Immediate Loading of Threaded Implants at Stage 1 Surgery in Edentulous Arches: Ten Consecutive Case Reports With 1- to 5-Year Data

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Immediate loading of threaded implants with a fixed provisional restoration at stage 1 surgery was evaluated in 10 consecutive patients. The patients selected had to be completely edentulous and have adequate bone for a minimum of 10-mm-long implants. A minimum of 10 implants were placed in each patient’s arch. A minimum of five implants were submerged initially for medicolegal reasons and allowed to heal without loading. The remaining implants were loaded the day of stage 1 surgery. Once the provisional restoration was relined, it was cemented or screw retained. A total of 107 implants were placed in these 10 patients; 6 had them placed in the mandible, and 4 in the maxilla. Six patients were treated with Nobel Biocare implants, one with ITI Bonefit implants, two with Astra Tech TiOblast implants, and one with a 3i implant. Sixty-seven of 69 implants that were loaded integrated, and 37 of 38 submerged implants integrated. All 10 patients have been restored with a definitive prosthesis, and all had a fixed provisional prosthesis from stage 1 surgery. The results of this study indicate that immediate loading of multiple implants rigidly splinted around a completely edentulous arch can be a viable treatment modality.

Key words: immediate loading, implant, micromovement

According to Adell et al and Brånemark et al, one of the prerequisites for establishing osseointegration is a nonloaded condition. Strict surgical protocol requires a stress-free healing period of 3 to 6 months for osseointegration to occur between a titanium dental implant and the bone. This stress-free healing period is achieved by submerging the implant below the soft tissue and allowing the surgical site to heal without placement of any direct load on the implant. If the patient is edentulous, a 2-week period is recommended before a removable prosthesis is placed. When this protocol is followed, it is met with a high degree of success.

For many edentulous patients who have been wearing complete dentures and are to undergo implant therapy, the need to be without dentures for 2 weeks postsurgery or to spend several additional months with a removable prosthesis may be tolerated as a necessary inconvenience. Until recently, complete transitional dentures have been the only available method to restore dental function during the 3- to 6-month healing period of implant sites. Schnitman et al described a technique that avoids the need for a removable denture during this interim phase of therapy. The immediate loading protocol they discussed allows the patient to wear an interim fixed partial denture without compromising the long-term success of the overall reconstruction. In their study, nine patients were selected, and 58 standard Nobel Biocare (Nobel Biocare, Göteborg, Sweden) implants were placed in the mandibles of these patients. Schnitman recently reported 9-year follow-up results. All nine prostheses supported by 25 implants placed in immediate function at the time of implant placement were successful during a 4-month healing period. Of
the implants placed in immediate function, four failed, three prior to 6 months, and one at 18 months postimplantation. All failures of immediately loaded implants were distal to the incisor regions. Of the 33 submerged implants, all were osseointegrated and remain in function to date. According to Schnitman, the failures were probably the result of inadequate implant length (7 mm for the posterior implants) and poor bone quality in the posterior mandible.

Utilizing a small number of rhesus monkeys, Lum and coworkers presented clinical and histologic evidence of osseointegration of immediately loaded implants. They suggested that hydroxyapatite-coated blade implants may form a direct bony interface when they are loaded immediately after implant placement at stage 1 surgery, provided that they are splinted to a firm natural tooth. In 1992, Linkow et al reported on an immediately loaded blade retrieved after 231 months of clinical function. Histologically, the bone-to-implant interface showed a mixture of interfacial tissue components and direct bone contact (46.4% to 82.3%) for classification as osseointegrated. Utilizing beagle dogs, Sagara et al also showed evidence of osseointegration when titanium screw implants were immediately loaded with a unilateral prosthesis. Their findings showed that osseointegration did occur, although the immediately loaded implants exhibited less direct bone contact than did the controls.

Salama et al reported on two patients in whom titanium root-form implants were immediately loaded and successfully utilized to support provisional fixed restorations in the maxilla and the mandible. Both patients were followed from 37 to 40 months after implant placement and immediate loading. All implants osseointegrated and were restored with a fixed prosthesis.

The purpose of the present study was to evaluate immediate loading of threaded cylinder implants at stage 1 surgery with a larger number of implants that were at least 10 mm in length.

