

The Use of a Custom Template for Immediate Loading With the Definitive Prosthesis: A Clinical Report

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Abstract

A new approach to implant dentistry for the fully edentulous arch is presented. Using a conventional computer tomography scan and specialized surgical planning software, a fixed final prosthesis is fabricated before the surgical procedure so the prosthesis may be delivered immediately after the implants are placed. Initial prospective studies of 10 patients with observation times of up to 24 months have shown all patients to have a functional prostheses. Long-term studies are being performed to validate this new procedure.

The development of dental implants has had a major impact on edentulous patients. For some, a nonremovable fixed complete denture can replace a complete denture. Treatment with a nonremovable fixed complete denture is typically initiated in a patient who is edentulous in at least one arch. A complete denture wax-up is fabricated to establish the setup of denture teeth for esthetics, phonetics, and vertical dimension of occlusion. Then a radiographic template is fabricated by duplicating the wax denture; and a preoperative panoramic radiograph is taken for initial evaluation, followed by additional radiographs, such as a computer tomography scan, to verify the volume of bone and identify vital structures. For the traditional technique described by P.I. Brånemark, five or six dental implants are placed.¹ The protocol calls for the patient to refrain from wearing any prosthesis over the surgical site for the first two weeks. After the initial healing period, the patient can resume wearing a denture prosthesis with a soft liner in place. The typical healing time is approximately four months for the mandible and six months for the maxilla.

After osseointegration of the dental implants, a second surgery exposes the

dental implants through the gingival tissues; and the existing denture is retrofitted, with a soft liner, over the implant abutments. The tissue is allowed to heal for six to eight weeks.² The appropriate final abutments are placed, and the prosthetic phase of treatment may begin. The average time to complete treatment is one year.

With the many technological advancements occurring with implant surfaces,³⁻⁵ CT scanning techniques,^{6,7} computer assisted treatment planning programs,^{6,8,9} the fabrication of stereolithography casts,^{6,8} and restorative techniques, a new treatment modality has been developed for immediate loading of dental implants with a pre-fabricated definitive restorative prosthesis.^{6,12} This paper will describe a new technique of treating patients by using a custom surgical template to provide accurate placement and positioning of the dental implants for immediate



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Custom Template



Figure 1. The radiographic markers are used as reference points to superimpose the two images.



Figure 2. The interocclusal record orients the patient in the centric relation position during the CT scan.

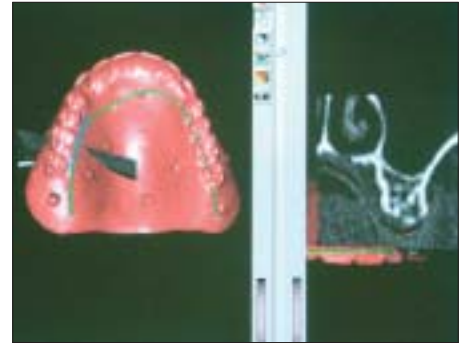


Figure 3. The Oralim software allows for 3-D views for implant planning.

loading with the definitive prosthesis (Teeth in an Hour, Nobel Biocare, Yorba Linda, Calif.).

Materials and Methods

Treatment starts with the selection of a patient who is edentulous in one or both arches. The fabrication of an ideal denture is necessary to define tooth position and placement for esthetics,¹⁴ speech,¹⁵ and occlusal vertical dimension.¹⁶ After adequate bone volume is established through a panoramic X-ray, the patient is sent for a double-scan-technique CT scan.⁶ The two-scan technique allows scanning of different objects at different densities: the patient's jaw and the acrylic denture or replica of the denture. Thus, the CT data may reformat the edentulous arch and the removable prosthesis in relation to that arch separately. The two CT scans are then superimposed onto each other.

The reformatted images, created with a special software package for the CT scanner, are then returned to the dental team for the planning session to determine the number of implants, implant positions, and angulation. A three-dimensional, implant planning software program (Oralim, Medicim, Leuven, Brussels) allows the clinician to evaluate the osseous tissues in relationship to the position of the denture teeth. From this information, the posi-

tions and sizes of the dental implants may be digitally placed and evaluated in three dimensions with the surrounding structures. The planning is guided by bone quality and quantity, as well as the position of the teeth for esthetics and phonetics.

