. At 2 years, the mean PI score was increased in both the test (0.92 ± 0.37) and control groups (0.95 ± 0.22) and also the mean PBI scores were increased in both the test (0.85 ± 0.35) and control groups (1.15 ± 0.25) compared to baseline score, but the difference was statistically non-significant for both groups [Table 3; Graph 1]. Difference in the mean PPD reduction, CAL gain, and mean CIMS score for the test group and control group was found to be non-significant, whereas difference in the width of keratinized gingiva between both groups was significant [Table 4; Graph 2]. The control group showed greater amount of marginal bone loss (2.2 ± 1.11) as compared to 1.5 ± 0.39 in the test group although difference was non-significant [Table 5; Graph 3].

DISCUSSION

The purpose of the present retrospective study was to evaluate the success rate of early loading (7–14 days) with delayed loading (4–5 months) after 2 years of clinical function. The results showed that functional loading of early implants as early as 7–14 days as well as delayed loading at 4–5 months did not result in statistically significant different outcomes.

Table 1: Distribution of single-tooth edentulous sites treated with implants

Location	Number of implants	
	Test group	Control group
Maxillary central region	4	-
Mandibular molar region	6	10

Table 2: Dimensions of implants

Dimensions (diameter and length) (mm)	Number of implants	
	Test group	Control group
2.8 \times 10	3	-
2.8 \times 13	1	-
3.25 \times 10	-	4
3.25 \times 12	-	1
3.7 \times 10	1	2
3.7 \times 13	5	3

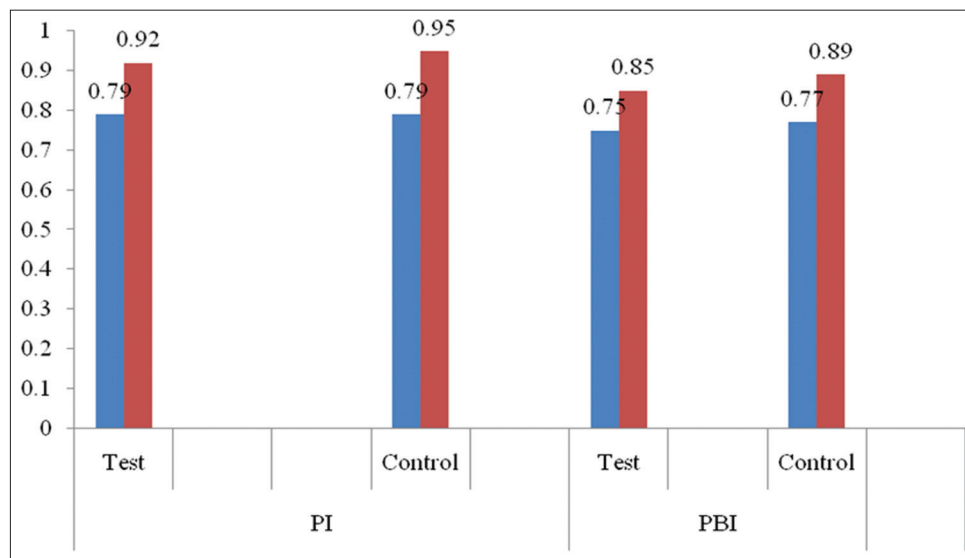
Table 3: Full-mouth plaque index and full-mouth papillary bleeding index at baseline and 2-year follow-up (MV \pm SD)

Parameters	Group	Baseline	2 years
Plaque index	Test	0.79 \pm 0.08	0.92 \pm 0.37 NS
	Control	0.79 \pm 0.03	0.95 \pm 0.22 NS
Papillary bleeding index	Test	0.75 \pm 0.14	0.85 \pm 0.35 NS
	Control	0.77 \pm 0.03	0.89 \pm 0.25 NS

S: Statistically significant ($P < 0.05$); NS: Statistically non-significant ($P > 0.05$)

In the present study, one implant in the test group showed mobility score 2 (CIMS) at 2 months after restoration due to periapical infection. However, after 1 week antibiotic therapy, periapical infection resolved with decreased in implant mobility after 2 weeks and implant becomes stable. The definite prosthesis was placed after 3 weeks. It should be noted, however, that at 2-year examination, same implant presented no clinical or radiographic differences from the other implants. Hence, the observation of occasional complications does not seem to question the overall success of early loading.^[8]

