Fabrication of a Laser-Welded Fixed–Detachable Prosthesis for Immediate Loading

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Immediate loading of dental implants in completely edentulous patients is receiving great attention. Standard surgical protocol is used with primary stabilization of the implants as a goal. The restorative dentist must coordinate with the surgeon and the laboratory technician to make immediate loading a reality for the completely edentulous patient. This article describes a technique developed to fabricate an immediately loaded fixed–detachable prosthesis using laser welding technology. Advantages, which are applicable to various implant systems and patients, are discussed.

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A BETTER UNDERSTANDING of the bone-to-implant healing process, improved implant surface technology, and patient desires have led not only to reduced healing times, but also to the practice of immediate loading. Since the mid 1980s, the success of immediately loaded implants, particularly in the anterior mandible, has been documented with various implant systems, provided certain guidelines have been followed. References of particular importance propose the reduction of micro-motion during the initial loading period. Currently, several authors advocate immediate loading of implants in the anterior mandible.[1-7]Animal studies as well as human studies confirm that osseointegration does occur in immediately loaded implants in the anterior mandible region.[8-10]

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The surgical technique for a patient planned for immediate loading of dental implants presents no change from the delayed loading technique; however, the restorative dentist must adapt to the shortened protocol, in order to deliver the final prosthesis within the reduced time period. Nobel Biocare USA (Yorba Linda, CA) recently introduced the Novum system to address this challenge. This system requires additional surgical armamentarium, changes in surgical protocol, and is not readily adaptable to variations in arch form, location of the mental nerve, or surgical error. It does, however, allow the delivery of teeth in a day to a large group of patients.

When splinting multiple implants, passive fit of the framework should be achieved to avoid excessive force distribution to the implants. Several reports show that a laser-welded framework exhibits a more precise fit than a one-piece casting.[11,12] Laser welding technology can not only create a passive-fitting implant prosthesis, but also pre-fabricated implant components, including titanium bars and attachments, and can be laser-assembled directly on the master cast.[13,14]

This article describes a technique developed to fabricate an immediately loaded fixed–detachable prosthesis using laser welding technology. It incorporates titanium bars and attachments to expedite the delivery of a definitive prosthesis while providing maximum adaptability and passive fit. This technique may be used with any implant

system and any appropriately selected patient. It provides the patient a definitive restoration in 1 week, and is a predictable reality with the cooperative effort of the patient, restorative dentist, surgeon, and laboratory technician.

Technique

Diagnostic Procedures

1. Maxillary and mandibular wax trial dentures are fabricated on a semi-adjustable articulator. The maxillary denture is processed and ready for delivery on the day of surgery.
2. A diagnostic lower complete denture is fabricated and duplicated in clear acrylic resin. Five holes are drilled in the duplicated denture in the ideal implant positions and are filled with barium sulfate material (Sargeant Welch, Buffalo, NY) (Fig 1).
3. Panoramic and periapical radiographs are made to confirm pre-determined implant positions in relation to the mental nerve and osseous crest.
4. A CT scan is used to assess the buccal–lingual ridge width and positions of the mental nerve foramina (Fig 2).
5. The mandibular cast and the denture duplicate are analyzed to determine the arch form, appropriate interarch space necessary for a mandibular fixed hybrid prosthesis, and approximate implant positions according to the information gathered from the CT scan. The approximate implant positions are then marked on the cast.

Figure 1. Holes filled with barium sulfate material to identify ideal implant locations.

