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Review Article

IMMEDIATE VS. DELAYED ENDOSSEOUS INTEGRATION OF MAXI IMPLANTS: A TORQUE REMOVAL ANIMAL STUDY

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ABSTRACT

Statement of problem: Delayed loading is one of the concerns of implanted patients. Immediate loading can solve the problem and make patients more satisfied.
Objective: The present study aimed to compare the removal torque 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 months healing period, 3 implants were inserted in each quadrant (12 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. Dogs were sacrificed after 6 weeks and bone blocks were submitted for removal torque test. Data were analyzed using ANOVA test ($P<0.05$).
Results: Mean torque values for the cases and the control groups were respectively 46.82±25.58 and 59.88±15.19 (p value=0.582; not significant).
Conclusion: It may be concluded that immediate loading does not effect on reducing the reverse torque values of the Maxi implants. This supports the advantages of immediate loading for Maxi implants.

INTRODUCTION

The high success rate and predictability of outcomes with the conventional delayed loading techniques encouraged the dental implant profession to revise the surgical and the prosthetic protocols and tend towards the early and immediate loading techniques. Immediate loading is today considered as a predictable treatment strategy in implant dentistry (Brunski, 1979; Lum, 1991).

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Less trauma, high patient acceptance and comfort, decreased anxiety, reduced overall treatment time and superior esthetics are among the most important advantages of immediate loading (Akagawa, 1986; Deporter, 1986). On the other hand, the application of Mini Implants (OsteoCare™, Slough, Berkshire, UK) 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 (OsteoCare™, Slough, Berkshire, UK) 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 (OsteoCare™, Slough, Berkshire, UK) and their advantages are yet to be investigated (http://www.osteocare.uk.com/pdf/Catalogue.pdf, http://www.osteocare.uk.com/implants/maxi.htm) Improved osseointegration is obtained especially when implants are loaded immediately or early on compromised sites (Abrahamsson, 2008). Recent reviews of the literature conclude that moderately rough surfaces (Sa 1–2 mm) show stronger bone response in experimental investigations than smoother or rougher surfaces (Albrektsson, 2004; Albrektsson, 2004 and Wennerberg *et al*., 2010). Better clinical outcome, however, can only be documented under challenging conditions such as direct loading, grafted bone or when using short implants (Balshee, 2009). The present study aimed to compare the reverse torque test of maxi implant in maxi implant 3.75 mm widths and 13 mm lengths in immediate loading and delayed groups in dogs.

MATERIALS AND METHODS

This study has been approved by ethical committee of Shiraz University of Medical Sciences. Two mixed-breed, male dogs were randomly selected. Dogs were primarily examined by a veteran 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 acepormazine 2% (0.5 mg/kg) and then nesdonal (17mg/kg). Condensing silicon (speedex coltene, Coltène/Whaledent AG, Altstätten, Switzerland) impressions of the entire dentition were then made for both dogs to be a model for future reference in 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 (Fig 1). Care was taken to save the bone and make surgical procedure as atraumatic as possible. Extraction sites were then sutured and diet was changed to soft for two weeks. Penicillin 200000 iu/kg was added to diet for 5 days post-operatively to prevent infection (Piattelli, 1993).

Table1. Descriptive statistics of the mean removal torque of the groups (E1&E2: Implants loaded immediately, C: Implants maintained unloaded)

	E1	C	E2
1L	53.7	79.1	82.5
1R	75.8	47.7	50
2L	43.1	47.7	1.3
2R	34.4	65	33.8
Mean	51.75	59.88	41.90
SD	17.87	15.19	33.80

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. After 3 months (the time needed for the healing of extraction sockets) animals were given general anesthesia again and 3 maxi implants (OsteoCare™, Slough, Berkshire, UK) were inserted in each premolar region of each dog (a total number of 6 per dog) without osteotomy or flap (Fig 2). Surgical stent was used as an aid. Sufficient primary stability (32 and 40 Ncm) (12) was assured by a torque wrench limit of 30Ncm.Temporary prostheses were made (GCTempron, GC Corporation, Shizuka, Japan) right after implantation (Fig 3). 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 (SS White Burs, Inc.Lakewood, USA). Modified ridge lap was formed on the pontics. Soft diet was followed for two weeks postoperatively and penicillin 200000 iu/kg was added to diet for 5 days. Due to the high volume of torque-meter device and the need for histological evaluation, dogs were sacrificed 6 weeks after surgery. Bone blocks containing implants were removed from the jaw bone. Bone was removed using diamond saw (Hager & Meisinger, Neuss, Germany) which cut with copious amount of water to decrease heat generation. Soft tissue overlying the bone was then reflected using a periosteal elevator (Hu-Friedy Europe, Zweigniederlassung Deutschland). Bone blocks were stored in formalin 10% and transferred to the laboratory. Acrylic temporary prostheses were cut and removed and the healing abutments were detached. Diamond saw (Hager & Meisinger, Neuss, Germany) was used to cut bone around each fixture. Blocks were fixed into polymethyl methacrylate self curing acrylic resin (Acropars ,Tehran, Iran) for reverse torque test. A coupling was made to fit the 2.2 mm internal diameter of internal hex to the 9.6 mm external diameter of torque-meter. Torque was measured using a manual torque-meter in counter-clockwise motion and fixture withdraw torque values were recorded. Torque-meters were placed vertical to the long axis of fixtures and care was taken to avoid lateral forces. For the RTT (Removal Torque Test) test, wax cubes were prepared and poured with polymethyl methacrylate self curing acrylic resin (Acropars ,Tehran, Iran). The complex was then stored into formalin to avoid the adverse effect of polymerization heat on the bone-fixture interface. The Blocks were transferred to laboratory for torque test. To analyze the mean differences of the removal torques, ANOVA test was used (P value <0.05).

