

Immediate vs. Delayed end osseous integration of maxi implants: A Radiographic study in dogs

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Abstract

Statement of the problem: Delayed loading is one of the anxieties of implant patients. Immediate loading can solve the problem and make patients more satisfied.

Purpose: The present study was aimed to compare the marginal bone level in periapical radiographs of maxi implants under different loading (immediate and delayed) patterns.

Materials and methods: This split mouth experimental study included 2 dogs. Impressions were made and then, all premolars were extracted under general anesthesia. After a three month healing period, 3 implants were inserted in each quadrant (24 implants). Anterior and posterior implants (case group) were splinted by an acrylic temporary bridge. In order to make middle implants (control group) off the occlusion, parallel long cone technique was used to assess the marginal bone level at base line and 42 days post loading. Data were analyzed using t- test ($\alpha=0.05$).

Results: Mean bone loss values for the case and the control groups were respectively -0.52 ± 0.53 and -0.44 ± 0.40 ($P=0.667$).

Conclusion: Within the limitations of the present study, it may be concluded that immediate loading has negative effect on implant bone loss and delayed loading protocol is supported.

Keywords: Dental Implants, Denture, Partial, Fixed, Osseointegration, Marginal Bone Level.

INTRODUCTION

The high success rate and predictability of outcomes with the conventional delayed loading techniques encouraged the dental

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implant professionals to revise the surgical and the prosthetic protocols and tend towards early and immediate loading techniques. Immediate loading is today considered as a predictable treatment strategy in implant dentistry. Less trauma, patient's high acceptance and comfort, decreased anxiety, reduced overall treatment time and superior esthetics are

among the most important advantages of immediate loading.⁽¹⁻³⁾

On the other hand, the application of Mini Implants appeared to be of high benefit especially in clinical situations where narrower fixture diameters should be indicated. Mini implants were placed with a more conservative approach and loaded immediately. There was also no need for bone grafting.

Maxi implants were, then, developed to combine the main advantages of Mini and conventional implants. The goal was to allow easy insertion, predictable stability and immediate loading concurrently. Although the dental implant literature includes thorough discussions on the different aspects of conventional implant therapy, Maxi implants and their advantages are yet to be investigated.⁽⁴⁾

Radiography is one of the implant health indicators. Marginal bone loss is evaluated from the radiography which should not be greater than 1.5 mm in the first year (osteointegration period), and 0.1 mm during each successive year (follow-up period).^(5,6)

The present study aimed to compare the reverse marginal bone level of maxi implant in maxi implant 3.75 widths and 13 lengths in immediate loading and delayed groups in dogs.

MATERIALS AND METHODS

Two mixed-breed, male dogs were randomly selected. Dogs were primarily examined by a veterinarian to ensure there

is no interfering factor such as diabetes, osteoporosis, etc. Dogs were fasted for 12 hours before anesthesia to prevent nausea and vomiting during the course of surgery. General anesthesia was provided by a veteran with the administration of acepromazine 2% (0.5 mg/kg) and then Nesdonal (17mg/kg). Condensing silicon (speedexcoltene, Coltène / Whaledent AG, Altstätten, Switzerland) impressions of the entire dentition were then made for both dogs for future reference as a model for making temporary prostheses and clear stents.

Teeth were extracted in sterile conditions. First premolars were extracted by simple rotational movement. Second and third premolars were vertically sectioned by a long knife bur (SS White Burs, Inc., Lakewood, USA) and then extracted. Care was taken to save the bone and make surgical procedure as traumatic as possible. Extraction sites were then sutured and diet was changed to soft for two weeks (figures 7 and 8). Penicillin 200000 IU/kg was added to the diet for 5 days post-operatively to prevent infection.⁽⁷⁾ The periodontal status of the dogs was checked periodically due to the diet change. Impressions were poured into dental stone casts and clear surgical stents were made accordingly using a vacuum machine and transparent sheets. Bridge was also checked for retention and integrity.

