

Immediate Loading of Implant Overdentures Using Modified Loading Protocol

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Successful osseointegration of dental implants has traditionally meant that clinicians allow for a stress-free healing period for implants. This 2-stage protocol initially calls for the submerging of several implants, which remain load-free for 3-6 months to ensure implant integration with the alveolar bone. However, the edentulous anterior mandible often lends itself to immediate or delayed loading of implants in a 1-stage protocol, allowing the clinician and patient the benefits of a considerably shortened implant-to-restoration timeline. This process includes more patient comfort and less anxiety, as well as less expense and more convenience for both the patient and clinician.¹⁻⁵

Although success rates are not as high for immediately loaded and early implants placed in a 2-stage protocol (and allowed to heal for several months before loading), conditions often warrant the 1-stage surgical option, particularly in the anterior mandible, even when systemic illness and smoking are not precluded from the patient criteria.^{6,7} Of course, successful immediate loading or early loading procedures in the mandible require attention to a number of factors, including hard tissue (e.g., predictable osseointegration, bone loss) and soft tissue (e.g., esthetics, peri-implant health) concerns.⁸ This report includes a limited patient complement but, nevertheless, confirms the success rates reported in the

To our knowledge, this study shows the first longitudinal results (range 12-30 months) of immediate loading of implant-supported overdenture with ball attachment connection placed in the anterior mandible. Immediately after surgery, the overdenture was connected to the implants with 2-ball attachments. The housings were filled with Impregum™ (3M Espe AG; Seefeld, Germany) impression material to provide retention as

well as reduce forces in the initial phase of loading. Of the 28 implants placed, only 1 failed; the 1 failed implant for total implants placed represents a success rate of 96.4%. The minimal bone loss (1 mm) in 2 sites represents a success rate of 92.8%. (Implant Dent 2006; 15:35-40)

Key Words: immediate loading, occlusal forces, implant-supported overdentures

literature for immediate and early loading of a limited number of implants placed in the anterior mandible to support an overdenture. It further suggests that the use of a common impression material to reduce the occlusal forces during the first several weeks of initial prosthetic use increases the likelihood for a successful outcome.

MATERIALS AND METHODS

A total of 10 patients, including 4 males and 6 females, with a mean age of 68 years (range 58-75), participated in the study. There were 6 patients who were completely edentulous. Four patients had teeth 6-11 in the maxilla, with removable partial dentures. All patients were completely edentulous in the mandible, and all the implants were inserted in the mandible for immediate prosthetic restoration. Implants used in the study were Zimmer Dental, Tapered Screw-Vent 13 × 3.75 mm or Advent (Zimmer Dental, Carlsbad, CA) 13 × 4.7 mm.

All patients in this study had ridges of adequate size and did not require membrane barriers or bone grafting to augment the alveolar bone.

In addition to the prerequisite of adequate bone, patients could have no systemic illness that might cause delay in healing (e.g., diabetes). Furthermore, the study required nonsmokers.

Before surgery, final impressions of the arches were made, and working models were cast. The models were mounted in an articulator using face-bow and bite registration on occlusal rims for establishing the centric relation. Tooth settings were made and confirmed by the patients. The settings were processed into the denture to re-line and retrofit onto the implants at surgery, and setting data were also duplicated into a clear acrylic apparatus to be used as a surgical template to ensure that the implants were placed in an appropriate buccal-lingual position to allow for retrofitting of the denture onto the dental implants. The implants were placed according to the parameters established by the clear acrylic template. There were 3 implants placed in the anterior mandible, from mental foramen to mental foramen. Only 2 of the 3 implants were immediately loaded. The third was not activated so as to have it available in the event that 1 of the immediately loaded implants

failed. Of the patients, 2 had only 2 implants placed because of financial reasons.

Immediately after surgery, the overdenture was connected to the implants after 2-ball attachments were placed on the 2 distal implants, leaving the 1 implant inactivated in the mandibular midline. The denture was then checked to see which area was directly above the implants and their ball attachments. The appropriate area of the denture was hollowed out and metal housings attached to the denture with cold-cure acrylic. The plastic apparatus was not placed into the housing because doing so would produce excessive retention, and possibly put excessive tensile force on the implants and cause their failure. Instead, the housings were filled with Impregum™ (3M Espe AG; Seefeld, Germany) impression material, which is a rubbery textured polyether material, to provide retention as well as reduce forces in the initial phase of loading. The Impregum™ was replaced every 2 weeks for 3 months following the surgery.

