

Immediately Loaded Intraorally Welded Complete-Arch Maxillary Provisional Prosthesis



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Guided implant surgery is not completely accurate when using computer-designed stereolithographic surgical guides. Complications are frequently reported when combining computer-guided flapless surgery with an immediately loaded prefabricated prosthesis. Achieving passive fit of a prefabricated prosthesis on the inserted implants the same day of the surgery can be difficult. The aim of this report is to show a new treatment approach to immediately loaded implants inserted with computer-guided surgery using an intraoral welded full-arch provisional prosthesis. (Int J Periodontics Restorative Dent 2015;35:725–731. doi: 10.11607/prd.2293)

Computer-guided implantology (CGI) was developed to overcome the errors encountered during implant osteotomies and to more precisely position the implants.¹ Possible advantages of CGI include the integration of the restorative determinants into the surgical planning, resulting in predictability of the prosthetic outcome and allowing for the production of the prosthesis before the surgery, thereby simplifying immediate-loading protocols.^{2,3}

Data obtained with computed tomography (CT) or cone beam computed tomography (CBCT) can be processed in implant simulation software.^{4–6} Using a scanning template representing the planned prosthesis, it is possible to properly position implants virtually, taking into account both the jawbone anatomy and the planned superstructure.⁷ The virtually planned implant position can afterwards be transferred to the patient, and the surgical procedure guided with the use of a stereolithographic surgical template. A recent literature review on the accuracy and complications of using computer-designed stereolithographic guides concluded that complications are frequently reported when combining computer-guided flapless surgery with an immediately loaded prefabricated prosthesis and can be caused by the misfit between the implants and

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Fig 1 Preoperative clinical condition.

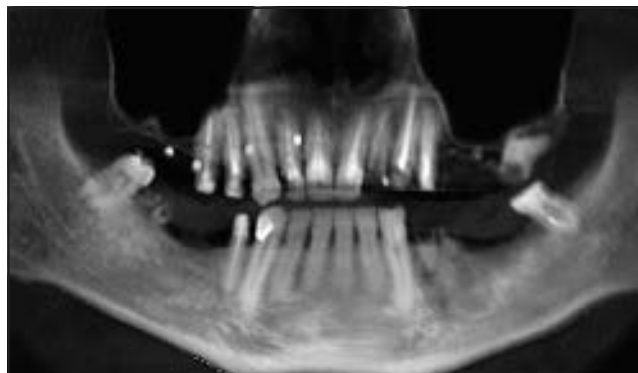


Fig 2 Panoramic radiograph showing the failing dentition in both the maxilla and mandible.

the prefabricated prosthesis.⁸ This literature review and another by Van Assche et al⁹ on the accuracy of CGI placement also illustrated that a certain inaccuracy of 1 to 2 mm has to be accepted. Many mistakes may occur in the sequence of diagnostic and therapeutic steps in CGI.¹⁰ Moreover, the mechanical tolerance between drill and drill guide implies an intrinsic error of a stereolithographic surgical template in CGI.¹¹ Reducing the accuracy below 0.5 mm seems extremely difficult.⁹

In 1982, Mondani and Mondani¹² introduced a time-effective intraoral welding technique of titanium components for different dental and implant restorations. In 2006, Degidi et al¹³ published a protocol for the immediate loading of multiple implants by welding a titanium bar to implant abutments directly in the oral cavity so as to create a customized metal-reinforced provisional restoration. The intraoral welding technique subsequently proved to be a successful option in the full-arch immediate restorations of the mandible and maxilla.^{14–16}

This article describes a new treatment approach, in which implants inserted with computer-guided surgery are immediately loaded with a provisional prosthesis supported by an intraoral welded titanium framework.

Clinical and laboratory procedure

A 55-year-old man presented with failing dentition and periodontal disease of the maxilla and the posterior mandible, and requested an immediate solution (Figs 1 and 2). Because many residual teeth had unrestorable crowns or could not be predictably used as definitive abutments for a fixed prosthesis, treatment with immediate postextraction implant placement and restoration was proposed to the patient. A CGI procedure was planned for maxilla rehabilitation and a free hand procedure was preferred for posterior mandible rehabilitation. Impressions were made of the maxilla and mandible, and laboratory

casts were made and mounted on a semiadjustable articulator to fabricate a diagnostic wax-up. On the ground of the diagnostic wax-up, hollow acrylic resin provisional restorations of the maxilla and posterior mandible were fabricated.¹³ A radiographic guide was made as a perfect copy of the diagnostic wax-up for the maxillary CGI procedure and relined in the patient's mouth. Because the patient wanted to retain his maxillary teeth until surgery, a two-piece radiographic guide was made for the maxillary CGI procedure as suggested by Cantoni and Polizzi.¹⁷ This guide was a perfect copy of the diagnostic maxillary wax-up. Cone beam computed tomography (CBCT) scans were obtained through a dual scan protocol (guidelines for Simplant, Materialise Dental). The first scan was taken with the patient wearing the base portion of the radiographic guide. The second scan was taken with the two parts (the base and the teeth setup portions) of the radiographic guide assembled. Digital Imaging and Communications in Medicine

