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IMPLANTS

A New Protocol for Immediate Functional Loading of Dental Implants

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In the last two decades, it became clear that clinical implantology had advanced to the point that this treatment represented a predictable approach to the replacement of lost teeth. As initially introduced, a complex surgical protocol was required, with the implants submerged in the soft tissue and alveolar bone to allow for healing without loading. Surgical uncovering and restoration occurred 3 to 6 months later. Per-Ingvar Brånemark, a Swedish physician, developed this two-stage protocol based on meticulous research conducted over a 20-year period.[1,2] Brånemark estimated that implants placed with this protocol had "an expected function time of several decades–perhaps 50 years."[3]

Later, evidence was beginning to suggest that a one-stage protocol might offer patients the prospect of expedited dental rehabilitation.[4,5]

In 1993, the authors initiated a study[6] in which they immediately loaded 40 Brånemark implants placed in conjunction with 90 unloaded implants in 10 edentulous mandibles. Although some (20%) implants were lost, all of the patients successfully retained their prostheses. Since then the authors have further developed and refined this protocol (known as "Teeth in a Day"). This article reviews and explains the protocol and provides a quick overview of the scientific evidence upon which it is based. A case illustrating the application of the protocol is also presented.

BACKGROUND

The idea of immediate functional loading of dental implants is not new. By the late 1800s, dentists on both sides of the Atlantic were experimenting with numerous designs and materials for early implant prototypes, many of which were immediately loaded, and some of which survived for protracted periods.[7] Failure was also widespread, however, due at least in part to the lack of understanding concerning the scientific basis or successful placement of implants.

Brånemark's work forever changed the landscape of implantology. His scientific research and subsequent clinical studies in the Department of Anatomy at Gothenburg University led him to conclude that a number of elements were crucial to achieving long-term survival of endosseous implants.[3] That work emphasized that trauma to the recipient bone should be minimized, and osteotomies should be created that promote a tight fit of implant to bone. Brånemark also believed that, once placed, implants should be protected from any mechanical forces that might lead to the formation of fibrous encapsulation. Such encapsulation would interfere with the healing of bone to the titanium surface of the implant, a phenomenon which Brånemark termed "osseointegration."

The accumulated experimental and clinical evidence supporting Brånemark's two-stage implant-placement protocol as a means of ensuring osseointegration is overwhelming. What has occurred, however, is that a

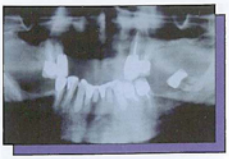

Figure 7. Preoperative panoramic view demonstrating remaining bone structure and anatomic landmarks.

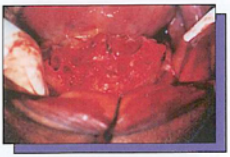

Figure 8. Facial view of alveolar bone following extraction of the mandibular teeth and prior to alveoloplasty.

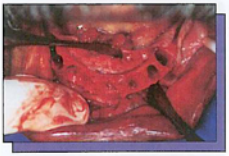

Figure 9. Occlusal view of mandibular alveolar ridge after extraction and prior to alveoloplasty.

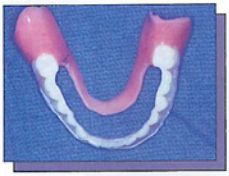

Figure 10. Labial wire-reinforced mandibular immediate complete denture with lingual reduction.

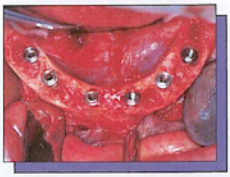

Figure 11. Occlusal view of six Brånemark implants in place following alveoloplasty.

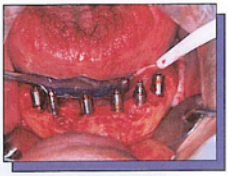

Figure 12. Facial view of Brånemark abutments secured to implants.

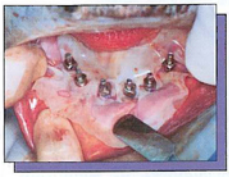

Figure 13. Facial view of rubber dam in place over customized prosthetic copings (modified stainless steel screw-retained Brånemark impression copings).