Patients were evaluated every 2 weeks to check tissue and implants, and remove the flexible Impregum™ lining in the metal housing placed inside the denture and replace it with new Impregum™. The old impression material has a tendency to become less resilient, thus providing less retention and more pressure on the ball attachments screwed into the implants. In addition, patients were instructed to chew only soft food for 3 months. After 3 months, the plastic cap was connected. The plastic retention piece was then placed into the metal housing of the denture after 6 months. Panoramic x-rays were taken after the surgery as well as after 6 months of loading; every year after the first year of loading, bone support was measured from the implant and crestal bone. After 3 months, the plastic cap was connected. The plastic retention piece was then placed into the metal housing of the denture after 6 months. Panoramic radiographs and periapical radiographs were taken at this time to assess the implants in addition to the clinical assessments.

completely edentulous patient population, acceptance of the 2-implant mandibular overdenture is often very high because of the reduced cost and added convenience of the procedure, not to mention the original impetus to facilitate nutritional and social needs caused by higher retention provided by the overdenture, whether the securing mechanism consists of studs, linked bar, or magnets.^{22,23}

In this study, Zimmer Dental provided all mandibular implants used for immediate prosthetic restoration. Specific implant designs used were the Tapered Screw-Vent 13 × 3.75 mm, or Advent 13 × 4.7 mm. See Table 1 for the distribution pattern among patient complement. A number of studies have shown comparable success rates in overdenture retention and overall implant osseointegration, even when different implant designs or implant systems were used in the mandible.^{11,24-28}

Adequate ridge size is an essential criterion for the clinical decision to load implants immediately, along with other criteria, including implant location, implant coating, and implant length.^{19,29,30} This was no different in its insistence on the prerequisite of adequate bone in the mandible. Nor was any systemic illness allowed in the patient complement because such conditions could delay healing and osseointegration. The study also insisted on precluding smokers from the complement.

It is noteworthy that a number of studies have had a variety of patient criteria for measuring the performance and outcomes of procedures involving immediate loading of the anterior mandible. For example, criteria may have included, as this one did, mandibular bone quantity, including both height and width, and shape based on preoperative radiography, oral hygiene, residual teeth, soft tissue inflammation or disease, previous radiation therapy, gagging reflex, clenching or bruxism, patient history of implant success, substance abuse, smoking, chronic disease (e.g., diabetes, hemophilia, renal or liver disease), steroid treatment, pregnancy, and physical/psychiatric disabilities.²⁵

In this study, as in many others, final impressions of the arches were made, and working models were cast

Table 1.

| Number/Type of Implants | Location | Complications | Bone Loss | Follow-up (months) |
|-------------------------|------------|----------------------|------------|--------------------|
| 3-TSVB | 27, 24, 22 | none | none | 24 |
| 3-TSVB | 27, 26, 23 | none | none | 24 |
| 2-TSVB | 26, 23 | none | none | 24 |
| 3-AdVent | 27, 26, 23 | none | none | 12 |
| 3-TSVB | 27, 26, 23 | 26 failed & replaced | 1 mm at 27 | 12 |
| 3-TSVB | 26, 23, 21 | none | none | 18 |
| 3-AdVent | 26, 23, 22 | none | none | 24 |
| 3-TSVB | 26, 23, 22 | none | none | 12 |
| 3-TSVB | 26, 23, 22 | none | none | 18 |
| 2-TSVB | 26, 23 | none | 1 mm at 26 | 30 |

RESULTS

Of the 28 implants placed, only 1 failed; the failure occurred in a patient checked at a 12-month follow-up visit. This patient also had signs of bone loss (1 mm) in another implant. Two other patients who were checked at 12 months had no signs of complication or bone loss. Other patients in the study, with follow-up visits ranging from 18 (2 patients), 24 (4 patients), and 30 months (1 patient), had no signs of complications or bone loss, with the exception of 1 patient (follow-up at 30 months) having signs of 1 mm of bone loss in 1 of only 2 implants placed. Another patient had only 2 implants placed but had no signs of complications or bone loss. The 1 failed (and subsequently replaced) implant for total implants placed represents a success rate of 96.4%. The minimal bone loss (1 mm) in 2 sites represents a success rate of 92.8% (Table 1).