After 3 months (the time needed for the healing of extraction sockets) animals were

given general anesthesia again and 3 maxi implants were inserted in each premolar region of each dog (a total number of 12 per dog) without osteotomy or flap. Maxi implants use the flapless technique that was shown to have less bone loss.⁽⁸⁾ In the flapless surgical technique, a round tissue punch is used to remove the soft tissue on the crestal bone at the implant site (9-11) or the osteotomy is directly initiated through the soft tissue.^(12,13)

Roman⁽¹⁴⁾ recommended this technique to minimize interproximal crestal bone loss and possible loss of papillae. Surgical stent was used as an aid. Sufficient primary stability (32 and 40 Ncm)^(15,16) was assured by a torque wrench limit of 30Ncm. Temporary prostheses were made (GC Tempron, GC CORPORATION, Shizuoka, Japan) right after implantation. Using direct technique, the first and the last implants were splinted. The middle implants were left embedded and hence off the occlusion (to serve as the control group). Also, the tissue surface of the temporary prostheses was relieved over the middle implants using an acrylic resin polishing bur (SSWhite Burs, Inc. Lakewood, USA). Modified ridge lap was formed on the pontics. Intraoral parallel periapical radiographs were taken with aid of condensing silicon radiographic stent (speedex coltene, Coltène/Whaledent AG, Altstätten, Switzerland) were taken just at insertion of fixture and 6 weeks after post-surgery. Marginal bone level measurement

was made from reference area to the crestal bone at the mesial and distal surfaces of the fixture. The reference area was the fixture's first thread. The distance was measured by Adobe Photoshop after length calibration with fixture diameter. All the measurements were made by one examiner. Soft diet was followed for two weeks postoperatively and penicillin 200000 IU/kg was added to diet for 5 days.

Dogs were checked by a periodontist for periodontal status and by a prosthodontist for temporary bridge integrity and occlusion weekly. No problem was found during the test period until the last week when one of the temporary bridges was broken (on the implant with the lowest removal torque test).

To analyze the mean differences of the amount of marginal bone level after six weeks from base line, we used t-test and p-values < 0.05 were considered for determine statistical significance.

RESULTS

From 12 implants used in the present study, 8 were loaded immediately. One of the 8 immediately loaded implants failed to pass removal torque test minimum torque (dog 2, group 2, left side, code 12) and the other 7 implants showed evidence of osseointegration. Success rate was 87.5% in the immediate loaded group. Also, 4 implants were placed without loading, for which a 100% success rate was observed. Overall success rate of under-study implants was 91.6% (11 of 12 implants).

One of the temporary fixed partial dentures showed fracture but it was not detached from the abutment (partially retained). Other 3 FPDs were actively in function throughout the experiment. Overall success rate was 75% (3 of 4) for the FPD. Acrylic resin showed some abrasion which did not result in disocclusion (Gctempron).

Bone level difference in immediate group (Table 1, 2) ranged from 0.08 mm to -1.6 mm and difference in delayed group (Table 2) ranged from 0.3 mm to -0.84 mm. Mean bone level difference was respectively -0.52±0.53 and -0.44±0.40. T-test was used for analysis ($P = 0.0499$). (Table 3)

Table 1: Immediately loaded implant bone loss

Implant	Bone loss
1 mesial	-0.66
1 distal	-0.05
2 mesial	-0.28
2 distal	-0.32
3 mesial	-0.5
3 distal	-0.74
4 mesial	-1.6
4 distal	-1.41
5 mesial	-1.14
5 distal	0.08
6 mesial	-1.17
6 distal	-0.09
7 mesial	-0.33
7 distal	0.08
8 mesial	-1.01
8 distal	-0.58
Avg	-0.52
Sd	0.53
Max	0.08
Min	-1.6

Table 2: Delayed loaded implant bone loss

IMPLANT	Bone loss
1 mesial	0.3
1 distal	-0.38
2 mesial	-0.72
2 distal	-0.74
3 mesial	-0.84
3 distal	-0.09
4 mesial	-0.72
4 distal	-0.3
Mean	-0.44
Sd	0.40
Max	0.3
Min	-0.84

Table 3: Radiographic comparison of immediate and delayed loading groups

	Immediate loading group	Delayed loading group	
Avg	-0.52	-0.44	P =0.193
Sd	0.53	0.40	
Max	0.08	0.3	
Min	-1.6	-0.84	

*T-test

DISCUSSION

High success rate of implant immediate loading led the professionals to revise the surgical and prosthodontics protocols and hope for high success rate in immediate loading protocol. Patients with immediately loaded restorations take advantage of the immediate rehabilitation of mastication.