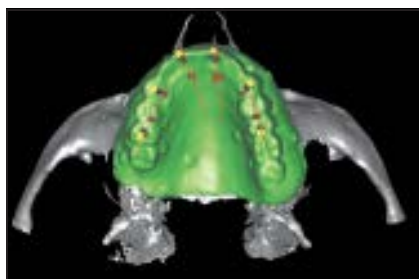


Fig 3 Virtual prosthetic-driven planning. Red lines, yellow lines, and numbers represent implant axes, abutment axes, and implant positions, respectively.

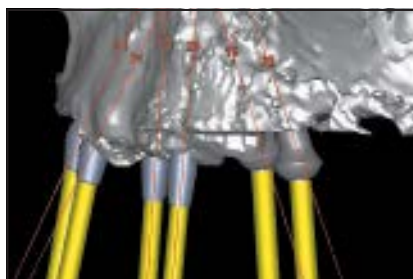


Fig 4 Virtual planning of abutments angulation.



Fig 5 The surgical guide.



Fig 6 The titanium bar preshaped on the model.



Fig 7 Close-up of titanium bar-abutment contacts.



Fig 8 Hollow acrylic resin provisional restoration on the model.

(DICOM) data sets were matched, and maxillary postextraction restoration with six 3.5×14 mm Ankylos plus implants (Dentsply Implants) was planned using Simplant software. Implant position and angulation were planned according to the prosthetic-driven position because radiologic guide is a perfect copy of the final prosthetic plan (Fig 3). During virtual planning, proper abutment selection was also possible based on the prosthetic plan, and the possible final position of the titanium bar after intraoral welding positioning was considered (Fig 4). Then computer-aided manufacture (CAM) of the stereolithographic surgical template was carried out to transfer the digital plan to the sur-

gical environment (Materialise Dental) (Fig 5). Implant positions were transferred from the surgical guide to a master model using special components as well as implant replicas. With the abutments seated on implant replicas, a titanium bar was preshaped following the curvature of the implant positions (Figs 6 and 7) and remaining inside the prosthetic design (Fig 8).

Antimicrobial prophylaxis was performed with 2 g of amoxicillin 1 hour before surgery, with the administration of intravenous sedation. After local anesthesia (mepivacaine 2% with adrenaline 1:100,000), the posterior mandibular teeth were carefully extracted. Two dental implants were immediately placed on

each side using a flapless approach. A minimum insertion torque of 25 Ncm was registered. Then titanium abutments specific for intraoral welding were connected to implants. A titanium bar was cut and shaped according to the implant positions. Titanium implant abutments were welded with the titanium bar in the oral cavity as described by Degidi et al¹³ using WeldOne Welding Unit (Dentsply Implants). The two elements to be welded are placed between the two electrodes of a welding clamp. Current flowing through the points that are in contact with the parts to weld warms up to the point of fusion, achieving a solid, welded junction. The process is carried out without producing any



Fig 9 The bar welded with abutments and copings in the mouth of the patient.



Fig 10 Extraoral view of the bar welded with abutments and copings.



Fig 11 Intraorally welded and opaqueted titanium bar.

heat, causing no discomfort to the patient or damage to surrounding tissues.¹⁸ The prosthetic frameworks, created by welding the titanium bar to the implant abutments, were removed, and opaque was applied to avoid metal shining through the acrylic resin.

All maxillary dental elements were carefully extracted. The surgical guide (mucosa-supported) was fixed with osteosynthesis screws in the correct position and flapless CGI was performed with the ExpertEase system (Dentsply Implants). Sequential drills were used to prepare the osteotomy at each implant site, and the implants fully seated into the osteotomies. With the exception of the initial drill that was directly axially guided by the tube of the surgical guide, all drills were accurately guided using a sleeve that was fixed to the instrument (Sleeve-on-Drill system). All drills had a mechanical depth stop, which ensured that the planned depth was not exceeded. After the implant placement was completed through the sleeve of the surgical guide using a specific delivery mount, the sur-

gical template was removed from the oral cavity. Two implants had an insertion torque < 20 Ncm but the other four implants had an insertion torque ≥ 25 Ncm. These values were compatible with an immediate loading with a rigid framework splinting¹⁹ so then the restoration was carried out. After a socket preservation procedure of implant sites with Bio-oss Collagen (Geistlich Pharma), the titanium abutments specific for intraoral welding were connected to canine implants. Four welding copings were positioned on the abutments connected to the central incisor implants and to the premolar implants. The titanium bar preshaped on the model was tested in position. Only a few corrections were needed to achieve perfect contact between the titanium bar and all four copings and two welding abutments to ensure a passive fit after the welding procedure. Then titanium implant abutments and copings were welded with the titanium bar in the oral cavity (Fig 9). The prosthetic framework was removed (Fig 10) and opaque applied (Fig 11). The provisional restorations were re-