DISCUSSION

Although the patient complement for this study was relatively small and limited by age (10 patients with a mean age of 68 years), the study proceeded under the literature-buttressed assumption that immediate or early loading of implant-supported overdentures and fixed bridges in the mandible is a highly successful procedure when

the clinician exercises proper caution, with results sometimes rivaling those of traditional 2-stage protocols.⁹ The literature documents the more traditional, time-tested practice of using multiple, interforaminal implants connected by a bar, as well as more recent practice of using only 2 or 3 similarly placed implants not connected by a bar.¹⁰⁻¹⁹ Implants in the anterior mandible have such a high success rate that using only 2 or 3 implants to retain an overdenture is becoming more and more common, thus reducing the time, cost, and inconvenience of the more traditional practice of placing a bar-retained 4-implant overdenture.²⁰ In fact, even in cases in which a patient's condition may seem to contraindicate or otherwise preclude the use of implants and their immediate or early loading (e.g., cases of a patient undergoing diphosphonate treatment for osteoporosis²¹), the anterior mandible may still offer the clinician and patient attractive alternatives for prosthetic rehabilitation. Today, restoring an edentulous patient with an overdenture on 2 implants may be considered to be state of the art.

All patients participating in the study were completely edentulous in the mandible, and 6 were completely edentulous. There were 4 patients who had removable partial dentures in the maxilla, retaining teeth 6-11. Of the

before surgery began. An articulator was used to mount the models. A face-bow and bite registration on occlusal rims established the centric relation. Patients then confirmed the tooth settings. The setting data were duplicated to create a clear acrylic surgical template for placing the implants in the correct buccal-lingual position to facilitate retrofitting of the denture onto the dental implants. The foregoing description reflects the procedure followed by many "immediate restoration" systems for restoring the edentulous mandible, perhaps the most well known of which is the Brånemark Novum system, which also uses drill templates and guides to position 3 implants. This particular system uses a double-bar retention system, but fabrication of the final restorative prosthesis is similar to the procedure used in this study.³¹

The clinicians placed implants according to the clear acrylic surgical template: 3 were placed in the anterior mandible, from mental foramen to mental foramen.³² It has been noted that if the patient presents with tense labial musculature or limited attached gingiva, the clinician should guard against placing implants too deep or labially because doing so could impede the growth of gingiva over abutments.²⁰ In our study, 2 of the 3 implants were loaded immediately, and the third remained an inactivated "back-up" in case 1 of the other immediately loaded implants failed. Ball attachments were placed on the 2 distal implants, and the overdenture was connected to the implants.

An earlier study followed a similar protocol, allowing a number of implants to heal conventionally in case of failure of the immediately loaded implants.³³ Similarly, "expendable" implants have been used to support both maxillary and mandibular provisional fixed restorations during the healing phase of submerged fixtures.³⁴ Such precautions reflect the importance of the clinician's considering the possible need for rescue procedures, given the less than ideal predictability of immediately loaded and early loaded implants, even in the anterior mandible. Considerations should include the possible choice of implant systems designed for such an eventuality.³⁵

Furthermore, the clinician should not underestimate the advantage of us-

ing alternative therapies for immediately loaded or early loaded mandibular overdentures, including the use of a U-shaped bar in conjunction with 4 implants, not singly placed and "unconnected" implants as in this study. In fact, some studies indicate the near identical success results of such procedures with traditional 2-staged approaches to mandibular overdenture retention involving the submerging of implants that are allowed to heal for 3-6 months.²⁵ Such studies indicate that the bar's ability both to reduce rotational movements and transfer vertical load to the implants may have a great deal to do with the successful osseointegration of immediately loaded implants in the mandible. Therefore, this bar-approach for immediate loading allows less of a possible compromise with cost and convenience. Finally, in cases in which bone quality and quantity do not permit, immediate loading of implants in the anterior mandible should be abandoned, and the clinician should rely on the more traditional 2-staged approach.²⁶

When the denture is placed above the ball attachments, it is checked to see which of its areas sits directly above attachments. Once this area is determined, the clinician hollows it out. A metal housing is then attached to the denture via a cold-cure acrylic. It is noteworthy that the plastic piece for retention was not placed into the housing for retention. Placing the plastic piece in the housing probably would result in excessive retention, thus placing undue tensile force on the immediately loaded implants. Such an increase in tensile force could result in implant failure. Although the midline implant is placed in the event of such a failure, the clinician should note that such a risk to implant success in this case is unwarranted.

