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Original Research

Evaluation of early versus delayed loading in single piece implant systems: An original research

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ABSTRACT:
Background: Immediate loading protocol, in recent times, has gained popularity as it has not only shortened the treatment time but also resulted in enhanced patient satisfaction. The aim of this study is to evaluate and compare the effectiveness of Early implant loading protocol over conventional implant loading protocol with respect to peri-implant bone loss and implant stability. **Material and methods:** 40 patients selected for this study were divided into two groups. In Group I patients, implants were Early loaded, whereas in Group II, they were loaded with delayed loading protocol. Peri-implant bone loss was measured and compared using intraoral periapical radiographs with the grid at the time of implant loading within 1 month and 3 months after implant loading. **Results**: Change in radiographic bone loss in both the groups was found to be statistically significant when baseline was compared to 1, and 3 months, but the difference in the bone loss between Group I and II was not found to be statistically significant. **Conclusion**: No statistically significant difference was observed in the crestal bone loss on comparison of Early loading to delayed loading protocol.
Keywords: Early loading, Delayed loading, immediate loading, loading protocols, radiographic levels

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INTRODUCTION

Removable dentures have been a traditional and common way to restore edentulous patients for years. However, the progressive bone resorption of the edentulous alveolar ridge is the main concern when rehabilitation of the edentulous mandible using a removable denture is considered. Removable dentures are not sufficient to reestablish the oral function in relation to either chewing efficiency or bite force. Masticatory performance of people wearing complete dentures is less than 20% of the masticatory performance of those with natural dentition. Problems with the mandibular denture declared by patients are more likely than with the maxillary denture. The common reasons for dissatisfaction are pain, sore spots, poor denture stability, and eating difficulties. Functional loss results from the lack of support and stability but is also affected by reduced salivary flow, decreased tongue motor control, reduced bite force, and diminished oral sensory function. In 2002, an international symposium at McGill University concluded that a conventional denture was no longer the most appropriate option for restoring the edentulous mandible and that the Single piece-implant–retained prosthesis should become the first choice for treatment. Several researchers have

demonstrated that this treatment modality can be successful and that adequate satisfaction related to improved retention can be achieved. It is also manifest that the success rate of dental implants is high with this treatment modality. Three types of loading protocols have also been stated in the consensus report as follows:

(1) immediate loading, wherein the prosthesis is attached to the implants the same day the implants are inserted;
(2) early loading, wherein the prosthesis is attached at a second procedure, earlier than the conventional healing period of 3 to 6 months, and whose time of loading should be within months;
(3) delayed loading, wherein the prosthesis is attached at a second procedure after a conventional healing period of 3 to 6 months.

One-stage implant treatment, by the use of either non submerged implants or modified two-stage submerged treatment using a one-stage surgical protocol has recently become more popular. The placement of implants in a one-stage procedure has some advantages: only one surgical intervention is needed, treatment time is shorter, costs are lower, and clinical monitoring of the implants is possible during the osseointegration period. Rough-surfaced implants can osseointegrate faster than machined-surfaced titanium implants. Recent improvements of the implant surfaces (i.e., thermal oxidation, plasma spraying, grit blasting, acid etching) and the implant designs (parallel-wall implants, tapered implants) have encouraged researchers that immediate/early loading protocols are possible. The purpose of this prospective clinical trial was to evaluate the marginal bone loss and implant stability in Early-and delayed-loaded dental implants.

MATERIAL AND METHODS

40 partially or completely edentulous patients between 18 to 60 years of age were randomly selected from the local population. Criteria of selection included partially or completely edentulous patients who are cooperative, motivated, and committed with completely healed alveolar sockets, have adequate amount of bone volume (buccolingual width not <4 mm and mesiodistal width not <5 mm) and bone quality for implant placement and good periodontal health in the remaining dentition. The exclusion criteria included patients unable/unwilling to undergo minor oral surgical procedure, patients with any known systemic diseases/conditions and/or medication known to interfere with wound healing or minor surgical procedures, smokers, patients with insufficient interarch space to accommodate the required restorative component, patient unable to maintain adequate oral hygiene, and those who are on bisphosphonate therapy or have parafunctional habits. Selected patients were divided randomly into two groups comprising 10 patients in each group as follows (by GraphPad QuickCalcs software)

Test Group I – Early loading of the implant after fixture placement, that is, within 1 month.