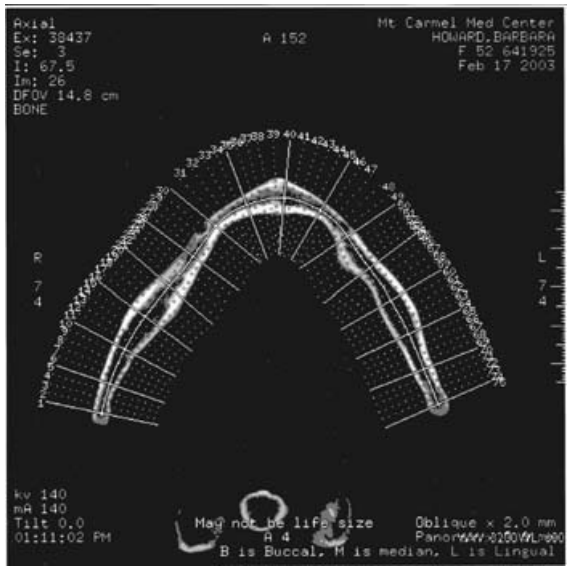

Figure 2. A CT scan is used to assess ridge width and mental nerve positions.

Surgical Appointment—Day One

1. At the time of surgery, centric relation position is determined, and fixed marks are placed on the patient's chin and nose areas to allow easy intra-surgical check of interarch distance (Fig 3).

Figure 3. Markers are placed on the patient's chin and nose to allow intra-surgical check of interarch distance.

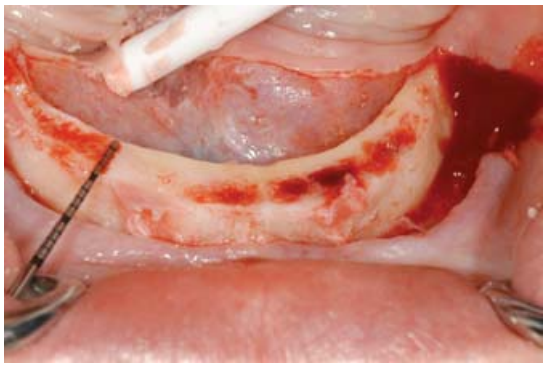

Figure 4. The bone is reduced to achieve the appropriate inter-occlusal clearance.

2. Following standard surgical protocol for implant placement of a fixed–detachable prosthesis, a full thickness flap is elevated past the mucogingival junction, and the mental foramina are identified.
3. Vertical ridge reduction, if necessary, is carried out to achieve the required inter-occlusal distance in an orientation parallel with the maxillary occlusal plane (Fig 4).[15]
4. The clear duplicate denture is modified and used as a surgical guide. Bilaterally, the location of the two most distal implants should be scored with a round bur. It is important to place these two implants 5 to 7 mm anterior to their respective mental foramen to accommodate the anterior loop of the nerve.
5. The remaining implant sites should also be identified and marked with a round bur.
6. The osteotomy sites for the five implants are drilled, and the implants are placed.

Figure 5. Implants and transmucosal abutments are placed.

Figure 6. The surgical template and conjoined impression posts are removed from the patient's mouth.

7. Prior to the patient's departure from the surgical office, five transmucosal abutments are placed and torqued to 35 N/cm. Soft tissue closure around the five abutments is obtained using 4.0 chromic gut suture. The patient then returns directly to the restorative dental office (Fig 5).

Restorative Appointment—Day One

1. At the restorative dental office, five impression posts are placed and tightened into the transmucosal abutments. GC auto-polymerizing pattern resin (GC America, Chicago, IL) is used to connect the impression posts to each other and to the modified surgical template.[16]
2. The impression posts and the surgical template are removed from the patient's mouth using a pick-up technique (Fig 6). In addition, a standard closed tray transfer impression of the abutments is made using medium body poly(vinyl siloxane) impression material (Reprosil, Caulk/Dentsply, York, PA) with the patient in centric relation position using a duplicate of the mandibular denture (Fig 7).[17,18]
3. Healing caps are placed on each transmucosal abutment. The patient is dismissed for the day (usually by 11:00 AM).

Laboratory Phase—Day Two

1. Laboratory abutment analogs are attached to the modified surgical template, and a verification cast is fabricated (Fig 8). This

Figure 7. Duplicate of the mandibular denture used to make an impression in centric relation position.

cast serves as an index to fabricate and assess framework fit.