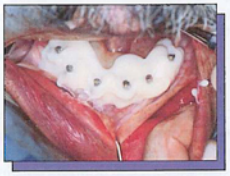

Figure 14. Autopolymerizing acrylic resin injected around the prosthetic cylinder. The rubber dam helps to isolate the site, protecting the soft tissue and exposed bone.

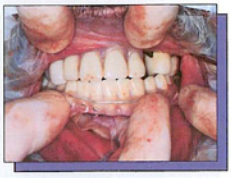

Figure 15. Modified immediate complete denture in proper interocclusal position at centric relation position, and held in place while autopolymerizing acrylic resin converts the denture to the prosthetic cylinders.

bilateral blocks of the inferior alveolar nerve and buccal and labial vestibular infiltrations.

All remaining anterior mandibular teeth were removed. The extraction sockets were thoroughly debrided of all soft tissue and irrigated with a solution of 500 mg tetracyline powder to 100 cc sterile saline (Figures 8 and 9). An alveoloplasty was performed to remove any prominent bony projections. Preparation of the implant receptor sites then commenced. In the course of modifying the alveolus, the surgeon determined that the bone quality was Type III bone according to Lekholm and Zarb's classification scheme.[23] Since this is normally sufficient to allow for use of the described protocol, the mandibular removable immediate denture that had been prepared in advance was sent to the on-site laboratory for initiation of the conversion-prosthesis protocol developed in 1986.[24] This involves reinforcing the prosthesis labially with a wire while relieving it lingually to allow for its placement in centric relation (CR) without contacting the prosthetic screws or cylinders (Figure 10).

While this was being accomplished by the laboratory technicians, six 3.75-mm (diameter), 20-mm (length) Brånemark implants (Nobel Biocare USA) were placed in the anterior mandible (Figure 11). Minimal bone tapping was used to ensure maximal stability of the implants. Four standard and two EstheticCone Brånemark abutments were connected to the implants and tightened to the recommended torque of 20 Ncm (Figure 12). Customized prosthetic cylinders (fabricated from stainless steel, screw-retained Brånemark impression copings) were placed onto the abutments and secured with customized-length guide pins that permitted the mandible to be closed in CR without the components interfering with the occlusion.

In order to protect the site during the next phase of the operation, transfer ink was applied to the top of the prosthetic cylinders, and a rubber dam (Hygenic, Coltene/Whaledent Inc) was placed in contact with the cylinders. This recorded the implant locations on

number of investigators, (including Brånemark[8]) have sought to determine whether osseointegration might also be achievable with immediate loading. In the late 1970s, Ledermann[9] began placing titanium-plasma-sprayed implants and the same day splinting and immediately loading them with a mandibular overdenture. In 1984, he reported a 91.2% survival rate for 476 implants placed in 138 patients.[10] Schroeder et al (in 1983)[11] and Babbush et al (in 1986),[12] following the same protocol, reported success rates of 98.1% and 96.1%, respectively. Since that time, more than a dozen other studies have demonstrated the effectiveness of immediate loading of endosseous implants.[13-21]

The Brånemark Novum System uses prefabricated components and surgical guides to provide a permanent metal reinforced fixed bridge on the day of implant placement.[8] Three implants are positioned in the mandible using a series of drilling templates so that a prefabricated titanium bar can connect the implants and support the fixed bridgework. The intention is to provide a quick and cost-effective implant restoration.

There is a substantial initial inventory required when using the Novum System. The Novum Kit involves four different templates, a series of eight twist drills, a screw tap, special guide pins, and drill guides. Special implants are used which support a unique two-piece prefabricated screw-retained bar system.

The surgical procedure is more time consuming than the standard two-page protocol due to ridge preparation and use of multiple surgical guides. The alveolar ridge needs to be reduced in height until a 7-mm width is achieved in order to accommodate the 5-mm wide implants. Reduction of the bone is not conservative; the additional trauma can lead to increased postsurgical pain and swelling.

