Optimization in Multi-implant Placement for Immediate Loading in Edentulous Arches Using a Modified Surgical Template and Prototyping: A Case Report

Sérgio J. Jayme, DDS, MScD[1]/Valdir A. Muglia, DDS, MScD, DSc[2]/
Rafael R. de Oliveira, DDS, MScD[3]/Arthur B. Novaes Jr, DDS, MScD, DSc[4]

Immediate loading of dental implants shortens the treatment time and makes it possible to give the patient an esthetic appearance throughout the treatment period. Placement of dental implants requires precise planning that accounts for anatomic limitations and restorative goals. Diagnosis can be made with the assistance of computerized tomographic scanning, but transfer of planning to the surgical field is limited. Recently, novel CAD/CAM techniques such as stereolithographic rapid prototyping have been developed to build surgical guides in an attempt to improve precision of implant placement. The aim of this case report was to show a modified surgical template used throughout implant placement as an alternative to a conventional surgical guide. (Case Report) Int J Oral Maxillofac Implants 2008;23:759–762

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Patient desires for shorter treatment periods and preservation of the esthetics at all stages of treatment have stimulated clinicians to explore immediate loading of dental implants. The majority of immediate-loading studies have limited their interest to the anterior region of the mandible.[1–6] In this region both bone quantity and quality are usually excellent, and in most cases it is possible to obtain bicortical anchorage and primary stability of the inserted implants. Primary stability is considered key to immediate loading[7,8]; however, due to a lower bone density in the maxilla, immediate loading in this region is perceived as a greater challenge than in the mandible. Furthermore, implant anchorage in the totally edentulous maxilla is often restricted due to bone resorption, which is especially frequent in the posterior region of the maxillary arch, where bone grafting is often indicated.

Rehabilitation of the maxilla requires a protocol in which implants are positioned according to the requirements of the restorative phase and not by the bone condition available in the region.[9] This approach requires an appropriate bone volume to sustain the implant and consequently provide support to the soft tissues, which is essential to an adequate prosthetic profile. The selection and positions of the implants are defined by the prosthetic restorations from the diagnostic waxup and later from the surgical template.[10] The healing and maturation of the soft tissues are guided by the temporary restoration, which aids the formation of the papillae through the orientation of the emergence profile, which is shaped by the temporary prosthesis.

[1]Graduate Student of Prosthodontics, Department of Dental Materials and Prostheses, School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, SP, Brazil.
[2]Assistant Professor of Prosthodontics, Department of Dental Materials and Prostheses, School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, SP, Brazil.
[3]Graduate Student of Periodontology, Department of Bucco-Maxillo-Facial Surgery and Traumatology and Periodontology, School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, SP, Brazil.
[4]Chairman of Periodontology, Department of Bucco-Maxillo-Facial Surgery and Traumatology and Periodontology, School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, SP, Brazil.

Correspondence to: Dr Arthur B. Novaes Jr, Faculdade de Odontologia de Ribeirão Preto, Universidade de São Paulo, Av. do Café s/n, 14040-904, Ribeirão Preto, SP, Brasil. E-mail: novaesjr@forp.usp.br

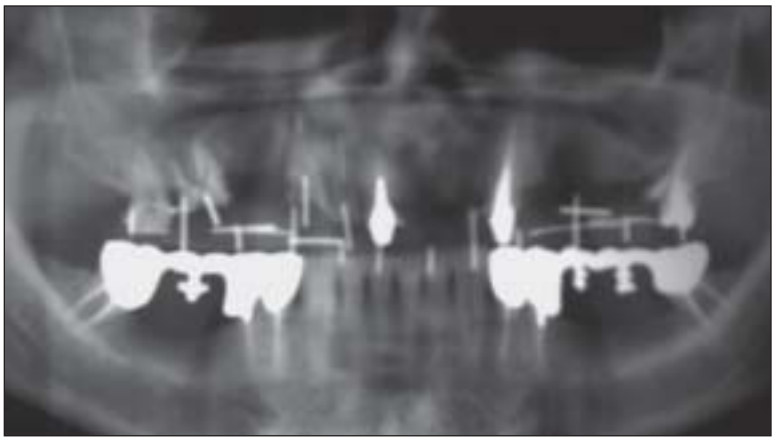


Fig 1 Preoperative panoramic radiograph.