**Materials and Methods**

**Patient Criteria.** Ten candidates for the study were selected from patients that presented for implant treatment at New York University, College of Dentistry, Department of Implant Dentistry. The patients selected for treatment had to meet the following criteria:

1. The patient was completely edentulous.
2. The patient refused to wear a removable denture at any time during therapy.
3. For mandibular implants, there was adequate bone distal to the mental foramina bilaterally to allow placement of at least 10-mm-long implants.
4. The patient consented to the experimental protocol.
5. A medical history revealed no contraindication to implant therapy.

**Laboratory Procedure.** A facebow transfer and centric relation record were utilized to mount diagnostic casts on a semiajustable articulator. A diagnostic waxup for a provisional fixed prosthesis was fabricated. This waxup was duplicated twice, first to fabricate a custom surgical template from clear autopolymerizing resin (Figs 1a and 1b), and second to fabricate the fixed interim prosthesis. An irreversible hydrocolloid impression was made and poured in stone. The provisional heat-processed acrylic resin restoration had a lingual casting fabricated of semiprecious metal, to provide reinforcement (Figs 2a and 2b) (Emtiaz and Tarnow, submitted for publication). This also provided rigidity and cross-arch bracing.
Surgical Procedure. A minimum of 10 implants were placed in each patient’s arch (Figs 3a and 3b). All implants were then tested for mobility (Periotest, Siemens Dental, Bensheim, Germany). The implants with the lower values (better resistance to load) and the most advantageous anterior-posterior distributions were selected for loading. For medicolegal reasons, a minimum of five implants were submerged and allowed to heal without any loading. This protocol was followed in the first five patients to avoid the need for further implant surgery if the loaded implants were all to fail. More implants were immediately loaded in the last four patients (see Table 1) as a result of the high rate of success of the implants in the first five patients. The stable implants were loaded the day of stage 1 surgery. Dry foil was placed over the sutures to prevent any acrylic resin from contacting the surgical sites.

Once the provisional restoration was relined, it was either cemented or screw retained (Figs 4a and 4b). The first five restorations were cemented with temporary cement. The last five were secured with screws into temporary cylinder abutments.

Ten patients were treated between October 1991 and March 1995. Six patients were treated with Nobel Biocare implants, one patient was treated with ITI Bonefit implants (Straumann, Waldenburg, Switzerland), two patients with TiOblast implants (Astra Tech, Mölndal, Sweden), and one patient with 3i implants (Implant Innovations, West Palm Beach, FL). A total of 107 implants were placed in these 10 patients. Sixty-nine implants were immediately loaded and 38 were submerged. Only completely edentulous arches were utilized in this study to ensure minimal rotation of the fixed provisional restorations.

Six mandibular arches and four maxillary arches were treated. Six of the mandibular restorations were opposed by complete maxillary dentures. Three of the maxillary prostheses were opposed by osseointegrated implants. One maxillary prosthesis was opposed by natural dentition that included a four-unit metal-ceramic prosthesis. Stage 2 surgeries were performed 4 to 6 months after placement of the submerged implants. Final restorations were then fabricated and placed (Fig 5).

For patients 2 and 3, the provisional restoration was removed at each postsurgical visit to evaluate implant mobility during the healing period. This was not done for any of the other prostheses. Panoramic radiographs were taken yearly, and the definitive prostheses were removed at the 1-year postinsertion visit. The patients were recalled every year.

Results
Of the 107 implants placed, 104 osseointegrated (Table 1). One submerged implant failed because of an infection attributed to an adjacent extraction socket, and two loaded implants were lost when the cemented provisional restoration was tapped off to verify healing before 4 months of healing had elapsed. Both of these implants had been placed in immediate implant sockets. All three implants that were lost were in patients 2 and 3. In patient 1 and in the last seven patients, no implants were lost. In these eight patients, the provisional restoration was not removed during the 4- to 6-month healing period. Of 69 implants that were loaded immediately, 67 integrated. Of the 38 submerged implants, 37 integrated successfully.

Discussion
The level of predictability and high success of current implant therapy have provided cause to reevaluate both the surgical and prosthetic protocol that have been proposed. A number of studies have reported that immediate loading of implants with a provisional prosthesis after stage 1 surgery can result in a high
success rate. The present study assessed the same concept, utilizing a larger number of implants within an arch as well as placement of some in the posterior region of the mandible. Except in two cases reported by Salama et al., posterior mandibular placement has been avoided in most studies because poor bone quality in this region was expected to result in high failure rates. In this study, the same procedure was performed in the maxillary arch, which was attempted in only one of the aforementioned studies on immediate loading papers. The results of this study indicate no difference in success rate between maxillary and mandibular arches.