After the surgical treatment is designed, a stereolithography cast (a CAD/CAM epoxy resin cast) is fabricated for the dental arch. The positions of the planned dental implant sites and the denture prosthesis are also integrated into the milled cast. This CAD/CAM cast is reproduced with great precision and can be mounted onto an articulator with interocclusal records made of the patient and the opposing arch. With such accuracy transformed to the cast and its mounting, all dimensions of the patient's dental arch and prosthesis are replicated prior to implant placement.

Implant replicas are then placed into the predetermined implant sites, and a surgical template is fabricated. The surgical template will provide for a precise positioning of the dental implants, which will guide the surgeon during placement.¹⁷ An interocclusal record is made between the surgical template and the opposing arch, to transfer the centric relation and vertical dimension information to the mounted casts and to position the surgical template to the patient's jaw during

surgery. Maintaining the accurate position of the surgical template during the surgical procedure is accomplished by the use of horizontal stabilization pins, which are integrated into the template and stabilized in the osseous tissues.

The accuracy of the surgical template from the stereolithography cast duplicates the exact implant position on the patient. With the exact transfer of implant positions, the definitive prosthesis is fabricated prior to implant placement. The prosthesis is fabricated at the correct centric relation and vertical dimension position. The initial denture prosthesis will dictate the position of the denture teeth for esthetics and phonetics. The prosthesis can be fabricated by traditional means with a gold casting, milled titanium, or a new carbon fiber material.¹⁸⁻²⁰ The denture teeth are then attached to the framework.

The surgery is a flapless procedure performed with local anesthetic.^{12,13} The surgical template is inserted with the interocclusal record to guide the surgeon in the proper seating of the template. The patient is assisted in closing into the interocclusal record in the centric relation position. While the patient is closed into the interocclusal record, the horizontal stabilization pins are placed



Figure 4a. The stereolithography cast is mounted on the articulator.



Figure 4b. The surgical template is fabricated and an interocclusal record is made between the surgical template and the opposing arch.

into the osseous ridge to hold the surgical template securely in position. The patient is asked to open, and the first implant is placed in the second-to-most posterior position. After the first implant is placed, a template abutment — which is a specially designed abutment providing additional stabilization of the surgical template to the dental implant — is inserted. The template abutment holds the position of the surgical template to the position of the first implant. A second implant is then placed in the second-to-most distal implant position on the contralateral side of the arch, and a second template abutment is attached to this implant.

The surgical template retained by three horizontal stabilization pins and two template abutments, ensures the stability and accurate position of the template. The remaining implants can be placed sequentially. Once all the implants are placed, the definitive prosthesis is inserted. If necessary, the occlusion can be adjusted after insertion of the prosthesis.

Clinical Report

A 60-year-old woman presented with a maxillary complete denture and a mandibular fixed metal-ceramic re-

construction. The patient had been edentulous in the maxilla for more than four years because she was never comfortable with a maxillary prosthesis. The oral surgeon and prosthodontist gave the patient a comprehensive examination to confirm the possibility of implant therapy with immediate loading of the dental implants.

Procedure

1. A new maxillary complete denture was fabricated to determine and confirm tooth position for esthetics, phonetics, and the vertical dimension of occlusion.

2. Six to eight radiopaque markers were placed into the denture. Three 2 mm holes were placed into the buccal surface of each side of the denture and two holes were placed to the lingual of the maxillary central incisors. The holes were filled with gutta-percha, which would then function as radiopaque markers (Figure 1).

3. An interocclusal record was made with a rigid polyvinyl siloxane material at the patient's appropriate centric relation and occlusal vertical dimension (Figure 2).

4. The patient was given a maxillary CT scan. The first scan was of the patient

with the denture, which had fiducials and the interocclusal record. The second scan was of the denture only, which was positioned in the CT scanner in a similar orientation as in the patient's mouth.