RESULTS

Dogs were checked by periodontist for periodontal status and by prosthodontist for temporary bridge integrity and occlusion weekly and no problem was found during the test period till last week, when one of temporary bridges was broken (on implant with lowest removal torque test). 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) 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 the study implants was 91.6% (11 of 12 implants). One of the temporary fixed partial dentures (FPD) showed fracture but it was not detached from the healing abutment (partially retained).

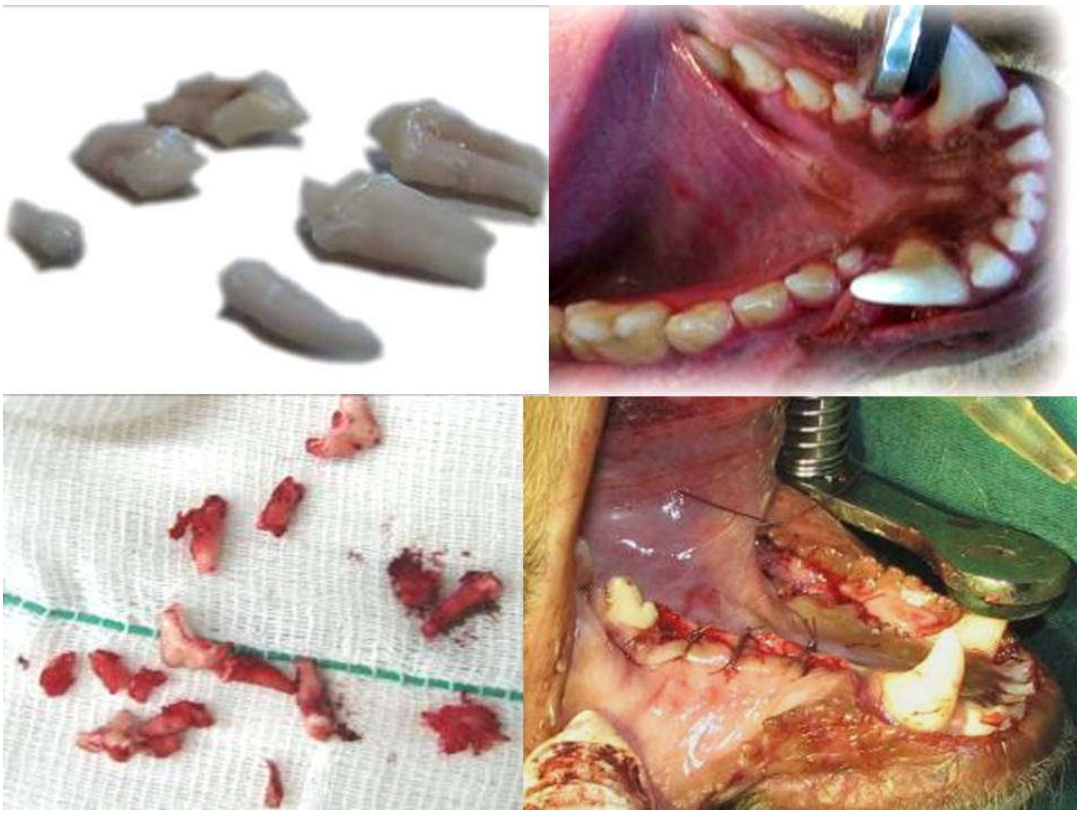

Fig. 1. Surgical Procedure of Premolars extraction

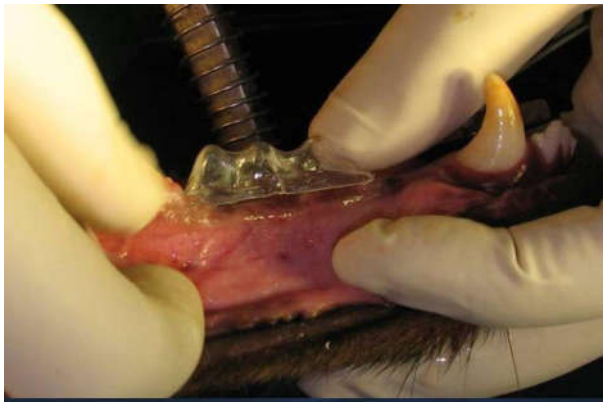

Fig. 2. Clear surgical stents were made using a vacuum machine and transparent sheets