Instead of the plastic piece being placed in the housings, the housings were filled with Impregum™ impression material, which is a rubbery textured polyether material. Such use of this impression material provides 2 benefits. Not only does the material provide retention for the overdenture, but it also reduces the occlusal forces the implants will undergo in the initial phases of loading. Like the inactivated midline implant, the Impregum™ adds

an insurance policy of sorts to the overall success of the procedure, helping to guarantee that the 2 immediately loaded implants are given every chance to survive in an oral environment where they are called upon to provide retention and stability in short order.

Every 2 weeks for the next 3 months, patients were evaluated not only to check soft tissues and the implants but also to replace the flexible Impregum™ lining in the metal housing inside the denture. This relatively frequent replacement procedure was necessary because the Impregum™ has a tendency to become less resilient over a 2-week period. This reduction in resiliency not only reduces overdenture retention but also increases the occlusal forces and pressures on the ball attachments, which have been attached to the implants.

An additional safety precaution to help ensure reduced occlusal forces is the instruction to patients to chew only soft foods for 3 months. In addition, after 3 months, the Impregum™ protocol ended, and the plastic cap was connected. After 6 months, the plastic retention piece was then placed into the denture's metal housing, and panoramic x-rays were taken, just as they were after initial surgery. Every year after the first year of loading, bone support was measured from the implant and crestal bone.

General criteria for survival and success of implants have been used to evaluate the efficacy of immediately loaded mandibular implants.²⁶ For example, survival criteria include how the implant performs, particularly regarding the absence of pain, infection, and paraesthesia. Implant mobility and the absence of periimplant radiolucency under radiography are 2 more criteria of implant survivability. Success criteria include the additional element of absence of vertical bone loss; specifically, less than 1 mm during the first year and less than 0.2 mm annually thereafter.

Only 1 of 28 implants in this study failed (96.4% success rate). This particular failure occurred in a patient who was checked during a 12-month follow-up. In addition to this failure, this patient had signs of bone loss (1 mm) in another implant. A 12-month

follow-up on 2 other patients showed no signs of complications (failures) or bone loss. Follow-up visits for other patients ranged from 18 (2 patients), 24 (4 patients), and 30 months (1 patient). None of these patients had signs of complications or bone loss except for 1 (a follow-up at 30 months), which had signs of 1 mm of bone loss in 1 of 2 implants placed. This patient and 1 other had only 2 implants placed. The other patient had no signs of complications or bone loss. A success rate of 92.8% for minimal bone loss (1 mm) reflects the occurrence in 2 sites.

CONCLUSION

Although this report covers a limited patient complement, it reflects success rates reported in the literature for immediate and early loading of implants placed in the anterior mandible to support an overdenture. In addition, the report concludes that an innovative use of Impregum™ impression material, not only for retention but also to reduce occlusal forces during the first several weeks of initial prosthetic use, increases the likelihood for success. Granted that success rates for immediate loading of implants in the edentulous mandible are not as high as rates for the traditional 2-stage approach, conditions nevertheless often warrant the 1-stage surgical option described here. Clinician caution regarding hard tissue and soft tissue concerns in the anterior mandible is warranted whenever a 1-stage protocol is attempted; however, immediate or delayed loading of implants in a 1-stage protocol presents the clinician and patient with numerous benefits.

Disclosure

The authors claim to have no financial interest in any company or any of the products mentioned in this article.

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Unmittelbare Belastung von Implantatdeckprothesen mittels modifiziertem Belastungsprotokoll

ABSTRACT: Die vorliegende Studie befasst sich mit den ersten Langzeitergebnissen (12 bis 30 Monate) einer Implantatgestützte Deckprothese nach herkömmlicher Verwendung einer Kugelgeschiebeverbindung im vorderen Unterkiefer. Unmittelbar nach dem Eingriff wurde die Deckprothese mittels Zweikugelgeschieben mit den Implantaten verbunden. Die Gehäuse wurden mit dem Abdruckmaterial Impregum™ gefüllt, um darüber einen festen Sitz zu gewährleisten und die Kräfte in dieser ersten Phase der Belastung zu reduzieren. Nur eines der insgesamt 28 Implantate versagte. In der Umrechnung auf die Gesamtlänge ergibt sich damit eine Erfolgsquote von 96,4%. Der minimale Knochengewebsverlust (1 mm) in beiden Implantationsfeldern bedeutet eine Erfolgsquote von insgesamt 92,8%.

SCHLÜSSELWÖRTER: unmittelbare Belastung, im Zahnreihenschluss auftretende Kräfte, Implantatgestützte Deckprothesen