5. The CT data was formatted to have the two sets of scans superimposed upon each other. One scan was of the osseous tissues; and the other was of the complete denture, which showed the position of the planned denture teeth. The reformatted data was returned to the surgical and restorative team to determine and plan for the implant positions. Planning for implant placement was completed with the Oralim software program. The data was transferred to a dental laboratory with special milling devices (Procera, Nobel Biocare, Yorba Linda, Calif.) to fabricate the stereolithography cast. The stereolithography cast would then have the preplanned osteotomy sites of the dental implants. In these sites, implant replicas could be placed, providing the exact positions of the implants (Figure 3).

6. The stereolithography cast was returned to the dental laboratory and was mounted, on the articulator, to the opposing cast with the original interocclusal record. A surgical template and a screw-retained implant denture were fabricated to the position of the implant replicas. A new interocclusal record was fabricated to index the surgical template and the opposing arch (Figure 4a, b).

7. The surgical procedure was started under local anesthesia. The surgical template was inserted and positioned with the interocclusal record in centric relation position. The initial surgical step was the placement of the stabilization pins, in three preplanned horizontal positions. A 1.7 mm twist drill was used creating retentive holes for the stabilization pins. After the pins were



Figure 5. The surgical template is held into position with the horizontal stabilization pins.



Figure 6. The first implant is placed, and a template abutment is inserted to hold the position of the surgical template.



Figure 7. The adjustable abutment allows for the variation in the Z-axis with the implant placement.



Figure 8. The initial closure of the patient, after implant surgery and the prosthesis inserted.

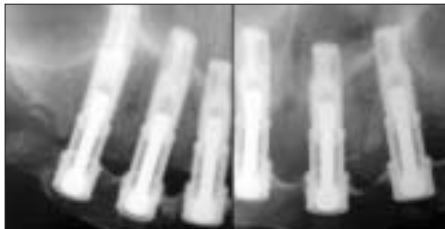


Figure 9. Postoperative periapical radiographs taken after implant surgery.

positioned into place and the surgical template secured, the patient was allowed to open (Figure 5).

8. The first osteotomy site was prepared, one before the most distal implant site, using the appropriate drilling guides and twist drills. The preplanned length and diameter of implant was placed using the implant guide. After insertion of the implant, a template abutment was inserted to provide additional stability of the surgical template (Figure 6).

9. The next implant was inserted in the opposite side of the arch, one before the most distal implant. After the implant was placed, a second template abutment was inserted, providing for an extremely stable surgical template.

10. The remaining implants were placed, using the same drilling guides and twist drills.

11. After all the implants were placed, the definitive prosthesis was inserted using an adjustable abutment that allowed for discrepancies in the Z-axis (Figure 7). The adjustable abut-

ment is an interlocked, two-piece sleeve that slides within the two cylinders. The interconnected sleeve allows for the Z-axis variable in the implant position. Once the prosthesis was seated, the retaining screws were torqued to place, and the occlusion checked and adjusted as necessary (Figure 8). Postoperative radiographs were taken to confirm the seat of the prosthesis (Figure 9).

Summary

A new approach to implant dentistry has been presented for the edentulous arch. Using a conventional CT scan and specialized surgical planning software, which produces an accurate stereolithography cast, a fixed final prosthesis is fabricated before the actual surgical procedure so that the prosthesis may be delivered immediately after the implants are placed. Another immediate load system, the Novum System (Nobel Biocare, Yorba Linda, Calif.), requires the prosthesis to be fabricated over a premilled framework

after the implants have been placed. The benefits of this new procedure to patients are:

- Shorter surgery times;
- Shorter treatment times;
- Less invasive, flapless surgery and therefore less chance of swelling, less pain, and faster initial healing times;
- A prefabricated definitive prosthesis; and
- Use of the fixed prosthesis immediately.

This is a short list of potential benefits to patients. However, this treatment option is new and under investigation. Traditional two-stage techniques are predictable, having cumulative success rates of 99 percent in 15-year studies.²¹ Initial prospective studies of this new option of 10 patients with observation times of up to 24 months have shown all patients with functional prostheses.⁶ Long-term studies are being performed to validate this new procedure. **CDA**

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