In cases where the treatment requires the placement of several implants for the rehabilitation of the full arch, the positions of the implants should be ideal because the prosthetic restoration should be able to reproduce exactly what was obtained in the diagnostic waxup. For diagnosis, computerized tomographic (CT) scanning is a precise, noninvasive surveying technique.[11–15] Visualization of CT scan images by the clinician can be achieved using printed film or computer software packages,[16,17] which allow for 3-dimensional viewing using computer-aided design technology.[18,19] When coupled with templates worn at the scanning visit, visualization of the restorative plan also improves presurgical evaluation.[20–23] In addition to visualization and the ability to evaluate bone density,[24] these software programs allow for placement of virtual implants to further assist the surgeon in foreseeing positioning and size of implants prior to surgery.[25,26] However, the transfer of a sophisticated plan to the surgical field remains difficult. To overcome this issue, several novel approaches have been developed, one of which utilizes a computer-aided manufacturing technique to generate bone-supported surgical guides as well as anatomic models that can fit intimately with the osseous surface.

Prototyping produces a physical cast of a selected anatomic region in real scale, making it possible to plan the position, distribution, and size of the implants as well as facilitating the construction of a more accurate surgical template.[27] The use of acrylic resin dental casts obtained from the CT scan, allows the best surgical planning in obtaining the precise 3-dimensional position of the implant.[28] The aim of this case report was to show a modified surgical template which remains stable, with the assistance of the antagonist arch, throughout the surgical procedure as an alternative to the conventional surgical guide.

CASE PRESENTATION

A healthy male patient, 50 years old, with a noncontributory medical history, presenting with multiple tooth loss with some remaining maxillary teeth (right second molar, left canine, left second molar) was referred to the authors for oral rehabilitation treatment. At the first periodontal visit, the compromised periodontal sites were detected by clinical and radiographic examination. Occlusal adjustments and full-mouth scaling and root planing were performed. After comprehensive oral hygiene instruction and the achievement of satisfactory levels of plaque control, the patient was ready for the reconstructive surgeries. Severe residual ridge resorption was detected in a radiographic analysis, and since the treatment of choice was implant placement, bone grafting was necessary (Fig 1). For the posterior region of the maxilla, a bone graft (anorganic bovine matrix/P-15 [PepGen P-15 flow; Dentsply Friadent, Mannheim, Germany] and calcium phosphate of plant origin [Algipore; Dentsply Friadent]) plus platelet-rich plasma was performed bilaterally through maxillary sinus floor elevation by the Caldwell-Luc approach. For the anterior region of the maxilla, guided bone regeneration was performed using an e-PTFE nonresorbable membrane (TefGen-Plus, Lifecore Biomedical, Chaska, MN) plus calcium phosphate of plant origin (Algipore) as the grafting material. After a healing period of 6 months, the bone topography was reacquired and the surgical-prosthetic phase started.

During treatment planning, the immediate loading protocol was selected, and a CT scan for the maxilla prototype construction was obtained (Fig 2). This examination allowed precise planning of the surgical and prosthetic treatment. Initial study dental casts were obtained to define the sequential phases of the

Fig 2 Prototype cast (occlusal view).

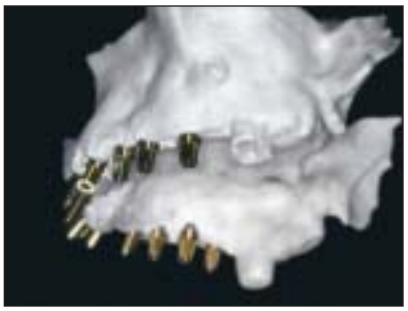


Fig 3 Implants positioned in the prototype.