Essentially, the Novum system retrofits the mandible to a prefabricated bar for a one-size-fits-all prosthesis. The system uses 5-mm diameter implants in precisely predetermined positions. If one implant fails to osseointegrate, several months of osseous healing would be needed prior to replacing the lost implant. This may require the patient to be without a fixed restoration, and would adversely affect the prosthesis survival rate. It may be difficult to achieve the proper aesthetics and vertical dimension of occlusion at this initial surgical visit. Since this is intended to be the final restoration, this may be problematic and require modification to improve the interocclusal registration and aesthetic result, especially if the surgical procedure is accomplished under general anesthesia. In addition, this procedure is limited to edentulous mandibles.

A recent study[22] that reported the immediate loading of implants with fixed restorations illustrates some of the concerns in interpreting the literature relative to study design. The fixed restorations were fabricated either chairside or in the laboratory and were either screw retained or cemented. Since the surgical procedures were performed in a private office and dental laboratory support was not immediately available, not all restorations could be delivered immediately. Only 11 of the 27 patients received office-processed restorations while 16 patients received restorations that were fabricated by an outside laboratory. Since the majority of the restorations were not delivered immediately, and a few required up to 1 week, this system does not provide "immediate loading." When evaluating different protocols it is important to understand what is meant by "immediate," and how quickly the patients received the restoration.

Also, in this study there were two different methods of attachment: either cemented or screw retained. There are inherent problems with cemented restorations in this type of protocol. If the cement seal breaks in one area, it may be difficult if not impossible to remove the provisional restoration for recementation without creating excessive motion to the other implants where the cement seal is intact.

A NEW PROTOCOL

Recognizing the significant advantages offered by immediate loading, the authors have developed a new protocol. Here, the prosthodontist fabricates a custom provisional restoration prior to surgery and then a series of standardized drills are used with copious irrigation to create implant sites. During creation of the osteotomy, bone quality and quantity are assessed. If the bone density is deemed sufficient to allow for good initial stability, one or more implants are placed. Selection of optimal implant diameters and thread design, as well as self-tapping the implants, may enable the operator to further increase the initial stability of the implant(s).

Immediately after the last implant is placed, the restoration is created by converting a previously constructed provisional prosthesis into an immediate implant-supported nonremovable prosthesis. While this conversion is occurring in the laboratory, the abutments and prosthetic cylinders are connected to the implants. The prosthetic cylinders are then fixed to the provisional restoration intraorally using auto polymerizing acrylic resin. This technique allows for the placement of the implants in the proper position for each individual patient, followed by customization of the provisional restoration before surgical flap closure.

Impressions for the final restoration can be taken either at the time of the initial surgery or at a later date. In either case, having the patient wear the restoration during the healing period gives the treating dentist the opportunity to evaluate the aesthetics, phonetics, and functional loading during the normal osseointegration healing period (3 months in the mandible and 5 to 6 months in the maxilla). Some microscopic distortion takes place at every stage of the prosthetic process, from making the impression to pouring the cast to casting the framework to applying the prosthetic veneering materials. The authors believe that using the all-acrylic splint as an impression splint eliminates one of these inaccuracies and creates an exceptionally accurate master cast. Furthermore, the prosthesis appears to have a splinting effect, locking the implants into place as healing of the alveolar bone occurs.

INDICATIONS FOR PROTOCOL

Not every patient or every tooth site should be considered for this protocol. Patients must understand the limitations of such treatment and be willing to accept the restrictions imposed during the healing phase. Chief among them is limiting the functional forces during osseointegration, and patients need to abstain from chewing anything but soft food or otherwise applying excessive force to the restoration for approximately 3 months. Because of this requirement, the authors consider severe bruxism to be a contraindication

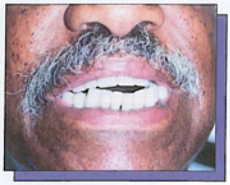

Figure 1. Preoperative full face.

