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Evaluating Immediate and Delayed loading protocols in anterior implants: A Randomized controlled trial

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ABSTRACT

Aim To compare the bone loss and the soft tissue condition , stability and patient satisfaction of the conventionally loaded dental implants with those loaded immediately. Materials and Methods This randomized clinical trial was conducted involving a total of 60 patients aged 18–55 years, each requiring replacement of a single tooth in the maxillary anterior region (central or lateral incisor). Participants were randomly assigned to two groups of 30 each. Group A (Immediate Loading) wherein a provisional screw-retained crown (kept out of occlusion) was placed within 48 hours and Group B (Delayed Loading) wherein Healing abutments were attached, and final restorations were delivered after 12 weeks Results Successful and stable osseointegration in both groups was observed at 12 months. After 12 months, no implant demonstrated bone loss exceeding 1.5 mm. Both modified plaque and bleeding indices remained within normal limits, showing no statistically significant intergroup differences ($P > 0.05$). At 3 months, patient satisfaction scores were significantly higher in the immediate loading group. Conclusion Both immediate and delayed loading protocols for single-tooth_anterior maxillary implants yielded similar outcomes at 12 months. Immediate loading offered better patient satisfaction without compromising implant stability or peri-implant health. Hence, is considered a priority for anteriorimplant rehabilitation.

KEYWORDS: *Immediate loading , Delayed loading , Implant stability*

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1. INTRODUCTION

Dental implants are an increasingly popular form of treatment among dental practitioners due to their ability to provide a desirable fixed functional and aesthetic outcome that closely resembles the properties of natural dentition. [1]

One of the most debated aspects in implant therapy is the timing of prosthetic loading: immediate loading, In cases of immediate loading, implants are utilized within 48 hours after their placement, whereas delayed loading provides a healing period of 3 to 6 months prior to the connection of the prosthetic.[2,3]

Immediate loading protocols reduce treatment time, allowing for faster rehabilitation and often improving patient satisfaction and comfort when compared to conventional loading methods concerns remain regarding its effect on osseointegration and long-term peri-implant health, particularly when bone quality or primary stability is suboptimal. In contrast, delayed loading has traditionally been favoured for promoting undisturbed healing, though it extends treatment duration.[2,3,4]

While some of the studies have shown no significant difference in failure rates when immediate loading and delayed loading were compared, but few other studies suggest that implant failures were significantly more in cases where immediate loading was done compared to conventional loaded dental implants.[5] The aim of the present study was to compare the bone loss and the soft tissue condition , stability and patient satisfaction of the conventionally loaded dental implants with those loaded immediately.

2. MATERIALS AND METHODS

This prospective randomized clinical trial was conducted in the Department of Periodontology and Implantology at Pacific dental college and Research centre, involving a total of 60 patients aged 18–55 years, each requiring replacement of a single tooth in the maxillary anterior region (central or lateral incisor). Participants were randomly assigned to two groups of 30 each.

Inclusion Criteria

- Single missing anterior tooth (FDI teeth 11–23)
- Adequate alveolar bone (≥6 mm buccolingual width and ≥12 mm height)
- Primary implant stability ≥35 Ncm
- Good oral hygiene (plaque index <1)

Exclusion Criteria

- Active periodontal disease
- Smoking more than 10 cigarettes per day
- Systemic diseases
- Bruxism or other parafunctional habits

Implant and Surgical Protocol

All procedures were performed under local anesthesia. Depending on the case, either a flapless or minimal flap technique was employed. NobelActive™ implants (diameter 3.5–4.3 mm, length 10–13 mm) were placed according to the manufacturer's standard protocol.

Group A (Immediate Loading): A provisional screw-retained crown (kept out of occlusion) was placed within 48 hours.
Group B (Delayed Loading): Healing abutments were attached, and final restorations were delivered after 12 weeks.

Outcome Measures

Primary stability: Measured intraoperatively using a torque wrench and resonance frequency analysis.

Marginal bone loss (MBL): Evaluated using standardized cone beam computed tomography (CBCT) at baseline, 6 months, and 12 months.

Peri-implant soft tissue parameters: Assessed using modified Plaque Index (mPI), modified Bleeding Index (mBI), and probing depth (PD).