Fig. 3. Implant placement in each premolar region

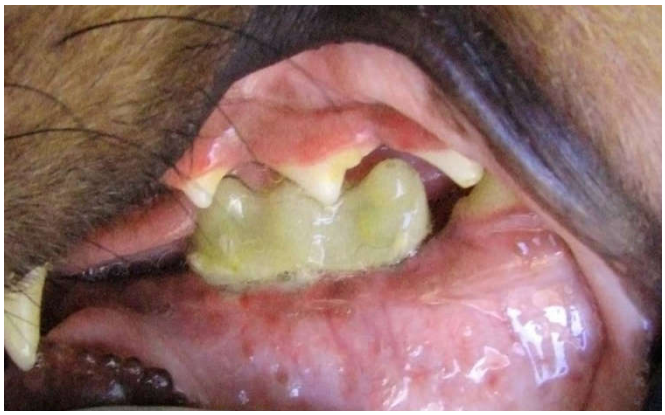

Fig. 4. Temporary prostheses right after implantation

Fig. 5. Bone blocks containing implants were removed from the jaw bone

Other 3 FPDs were actively in function throughout the experiment. Overall success rate was 75% (3 of 4) for the FPDs. Acrylic resin showed some abrasions. Removal torque ranged from 1.3 Ncm to 83 Ncm. This value was only 1.3 Ncm for the failed implant. Overall success rate was 91.6%. Mean removal torque was respectively 51.75%±17.87, 41.90±33.80 and 59.88±15.19 for groups 1, 2 and control.

DISCUSSION

High success rate immediate loading of implants led the profession to revise the surgical and prosthodontic protocols and expect a high success rate. Patients with immediately loaded restorations have the advantage of immediate rehabilitation of mastication. An insertion Torque of 32 to 40 Ncm is believed to be sufficient for a proper primary stability (Horiuchi, 2000). For this reason, an insertion torque of 30 N was assured with the application of torque wrench. Implant failure is highly dependent on the implant type. While a high percent of MTI mini-implants were lost in posterior mandible, standard implants were totally successful (Romanos, 2001) Maxi implants apply a combination of mini-implant theories (autoadvance and autocondensing) and the width of standard implants.

They are self-drilling, self tapping tow-piece dental implants that can be used in different bone qualities, also they have a buttress thread form and GBA (grit blasted and acid etched) surface (http://www.osteocare.uk.com/ pdf/Catalogue.pdf, http://www.osteocare.uk.com/implants/ maxi.htm) The present findings indicate Maxi implants' success. The success rate was 87.5% in the immediately loaded group and 100% in the delayed loaded groups. These values are significantly higher than those of mini-implants and are comparable to same values of conventional (standard) implants. Brunski (Brunski, 1979) and Lum *et al* (1991), reported 100% success in the control group and 100% failure in the immediate loading group. Zubery *et al*(14) reported a 58% success in immediate loaded MTI dentatus Mini-Implants and a 50% success in the control group**.** El-marssafy L *et al* showed that the Osteocare's Maxi Z one-piece, self-tapping self-drilling implant has shown high success rate regarding initial stability and successful osseointegration (El-marssafy, 2011). Acocella *et al* also presented data from a 3-year prospective study on immediately placed implants after tooth extractions in various clinical situations (Acocella, 2010 and Mertens, 2011). Sagara (1993) and Piattelli (1998), 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. Sato N *et al* stated that immediate loading might not inhibit osseointegration for smooth and rough implants in the late healing stages (Sato, 2014).

However, Felice P *et al* showed that there were more complications at immediate post-extractive implants when compared to delayed implants (Felice, 2011). Resistance to reverse torque in implants with similar size, topography and design depends on the interfacial contact of fixture and bone (Vafaei, 2011 and Rasmusson, 1999). Reverse torque reflects the shear strength at the interface of implant and surrounding tissues. Of course, bone geometry and properties are also influential in reverse torque values (Meredith, 1997). 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 (Ganeles, 2001). In the present study, one of the implants with mobile prosthesis was not osseointegrated. This indicates the importance of splinting and its effect on osseointegration. Sagara (Sagara, 1993) and Akagawa (Akagawa, 1993), used fixed partial dentures, Piattelli (Piattelli, 1993), and Corigliano (Corigliano, 1995), used single crowns, and Akagawa (Akagawa, 1986) used the abutment (no prosthesis) for loading. Failure of temporary crowns was one of the main problems in similar studies. Different reinforcement 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 (Powell, 1994). Proper oral hygiene is mandatory in the course of healing of the immediately loaded implants (Sagara, 1993 and Vafaee, 2010). 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 surface. Then corrected to ideal occlusion. Due to the present 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 to the findings of Emeka Nkante *et al* (71.4%) (Emeka, 2003).

Conclusion

Within the limitations of the present study, it may be concluded that immediate loading does not effect on reducing the reverse torque values of the Maxi implants. This supports the advantages of immediate loading for Maxi implants but it requires further investigations to generalize to humans.

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