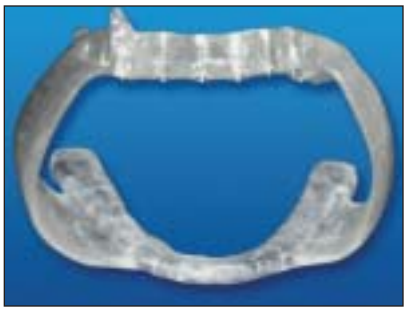
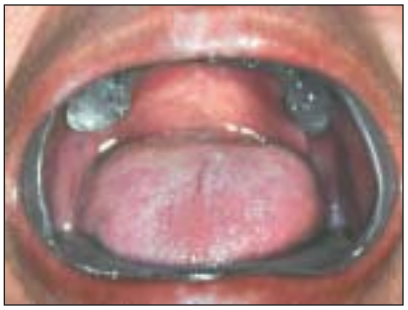
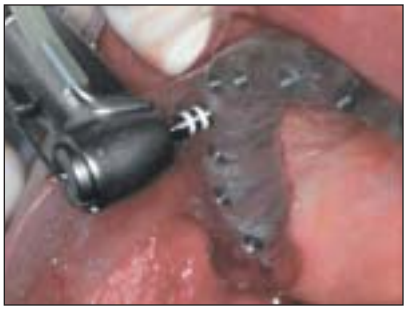


Fig 4 Surgical template (frontal view).

Fig 5 Surgical template in position before the drilling procedure. Note the stabilization of the mandibular arch.

Fig 6 Clinical view showing the preparation of the implant site.





treatment planning. The dental casts were mounted in a semiadjustable articulator, and a diagnostic waxup was produced. The waxup was transferred to the prototype, and an artificial gingiva was added to visualize the final result. The next step was pre-establishing the implant diameter/length, position, and inclination. For that, 2 acrylic resin templates were constructed, one for the maxilla and other for the mandible. Titanium tubes with a diameter of 2 mm were placed in the maxillary surgical template in a predetermined position and inclination. With the template in position, the patient was sent to a radiology center for a linear tomography. With the tomography it was possible to check the inclination of the titanium tubes in relation to the bone ridge and consequently the position and inclination of the initial bone drilling during the surgery.

Simulation of the implant placement surgery in the prototype was performed with the surgical template. After this, it was possible to individualize the abutments and to construct the temporary prosthesis (Fig 3). After checking all inclinations, the maxillary and the mandibular templates were joined through lip and cheek retractors with acrylic resin, becoming a single template (Fig 4).

Following the review of all planning procedures the surgical procedure was scheduled. The surgical procedures were performed under local anesthesia with mepivacaine chlorhydrate with epinephrine 1:100,000. Antibiotics (amoxicillin 875 mg + clavulanic acid 125 mg) were given 1 hour prior to surgery and daily for 6 days thereafter. A mucoperiosteal flap was raised at the ridge crest with bilateral relieving incisions on the buccal aspect in the second molar area. The surgical template was inserted and maintained in position during the surgical procedure (Figs 5 and 6). Twelve rough-surface acid-etched self-tapping screw-type implants 3.8 mm in diameter and 13 mm in length were used to replace the missing maxillary teeth. The implant sites were sequentially enlarged to 3.8 mm in diameter with pilot and spiral drills according to the standard surgical protocol. After this, the implants were placed according to the manufacturer's instructions. In sequence, the transfer posts were placed, and an impression was made from the already-placed implants to build a model in which adjustments to the temporary prostheses could be performed. After impression making the flaps were repositioned and sutured with nonresorbable sutures.

Sufficient primary stability plays an important role in immediate loading. In order to maintain this stability, rotational forces should be avoided. Here the abutment of the implant used (Tempbase; Dentsply Friadent) was ideal because it is a premounted abutment that served as an insertion abutment and was a basis for temporary restorations. A change of abutments was not necessary, and torque stress was avoided. A torque of more than 30 Ncm during inser-

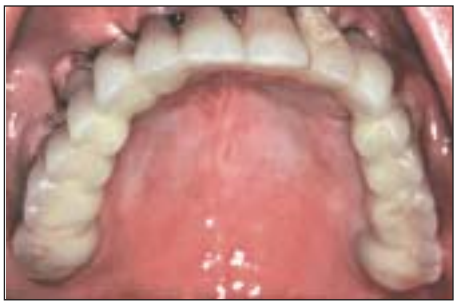


Fig 7 Postoperative view showing the provisional restorations in position (occlusal view).

tion indicates that temporary restoration of the implant is possible. The temporary abutment was placed on the model and finished in the laboratory. The provisional restoration was then placed and cemented (Fig 7) for refinement, and occlusal adjustments were performed. The patient was instructed to eat a soft diet for 4 weeks postsurgery. Biting anything hard or tearing food was discouraged. At 1 month the patient was converted to a harder diet. Analgesics were given on the day of surgery and postoperatively for the first 3 days as needed.

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