2. The closed tray impression is adapted to the mounted mandibular master cast using an altered cast technique for the anterior region.
3. Pre-fabricated implant components, including titanium abutment cylinders and bars (Attachments International, San Mateo, CA), are laser-assembled directly on the master cast by the laboratory technician (Figs 9 and 10). The bar is fabricated in an L-shape for strength,[19] and cantilever length is planned according to "anterior–posterior spread" protocol.[20] Passive fit is obtained and verified using the one-screw test and visual observation.[13]
4. The laboratory technician sets the denture teeth on the mandibular titanium frame using an index from the wax trial denture. The laser-welded titanium bar and arranged denture teeth are sent to the restorative dentist for the next appointment (Fig 11).

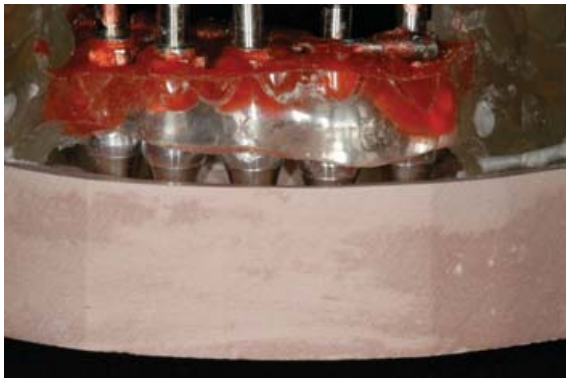

Figure 8. Surgical template was set on mounted mandibular cast. This master cast served as an index to fabricate and assess framework.

Figure 9. Pre-fabricated implant components were laser-welded directly on the master cast.

Restorative Appointment—Day Three

1. The passive fit of the framework, cleansability, esthetics, phonetics, and occlusion are checked.
2. The prosthesis is returned to the laboratory for final processing using heat-polymerized acrylic denture resin (Lucitone 199, Caulk/Dentsply, York, PA).

Restorative Appointment—Day Four

1. The definitive mandibular fixed–detachable prosthesis is delivered to the patient (Fig 12).
2. The abutment retaining screws are torqued according to the manufacturer information for

Figure 10. Titanium framework fabricated on master cast.

Figure 11. Laboratory technician set denture teeth on the mandibular titanium frame.

the system used. The patient is instructed to follow a soft-diet protocol for 6 to 8 weeks, and oral hygiene instructions are given.

3. Follow-up appointments are made at 4 days, 1 week, and 3 weeks.

Discussion

The Branemark Novum (Nobel Biocare USA) provides same-day loading with a final fixed restoration; however, the system is not applicable to all patients, due to anatomical limitations such as a V-shaped arch and limited distance between the mental foramina. The surgeon is limited to a single implant manufacturer, and the cost of the special surgical armamentarium is an additional expense.

The method described in this article involves little change to the surgical protocol, but it provides a framework that can accommodate any anatomic situation using any implant system. This technique can not only compensate for less-than-ideal angulated implant placement, but it will also eliminate the casting distortion and improve the fit of the framework without the need for sectioning and soldering. As a result, less clinical chair time and greater patient satisfaction are possible.

Figure 12. Delivery of definitive prosthesis.

The primary disadvantages of this approach are that the framework is not pre-fabricated, but must be laser-welded, and the fit must be verified in the patient's mouth. Therefore, at least 2 days are needed to complete the framework; however, an advantage is that the procedure is less limiting to the restorative dentist and laboratory technician, in that most implant systems may be used. The technique allows for a highly accurate, passively fitting prosthesis in only 4 days with excellent patient satisfaction.

Summary

This article describes the efficient 4-day delivery of a definitive fixed–detachable titanium implant-supported prosthesis using laser welding technology. The method described involves little change to the surgical protocol, but it provides a framework that can accommodate any anatomic situation using any implant system. This technique can not only compensate for less-than-ideal angulated implant placement, but it will also eliminate the casting distortion and improve the fit of the framework without the need for sectioning and soldering. Therefore, less clinical chair time and greater patient satisfaction are possible.

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