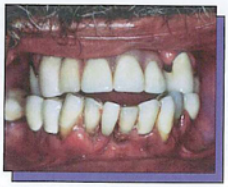

Figure 2. Preoperative anterior intraoral view.

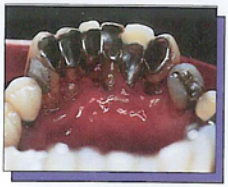

Figure 3. Preoperative lingual view of periodontally compromised mandibular anterior teeth.

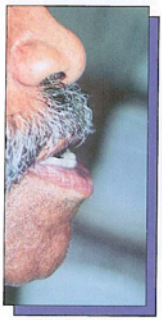

Figure 4. Preoperative lateral facial view demonstrating protruded lower lip.

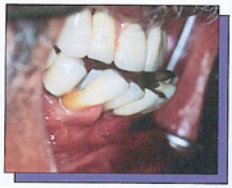

Figure 5. Preoperative lateral view demonstrating labial flaring of the mandibular anterior teeth.

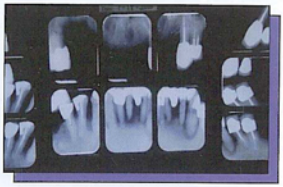

Figure 6. Preoperative periapical radiographs demonstrating advanced bone loss and periapical lesions.

for this protocol. However, judicious use of additional implants may enable mild or moderate bruxers to be considered candidates for immediate loading.

Although immediate functional loading can also be employed for replacement of single teeth or cases of partial edentulism, this protocol is generally contraindicated for single posterior teeth, especially molars. Posterior teeth may be subjected to three to four times the occlusal load of anterior teeth. Moreover, the aesthetic deficit of living with a missing posterior tooth is generally much less significant than it would be for an anterior tooth.

Similarly, when a patient has worn a removable denture for many years or when natural tooth abutments can be saved and used to support a provisional restoration, immediate loading may not be as critical as for the patient who faces the prospect of going directly from natural teeth to edentulism. For the latter, immediate loading provides an excellent option.

CASE REPORT

The patient was a 70-year-old male who presented with advanced periodontal disease involving the mandibular anterior teeth (Figures 1 through 3). Mobility of the remaining teeth in the mandibular arch and a pronounced tongue thrust were other contributing factors (Figures 4 and 5). To replace his missing maxillary anterior teeth, the patient was wearing a maxillary removable partial denture. Many of the molars were missing, and pronounced malocclusion was present.

A comprehensive radiographic analysis, including intraoral periapical films, a panradiograph (Figures 6 and 7), and a lateral cephalometric film confirmed that the patient suffered from advanced periodontal disease, complicated by large periapical lesions in the mandibular anterior region. Apical to these lesions, however, an ample amount of bone remained. The remaining mandibular molar was considered hopeless, from a restorative perspective.

Because of financial limitations, the patient requested that initial treatment be confined to the mandibular arch. He was advised that following the extraction of his remaining mandibular teeth and placement of the implants, he might be a candidate for the immediate loading protocol. He indicated that he preferred this option to that of wearing a traditional complete denture during the healing phase. He was informed that a final decision was dependent upon evaluation of the alveolar bone that would occur during implant-placement surgery. While every effort would be made to provide him with permanent teeth at that time, inadequate bone might necessitate use of a (temporary) removable denture. On this basis, he elected to proceed with the recommended treatment. He signed an informed consent.

Alginate impressions and interocclusal registrations were made to allow the laboratory to fabricate the immediate mandibular complete denture. A thorough debridement of all tooth surfaces was performed, and the patient thoroughly rinsed with a chlorhexidine mouthwash immediately before surgery. These are standard procedures for most patients treated by this protocol.

The authors have found that general anesthesia is advisable in about 50% of the patients using this protocol, typically when dental treatment phobias are present, or surgical procedures promise to be lengthy. However, as neither condition existed in this case, local anesthesia was achieved using bupivacaine hydrochloride (Marcaine 0.5%: Cook-Waite, Abbott Laboratories) for

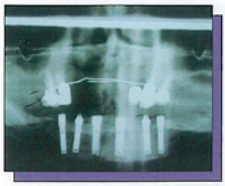

Figure 16. Postoperative panoramic radiograph showing position of the six Brånemark implants.