lined, trimmed, and polished (Figs 12 and 13). The maxillary provisional restoration was engaged with the central incisor abutments using the conic coupling while the other abutments and copings were screwed as the mandibular provisional restorations approximately 2 hours after the surgical procedures (Figs 13 to 15). Occlusal surfaces were flattened to reduce horizontal relations as suggested by Crespi et al.²⁰ Antimicrobial therapy was continued with 1 g of amoxicillin twice daily for 5 days. Postsurgical analgesic treatment was performed using 80 mg of ketoprofen twice daily for 3 days. No implant failure or other complications were registered during the 3 months of follow-up. After 3 months, no modifications of the keratinized tissues were evident relative to immediate postoperative results (Fig 16). During the healing period, provisional prostheses were retained to avoid compromising the osseointegration process. Four months after the implant placement, provisional restorations were removed, implant mobility was checked, and final impressions were recorded using



Fig 12 Maxillary metal-reinforced provisional restoration after relining, trimming, and polishing, ready to be delivered.



Fig 13 Occlusal view of screw-retained maxillary metal-reinforced provisional restoration.



Fig 14 Postoperative clinical examination.

Fig 15 (left) Postoperative CBCT scan.

Fig 16 (right) Clinical examination at the 3-month follow-up.



Fig 17 The definitive ceramic fused-to-metal restorations, frontal view.



Fig 18 Final patient smile.



Fig 19 Panoramic radiograph at the 5-month follow-up.

hydrophilic silicone material (Aquasil, Dentsply). Five months after surgery, definitive metal-ceramic restorations were cemented on abutments (Figs 17 to 19). The midline of the upper prosthesis was aligned with the midline of the lower teeth according to the patient's request.

Discussion

Articles analyzing errors and unexpected events in CGI procedures report frequent complications when combining guided flapless surgery with an immediately loaded prefabricated prosthesis.^{2,21-26} The

planning and the final implant positions might deviate at any diagnostic and/or therapeutic step in the treatment: during CT scanning, during transfer of the planning data, during manufacture of the surgical template, while positioning the surgical guide, and while placing

implants.^{8–10} Problems are reported in achieving passive fit of a prefabricated metal framework on the inserted implants.²⁶ This is probably because of the fact that prefabricated metal frameworks and computer-aided design (CAD)/CAM frameworks are made on planned and not on final implant positions. At the moment, the CGI inaccuracy^{8–11} makes final implant positions unpredictable. So final implant positions are frequently different, even slightly, from planned implant positions. This causes a misfit between the implants and the prefabricated prostheses.⁸ Absence of passive fit may further lead to mechanical (screw loosening) and biological (marginal bone loss) complications.²⁶ Other complications reported that combining computer-guided flapless surgery with an immediately loaded prefabricated prosthesis led to fractures of the acrylic denture used as restoration.^{21,22}

The intraoral welding technique has proved to be a successful option in the full-arch immediate rehabilitation of the mandible and maxilla^{14–16,19} with a fixed provisional restoration delivered the same day as implant placement. The intraoral welding concept allows the clinician to shape and weld the framework directly on the provisional abutments connected to the implants in the patient's mouth immediately after surgery. The passive fit of this kind of metallic framework is considered an important reason for the good results reported in immediate-loading protocols, limiting micromovements because of the rigid and passive framework splinting.¹⁹ Moreover, the

use of the intraoral welding technique makes the provisional restoration fracture extremely rare.¹⁴

The advantages of combining CGI with intraoral welding technique include:

- Provisional rehabilitation on the same day as the surgery with a metal-reinforced restoration that limits micromovements (very important for immediate-loading protocols)
- Correct passive fit implant prosthesis
- Optimized prosthetic procedure because of the chance of planning implant positions when considering the titanium bar encumbrance with respect to the provisional hollow prosthesis
- Possibility of titanium bar preshaping on the model cast by transferring implant positions from the surgical guide to the master model
- Consequent shorter time needed for intraoperative titanium bar shaping

Conclusions

Within the limitations of a single case report, the present study suggests that the use of the intraoral welding technique to load implants immediately with computer-guided surgery could be a good treatment approach. This approach allows for creation of an immediate and passive provisional restoration, which could reduce the number of complications from what was reported

in the past when combining computer-guided flapless surgery with an immediate-loading restoration.

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The authors reported no conflicts of interest related to this study.

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