The influence of oral hygiene on implant success has been controversial.^[13] However, it is generally agreed that plaque accumulation could



Graph 1: Full-mouth plaque index and full-mouth papillary bleeding index scores at baseline and 2-year follow-up (MV ± SD)

Table 4: Comparison of clinical parameters at implant sites between the test group (early loading implants) and control group (delayed loading implants) at 2-year follow-up (MV±SD; in mm)

Parameters	Test group	Control group
Postpartum depression Reduction	2.68±0.47	2.95±0.51 NS
CAL gain	2.68±0.47	2.95±0.51 NS
Width of keratinized gingiva	3.60±0.52	3.05±0.6 S
Clinical implant mobility scale	0.40±0.51	0.60±0.84 NS
Plaque index	1.35±0.47	1.08±0.27 NS
Papillary bleeding index	1.2±0.59	1.01±0.14 NS

NS: Statistically non-significant (P>0.05)

induce negative mucosal response. In the present study, no significant differences were observed in modified PI score at implant site in both the groups throughout the study period. The majority of scores were 0, implying that good oral hygiene had been maintained around the implants.

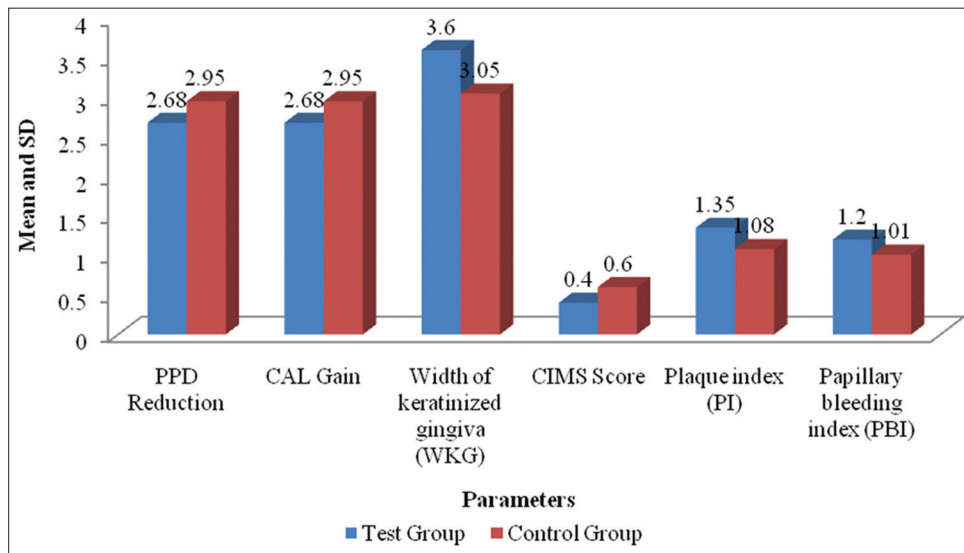
In the present study, the mean marginal bone loss at 2 years in the test group was 1.5 mm, while in the control group, it was 2.2 mm, showing significant marginal bone loss in both groups. However, when the amount of marginal bone

Table 5: Comparison of radiographic bone loss at implant sites between the test (early loading implants) and control group (delayed loading implants) at 2-year follow-up (MV±SD; in mm)

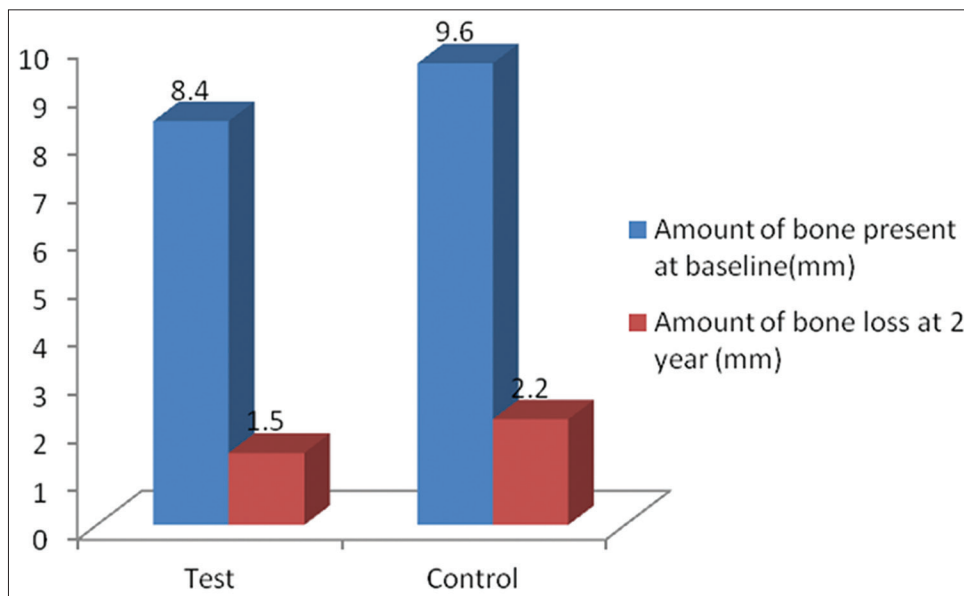
Group	Amount of bone present at baseline (mm)	Amount of bone loss at 2 years (mm)
Test	8.4±1.74	1.5±0.39 S
Control	9.6±0.62	2.2±1.11 S
Difference	1.2±0.6 NS	0.5±0.63 NS