Test Group II – Delayed/conventional loading (CL) of the implant after fixture placement, that is, after 3 months.

All the patients selected had edentulous site. Patient preparation included patient education and motivation for optimum oral hygiene regimen. The enrolled patients were subjected to Phase I periodontal therapy (Etiotropic phase). All patients who exhibited good oral hygiene with plaque index and gingival index values of <20% after Phase I therapy were only considered for the study. Patients with periodontal pockets were subjected to pocket elimination or reduction surgeries. Only after a stable periodontal status was attained, patients were selected to be included in the study. Meticulous evaluation included complete hemograms, casts (study and working model), ridge mapping, photographs, and standardized periapical radiographs with millimeter grid (X‑ ray mesh). Selection of the diameter and length of the implants were based on study casts, clinical and radiographic evaluation (orthopantomogram) of available bone. Surgical stent using self‑ cure acrylic resin (DPI) was fabricated in all the cases for proper placement of implants. The study protocol was explained to all the patients, and their consent for participating in the study was taken.

STATISTICAL ANALYSIS

The data collected were subjected to Friedman's test for comparison of mean radiographic bone loss at different intervals (baseline, 1 month and 3 months) for both Group I and Group II on mesial and distal side. For intergroup comparison, that is, for comparison of mean radiographic bone loss between Group I and Group II at different intervals on both mesial and distal side, Mann–Whitney test was used.

RESULTS

The comparison of mean radiographic bone loss (mesial side) was done among Group I (Early loading) and Group II (delayed loading) patients between baseline at 1 months, and at 3 months using the Freidman's test. The result showed a significant ($P < 0.05$) difference in mean radiographic bone loss (mesial) when baseline (mean: 0.00) was compared to 1 months (mean: 2.80), and 3 months (mean: 3.20) in Group I patients. Similarly, in Group II patients, significant ($P < 0.05$) difference in mean radiographic bone loss (mesial) when baseline (mean: 0.00) was compared to 1 months (mean: 2.05) and 3 months (mean: 2.60) was observed. However, it was nonsignificant ($P > 0.05$) when 1 month was compared to 3 month. Friedman's test used to compare mean radiographic bone loss (distal side) among Group I (Early loading) and Group II (delayed loading) between baseline at 1 months, and at 3 months also showed a significant ($P < 0.05$) difference in mean radiographic bone loss when

baseline (mean: 0.00) was compared to 1 months (mean: 3.00), and 3 months (mean: 3.00) with nonsignificant difference (P > 0.05) when 1 month was compared to 3 months in Group I patient. Similar result was observed in Group II patient with mean of 0.00 at 2.05 at 1 months, and 2.00 at 3 months. The comparison of mean radiographic bone loss (mesial and distal side) was done between Group I and Group II at baseline at 1 months, and at 3 months using the Mann–Whitney test. The result showed no significant difference (P > 0.05) in mean radiographic bone loss between Group I and Group II at baseline, at 1 months, and at 3 months.

Table 1 Radiographic Evaluation

	1 Month (Mean)	3 Month (Mean)
Early Loading	2.80	3.20
Delayed Loading	3.00	3.00

DISCUSSION

Implant dentistry has evolved to a stage that a high implant survival rate alone, achieved by CL approach, can no longer satisfy the patients and health‐care providers. Long waiting time for the implant to be osseointegrated, before the restoration can be placed, discourages patient acceptance of implant therapy. The restoration of mastication, phonetics, and esthetics that implants can provide is delayed. Different loading protocols have been developed and subsequently classified as conventional (i.e., loaded at 3–6 months), early (i.e., loaded at approximately 3-6 weeks), or immediate (i.e., loaded at the time or within 48 h of implant placement.