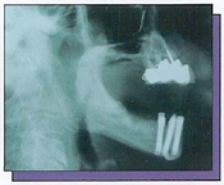

Figure 17. Postoperative lateral cephalometric radiograph showing inclination and anterior to posterior distribution of the six Brånemark implants in the anterior mandible.

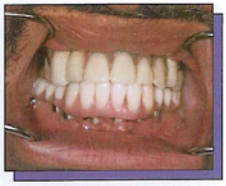

Figure 18. Facial view of completed conversion prosthesis.

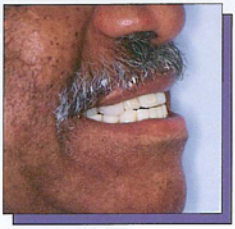

Figure 19. Close-up lateral view demonstrating retracted position of the mandibular teeth of the conversion prosthesis.

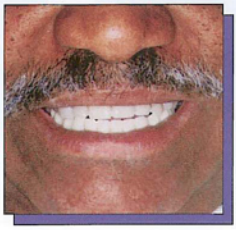

Figure 20. Facial view of the patient afer the procedure is completed.

the rubber. A rubber punch was then utilized to create tiny holes at these positions, and the rubber dam was slipped over the prosthetic components and moved apically to the junction of the prosthetic cylinders and the titanium abutments (Figure 13). The rubber dam protects the soft tissue and exposed bone from the heat generated by the autopolymerizing acrylic resin as it sets. It also provides a dry field for setting and prevents the acrylic from locking into undercuts between the abutments.

The barrel of a 50-mL syringe was loaded with Jet Acrylic (Lang Dental Manufacturing Co). After injecting the resin to thoroughly coat all the prosthetic components (Figure 14), a small amount of resin was also inserted into the newly hollowed denture. The denture was then placed in the patient's mouth in the proper interocclusal position in CR (Figure 15). The occlusal/vertical dimension was confirmed. The patient was instructed to remain motionless for approximately 4 minutes while the acrylic polymerized. Once the resin had hardened, the prosthesis was then unscrewed and taken from the operatory to the laboratory for structural enhancement, refinement, and polishing.

While this was occurring, the soft tissue was approximated, obtaining a secure adaptation around the titanium abutments using vicryl sutures. Postoperative panoramic and cephalometric radiographs were taken to evaluate the position of the implants (Figures 16 and 17). The completed prosthesis was attached to the abutments with gold screws, and the occlusal relationship was again assessed (Figures 18 and 19).

The patient was pleased with the aesthetic result (Figure 20). He was instructed to eat only soft foods and avoid placing pressure on the prosthesis for 3 months. After that period, he returned and a secondary impression was recorded, using the prosthesis as an impression stent. A week later, the patient returned for one final visit, during which the temporary prosthesis was unscrewed and replaced with the permanent prosthesis. No anesthesia was required on either of the two follow-up visits.

CONCLUSION

Although the protocol described in this article requires considerable sophistication in coordinating the actions of the treatment team, it offers patients a number of significant advantages. Compared with traditional implant-placement protocols, the number of office visits required is minimal. Patients who must travel long distances to undergo fixed prosthodontic rehabilitation particularly benefit from the condensed treatment time. Furthermore, this approach offers an almost instantaneous improvement in speech, aesthetics, and patient self-image, and soon thereafter an improvement in masticatory function. The overall dental experience becomes a positive one, helping to counterbalance the negative histories that so often create the dental phobias that lead to dental deterioration.

Appropriate patient selection is critical. Candidates for this procedure must have a sufficient quantity and quality of alveolar bone to ensure secure initial fixation. They also need to be conscientious about the postsurgical instructions. When these elements are present, however, the described protocol holds the promise of significantly improving the implant experience.✦

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