S: Statistically significant (P<0.05) NS: Statistically non-significant (P>0.05)

loss was compared between the test and control group, difference was not statistically significant. Turkeyilmaz *et al.* reported the average marginal bone loss for the test and control group 0.7 and 0.81 mm at 1 year recall, and 1.06 and 1.16 mm at 4 years recall, respectively.^[14] Vigolo *et al.* reported 0.8 mm marginal bone loss for implant-supported single crown 4 years after implant placement.^[15] In the present study, marginal bone loss observed in both the groups at 2-year follow-up was higher than previous reported studies. It could have been resulted from the distribution of the implant sites, as the majority of the implant in the present study were placed (16 of 20) in the posterior region (80%) where bone quality is relatively poor.



Graph 2: Comparison of clinical parameters at implant sites between the test group (early loading implants) and control group (delayed loading implants) at 2-year follow-up (MV ± SD; in mm)



Graph 3: Radiographic bone loss around implants in the test and control group (immediate one stage implants) at 2-year follow-up (MV ± SD; in mm)

In the present study, the survival rate of implants in the control group (delayed loading implants) was 100% at 2-year follow-up while in the test group (early loading implants), it was 90%. Findings in the present study are comparable with the previous reported study. Norton (2004) reported 96.4% survival rate for immediately loaded implants at 20.3 months (range 13–30 months) follow-up.^[10] After implant placement, while Cooper *et al.* reported 96.2% survival rate

for single-tooth implants restored 3 weeks after the surgery.^[16]

At 2 years, the mean CAL in the test group was 2.68 ± 0.47 mm while in the control group, it was 2.95 ± 0.51 mm. However, the difference between the groups was not statistically significant. Weber *et al.* found that attachments level surrounding the implants were stable over the study period and it was fluctuated over the 5 years period.^[17]

In the present study, the soft tissue was healthy over the entire observation period both in the test and control group. The mean pocket depth at 2 years was 2.68 ± 0.47 mm in the test group and 2.95 ± 0.5 mm in the control group. Haas *et al.* reported healthy soft tissues around the implant over the entire observation period despite the subgingival crown margin.^[18] Temporary swelling of the peri-implant mucosa was always due to a loosening of the suprastructure and completely disappeared after mechanical stabilization of the crown. The mean pocket depth was 2.2 mm.

Most standard protocols in implant dentistry suggest a healing period of 3 months for mandible and 6 months for maxilla.^[19] However, the time required for treatment, the need for additional surgical procedures, and especially the need for indefinite periods of temporization are obstacles that sometimes prevent the patients from implant treatments. To remove these obstacles, it would be beneficial to load implants within the few weeks after implant placement. Studies regarding different types of prostheses have shown that early loading of mandibular implants can provide treatment outcomes comparable to those achieved using standard healing periods before loading.^[20] The early loading of implants supporting a full-arch prosthesis in edentulous maxilla has also been studied.^[21] However, only few studies regarding early loading of implant-supported single-tooth crowns in the maxilla are available in literature.^[22] In the present study, both the test and control implant showed similar clinical and radiographic results after 2 years, suggesting that 15–16 weeks of unloaded healing in the control group did not further improve the treatment outcome.

CONCLUSION

The result of the present study, therefore, concludes that single-tooth implant may be loaded with predictable outcome as early as 2 weeks after installation. Further, clinical and histological studies are necessary to promote clinical application of this technique.

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