Patient satisfaction: Rated on a Visual Analog Scale (VAS) from 0 to 10 for aesthetics, function, and comfort.

3. RESULTS AND STATISTICAL ANALYSIS

Data were analyzed using SPSS version 21 using the independent t-test, and chi-square tests. P value < 0.05 was considered statistically significant as shown in table 1.

Demographic Data
Both groups were comparable regarding age, gender, and implant site distribution (P > 0.05). The mean age was 34.2 ± 5.4 years in Group A and 33.4 ± 3.2 years in Group B.

Implant Stability
The mean implant stability quotient (ISQ) at insertion was 62.2 ± 3.4 in Group A and 61.2 ± 3.1 in Group B (P = 0.61). At 12 months, ISQ values increased to 66.4 ± 4.2 and 67.2 ± 4.1, respectively (P = 0.62), indicating successful and stable osseointegration in both groups.

Marginal Bone Loss
After 12 months, mean marginal bone loss was 0.63 ± 0.32 mm in Group A and 0.59 ± 0.15 mm in Group B (P = 0.54).No implant demonstrated bone loss exceeding 1.5 mm.

Soft Tissue Health
Mean probing depth (PD) was 2.3 ± 0.1 mm in Group A and 2.1 ± 0.3 mm in Group B (P = 0.43). Both modified plaque and bleeding indices remained within normal limits, showing no statistically significant intergroup differences (P > 0.05).

Patient Satisfaction
At 3 months, patient satisfaction scores were significantly higher in the immediate loading group (VAS = 8.6 ± 0.8) compared to the delayed loading group (6.2 ± 1.1, P < 0.01). By 12 months, satisfaction scores were comparable between groups (8.8 ± 0.4 vs. 8.6 ± 0.6, P = 0.71).

Complications
Throughout the study period, no biological or mechanical complications (such as peri-implantitis or prosthetic screw loosening) were reported in either group.

4. DISCUSSION

The present study assessed the outcomes of immediate versus delayed loading of single anterior maxillary ımplants and demonstrated no significant differences in implant survival, marginal bone loss, or soft tissue health at 12 months. These findings align with Crespi R et al[6], that clinically assessed crestal bone level change around single implants in fresh extraction sockets in the esthetic zone of the maxilla either immediately loaded or loaded after a delay and the success rate and radiographic results of immediate restorations of dental implants placed in fresh extraction sockets were comparable to those obtained in delayed loading group. Similarly, Ebenezer V et al[7], reported that most of the immediate implants showed excellent osseointegrationThe marginal bone loss observed in both groups was within clinically acceptable limits (<1.5 mm), supporting earlier reports by Glauser et al.[8], who found no significant differences in crestal bone remodeling between immediate and delayed loaded implants. Similarly, Cannizzaro et al[9]. concluded that immediate loading can be a predictable procedure with good bone preservation when implants are inserted with adequate torque and stability.

Patient satisfaction was significantly higher in the immediate loading group at 3 months, likely due to early aesthetic rehabilitation. This supports the outcomes of Kushaldeep et al.[10], Schnitman PA, et al[11], who emphasized that the Immediately loaded implants help in counteracting psychological problems as the patient do not have to remain edentulous after placement of implants as in the case of conventionally loaded implants. Furthermore, they provide function, comfort, and speech, thus, leading to enhanced patient satisfaction

Hence, to conclude, Immediate loading are preferred for anterior implant rehabilitation over delayed loading.

5. CONCLUSION

Both immediate and delayed loading protocols for single-tooth anterior maxillary implants yielded similar outcomes at 12 months. Immediate loading offered better patient satisfaction without compromising implant stability or peri-implant health. Hence, is considered a priority for anterior implant rehabilitation.

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Conflicts of interest
There are no conflicts of interest.

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Table 1 Showing Clinical Outcomes

Parameter	Group A Immediate Loading	Group B Delayed Loading	P value
ISQ 12 months	**66.4 ± 4.2**	67.2 **±4.1**	0.62
Marginal Bone loss	0.63 **±0.32**	0.59 **±0.15**	0.54
Probing depth	2.3 **±0.1**	2.1 **±0.3**	0.43
VAS 3 months	8.6 **± 0.8**	6.2 **±1.1**	<0.01