Implant failure is highly dependent on the implant type. While a high percentage of MTI mini-implants was lost in posterior

mandible, standard implants were totally successful.^(17, 18)

In immediate loading group, we found more bone loss than that in delayed loaded group but Henry et al.⁽¹⁹⁾ reported a good clinical and radiological evolution, with no losses in dogs and Luzi indicated mechanical loading seems to induce an earlier increase in bone formation and a decrease in bone resorption.⁽²⁰⁾

Herrera-briones indicated that outcomes tend to be more favorable for implants that

are loaded after a period of osseointegration, although the difference in success rates between the immediate and delayed loading of implants does not reach statistical significance. ⁽²¹⁾

Results revealed that delayed loading is a favorable method of loading. Also, some authors confirmed that Mean bone loss in dental implants was minor in early loading compared with conventional loading. ^(22,23)

Jayne indicated Mean crestal bone loss was 1.57 +/- 0.22 mm for immediate loading, 1.23 +/- 0.19 mm for early loading (7 days), and 1.17 +/- 0.32 mm for advanced immediate loading (14 days) and There was no statistical difference for any of the parameters evaluated ($P > 0.05$) which was more than that of present study results. The difference may be caused by different implant type and loading protocols. ⁽²⁴⁾

Maxi implants apply a combination of mini-implant theories (auto advance and auto condensing) and the width of standard implants. The findings of the present study were indicative of Maxi implants' success. The success rate was 87.5% in immediately loaded group and 100% in delayed loaded groups. These values are significantly higher than those of mini-implants and comparable to the same values of conventional (standard) implants. Brunski⁽¹⁾ and Lum et al. ⁽²⁾ reported 100% success in the control group and 100% failure in the immediate loading group. Zubery et al. ⁽¹⁸⁾ reported a 58% success in immediate loaded MTI dentatus Mini-

Implants and a 50% success in the control group.

Sagara, ⁽²⁵⁾ Romanos, ⁽¹⁷⁾ and Piattelli ⁽²⁶⁾ reported 100% success rate in both immediately loaded and control groups. In two cases, the internal submerged implants were covered with soft tissue which was indicative of the high biocompatibility of implant alloy.

It has been shown that fixed partial dentures reduce the occlusal loads directed to the interface of implant and bone to the level of physiologic tolerance of bone. ^(27, 28) In the present study, one of the implants with mobile prosthesis was not osseointegrated. This was indicative of the importance of splint and its effect on osseointegration. Sagara ⁽²⁵⁾ and Akagawa ⁽²⁹⁾ used fixed partial dentures, Piattelli ⁽²⁶⁾ and Corigliano ⁽³⁰⁾ used single crowns, and Akagawa ⁽³¹⁾ used the abutment (no prosthesis) for loading.

Failure of temporary crowns was one of the main problems in similar studies. ⁽²⁸⁾ Different enforcement techniques, including temporary crown with single strand wire, metal plate, collar and multiple wires, have been discussed through literature. Multiple wire technique was applied in the present study because it has been widely used and accepted. ⁽²⁸⁾

Proper oral hygiene is mandatory in the course of healing of the immediately loaded implants. ⁽¹⁷⁾ Emergence profiles in the present study were then adjusted to self-

cleansing form using an acryl preparation bur.

The last and the most important consideration in the preparation of the single crowns was occlusion. Due to the needed occlusion of the crowns, they were prepared to be higher than the occlusal surfaces which were then corrected to ideal occlusion. Due to the presence of airway tube, occlusal check was not possible during the experiment. The occlusion was then corrected with the addition of acrylic resin or the reduction of the premature contacts. In the present study, the overall success rate of the implants was 75% which is consistent with the findings of Emeka Nkante et al. (71.4%).⁽³²⁾

CONCLUSION

Within the limitations of the present study, it may be concluded that immediate loading has negative effect on implant bone loss and delayed loading protocol is supported.

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