Brunski has stated, “Micromotion can be deleterious at the bone-implant interface, especially if the micromotion occurs soon after implantation.” Most studies indicate a need for a 3- to 6-month period in which implants are not loaded for osseointegration to occur. According to Brunski, micromotion of more than 100 µm should also be avoided, and motion greater than this level would cause the wound to undergo fibrous repair rather than the desired osseous regeneration. In 1972, Cameron et al. reported that bonding, meaning integration, also occurs in the presence of micromovement. In 1973, he concluded that the ingrowth of bone in pores of a porous substance will occur in the presence of micromovement, but not of macromovement. According to Brunski and Cameron, as long as there is no macromovement and no micromovement of more than 100 µm, the concept of immediate loading of implants can still allow for osseointegration.

Implants stabilized at initial placement by splinting and utilizing the widest anterior-posterior distribution of the implants are able to resist the critical degree of micromovement at the bone-implant interface. Apparently, the type of casting-reinforced provisional restoration used in this study both prevents any macromovement, or significant micromovement, and provides resistance to forces in all directions.

The only failures that occurred were in patients 2 and 3, in whom the provisional restoration was being tapped off to evaluate the implants with the Periotest instrument and to assess the mobility values obtained during the 4 to 6 months of healing. This removal created macromovement and lack of osseointegration. This probably caused two loaded implants to fail. For the last seven patients, the provisional splints were not removed during the healing period of 4 to 6 months. In patients 7 and 8, fewer implants were submerged because it had been observed that the loaded implants in the previous patients were integrating. In patients 9 and 10, all implants were loaded and none was submerged. The screw-retained provisional restoration also has the advantage of easy removal, which does not cause macromovement during the healing period.

These case reports, along with the others documented, may provide cause to reevaluate the essential principles of the Brånemark protocol for osseointegration. A submerged, nonloaded period of 3 to 6 months has certainly been proven to be a successful course of treatment. However, osseointegration can clearly be attained in selected immediately loaded situations as well. This in no way implies that submergence is no longer necessary. These results simply suggest that it is not essential in certain situations.

These 10 consecutive cases have led to the following guidelines to help ensure clinical success for immediate loading:

1. Immediate loading should be attempted in edentulous arches only, to create cross-arch stability.
2. Implants should be at least 10 mm long.
3. A diagnostic wax up should be used for template and provisional restoration fabrication.

4. A rigid metal casting should be used on the lingual aspect of the provisional restoration.

5. A screw-retained provisional restoration should be used where possible.

6. If cemented, the provisional restoration should not be removed during the 4- to 6-month healing period.

7. All implants should be evaluated with Periotest at stage 1, and the implants that show the least mobility should be selected for immediate loading.

8. The widest possible anterior-posterior distribution of implants should be utilized to provide resistance to rotational forces.

9. Cantilevers should be avoided in the provisional restorations.

**Conclusion**

These 1- to 5-year results in 10 consecutive patients suggest that threaded implants can be placed into immediate function to support a provisional fixed prosthesis in edentulous arches during a 4- to 6-month healing period, in both mandibular and maxillary arches. A delayed loading protocol still remains the treatment of choice; however, for a particular population, immediate loading of multiple implants splinted across the arch may prove to be a valuable adjunct to therapy.

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FIGURES

Figure 1a

Fig. 1a Custom surgical template fabricated from clear auto polymerizing resin.

Figure 1b

Fig. 1b Try-in of the surgical template.
Figure 2a

Fig. 2a Lingual aspect of the cast waxed for fabrication of a lingual casting to provide reinforcement.

Figure 2b

Fig. 2b Casting placed on the lingual aspect of the provisional prosthesis.
Figure 3a

Fig. 3a Thirteen guide pins in place after osteotomies were made with 2-mm twist drills to ensure proper alignment at stage 1 surgery in the mandibular arch.

Figure 3b

Fig. 3b Thirteen Nobel Biocare implants in place.
Figures

**Figure 4a**

*Fig. 4a* Provisional prosthesis seated with screws and access holes covered with cotton pellet and Cavit G.

**Figure 4b**

*Fig. 4b* Panoramic radiograph at stage 1 after implant placement and seating of the provisional prosthesis.
Figure 5

Fig. 5 Panoramic radiograph after seating of the definitive prostheses, a complete maxillary denture with a metal base and a fixed implant-supported mandibular prosthesis.

TABLES

Table 1

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References