The rationale for the CL protocol is to keep the implant in an undisturbed environment during the healing period. It was believed that applying forces to the implant during this critical period might cause micromovement at the implant‐bone surface, which in turn results in implant failure. Over the past few decades, implant treatment protocols have evolved with new implant designs and surface configurations and better surgical procedures, and as a result, the period between implant placement and functional loading has been shortened. Immediate and early loading of dental implants are techniques that are gradually gaining popularity. Such procedures are highly appreciated by the patients who can have their treatment periods drastically reduced and are able to live a normal life with minimal discomfort due to edentulism. Various criterions have been indicated to be crucial for the success of oral implants by Albrektsson et al. The most important of all is peri‐implant bone levels. Trials have reported comparable marginal bone‐level changes when comparing early versus conventionally loaded implants, but the results are contradictory. The results of this study suggested that in Group I on the mesial and distal side, significant increase in mean radiographic bone loss was seen from baseline to 1 and 3 months, suggesting that there was progressive bone resorption. However, there was no significant change in mean radiographic bone loss from 3 months and 6 months suggesting that the bone resorption stabilized after the initial period. Guruprasada et al. in 2013, have suggested that the surgical trauma and micromovement of implant caused due to the functional forces and nonfunctional forces of tongue and cheek in Early loading the implant after its insertion may have caused the peri‐implant bone loss. This can be attributed to the fact that after loading, the occlusal stresses that implants are subjected to initiate the bone remodeling immediately after loading. Recent studies have shown that mechanical strain stimulates osteoblasts to produce osteoprotegerin which enhances bone deposition and downregulates osteoclastic activity as the time after loading increases. In Group II on mesial and distal side, significant increase in the mean radiographic bone loss from baseline to 1 months, and 3 months was seen which was in accordance with a study conducted by Cardaropoli et al. in 2003, suggesting 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, but there was no significant change in mean radiographic bone loss from 1 months to 3 months. In CL, initial bone loss during the postsurgery healing period caused by remodeling of bone is avoided. Furthermore, at this stage, the healing site is prevented from the action of bacteria by creating a biologic seal around the top of the implant. After the insertion of the implant and its prosthetic connection, crestal bone undergoes remodeling and resorption processes. Woven bone is unorganized and weaker than lamellar bone, which is organized and more mineralized. Lamellar bone develops several months after the woven bone repair has replaced the devitalized bone caused by surgical insertion trauma around the implant. Furthermore, the occlusal stress levels may be high enough to cause woven bone microfracture or overload during the initial loading period, but the increase in bone strength achieved after complete mineralization and organization may be able to resist the same stress levels during the subsequent time. As functional forces are placed on an implant, the surrounding bone can adapt to the stresses and increase its density, especially in the crestal half of implant body during the first 6 months to 1 year of loading. In a histologic and histomorphometric study of bone, Piattelli et al. reported reactions to unloaded and loaded nonsubmerged implants, the bone changed from a fine trabecular pattern after initial healing to a more dense and coarse trabecular pattern after loading, especially in the crestal half of implant interface. When Group I was compared to Group II, there was no significant

change in the mean radiographic bone loss which is in accordance with the study conducted by Güncü et al in 2008 that immediate loading did not negatively affect implant stability, marginal bone levels, and peri‐implant health when compared with CL. Furthermore, Schingalia et al. (2008) concluded that more peri‐implant bone loss occurred in conventionally loaded implants than Early loaded implants. They concluded that mechanical bone strain stimulation is the key factor in regulation of bone remodeling. In both the groups, loading of implants was taken as the baseline and the factors that affect dynamics of the peri‐implant bone such as mechanical strain and other factors that primarily initiates and regulates bone remodeling worked almost same in both the groups. The longevity of the dental implants depends on the amount of crestal bone loss along the implant surface and the crestal bone remodels after loading of implants. In the present study, in both delayed and Early loading, there is initial bone loss which stabilizes after about a month of loading. This can be attributed to the fact that occlusal stresses, that implants are subjected to, initiates the bone remodeling immediately after loading. No statistically significant difference was seen in crestal bone loss on comparison of Early loading to delayed loading. Therefore, immediate loading can be used for the benefit of the patients as it reduces the period of edentulism, is minimally invasive procedure and less complex which further decreases the discomfort and gives more psychological satisfaction to the patient.

CONCLUSION

The present in vivo study assessed the influence of Early loading and delayed loading of dental implants placed in healed sockets with respect to peri‐implant bone levels. Evaluations were carried out at baseline, that is, at the time of loading 1 month, and 3 months for both the groups. Both Early and delayed loading protocols showed radiographic bone loss, at both mesial and distal sides which was not found to be statistically significant. Change in radiographic bone loss in both the groups was found to be statistically significant when the baseline was compared to 1 and 3 months. Within the limitations of the study, it can be concluded that there is no statistically significant difference in crestal bone loss on comparison of immediate loading to delayed loading.

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