Model Based Planning For Guided Impla

Pär-Olov Östman, DDS, PhD, MD

Guided surgery has grown in popularity due to clinicians' elevated interest in performing minimally invasive implant placement and providing patients with same-day restorative solutions. In single-unit and partially edentulous clinical situations, model-based fabrication of a surgical guide provides an ideal solution in areas where vital anatomical structures (nerves, vessels, adjacent tooth roots) are not present. By contrast, the use of Computed Tomography (CT) technologies should be used in areas such as a severely resorbed or edentulous arch where identification of vital structures is critical information to the planning process.

The Clinical Presentation that follows demonstrates a systematic approach to the fabrication of a model-based surgical guide used in combination with the Navigator™ System for precise implant placement. With this protocol, a laboratory-processed provisional restoration can be fabricated based on the planned implant position and delivered immediately at the time of implant placement.

A 64-year-old female patient presented with a partially edentulous space in the maxillary right quadrant. Teeth Nos. 4 and 5 [14 and 15] were missing due to endodontic/periodontal complications. The patient requested treatment that would provide immediate aesthetics with minimal time investment or inconvenience. The treatment plan accepted by the patient included implant placement and immediate placement of a provisional restoration to address her primary concern of aesthetics.

Clinical examination revealed a moderately resorbed alveolus and healthy soft tissues (Figure 1). The keratinized tissue width was adequate to allow for a flapless surgical approach. Radiographic examination showed more than 15mm of vertical bone height (Figure 2) and the absence of vital structures, providing an optimal site for implant placement. Teeth Nos. 3 and 6 [13 and 16] showed no interference with the surgical site. Model-based surgery with the Navigator System was selected as the preferred treatment protocol, rather than CT planned surgery. An alginate impression was taken, ensuring full capture of the ridge and gingival sulci in order to fabricate a master cast (Figure 3). A translucent vacuum-formed template was made on the master cast. Four holes were made with a pointed diamond bur on the buccal and palatal side of the template, in line with the planned implant position.

Diagnostic Mapping

The translucent, vacuum-formed template was placed intraorally. Using a periodontal probe, bleeding points were made through the holes in the template (Figure 4). The template was removed and measurements were taken of the soft-tissue depth by placing a periodontal probe with an endodontic rubber stopper through the bleeding points (Figure 5). To map the osseous ridge and soft-tissue depth accurately, four measurements were taken on the buccal aspect; two measurements on the top of the crest and three measurements on the palatal aspect. The depth of the soft tissue at each point was then calculated and recorded with an endodontic ruler measured in millimeters (Figure 6). The recording of the soft-tissue thickness was sent to the dental laboratory along with the template.

Laboratory Fabrication Of A Surgical Guide

The template was placed back on the master cast (Figure 7) and marks were made through the holes in the template with a carbon pen to accurately transfer the intraoral measurements to the master cast. Horizontal lines were drawn to connect the reference points (Figure 8). The master cast was then sectioned in the center-most point for each of the planned implant positions (Figure 9). Stone was removed according to the measurements provided by the mapping, thereby creating a "bone model." Additional stone was removed from each side of the sectioned portion of the master cast to allow for placement of the laboratory implant analogs corresponding to the planned implant configurations (Figure 10). Healing Abutments of the appropriate size were placed into the laboratory analogs to capture the emergence profile of the selected PreFormance® Posts during fabrication of the soft-tissue model. The template was then placed on the master cast and a soft-tissue model was fabricated by injecting material (Gi Mask, Coltène-Whaledent) between the template and the master cast (Figure 11). The template was removed and a soft-tissue punch was used to remove the excess soft-tissue material over the healing abutments. The healing abutments were then removed. Analog Mounts of appropriate height and diameter were selected from the Navigator System Laboratory Kit based on the surgical plan. Master Tubes were selected based on the planned implant configurations and mated with the Analog Mounts such that the hex timing pin was engaged into the notch on each of the Master Tubes. The Master Tube/Analog Mount assemblies were then placed into the implant analogs on the master cast (Figure 12).

Fig. 1

Fig. 2

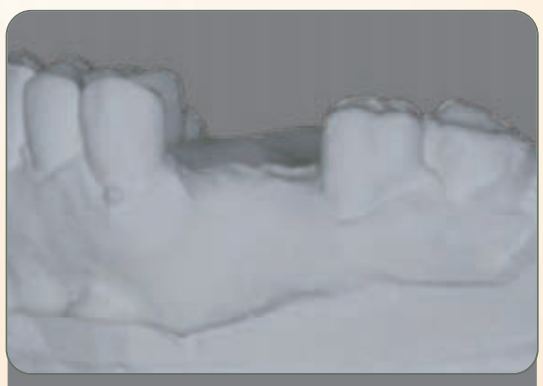

Fig. 3

Fig. 4

Fig. 5

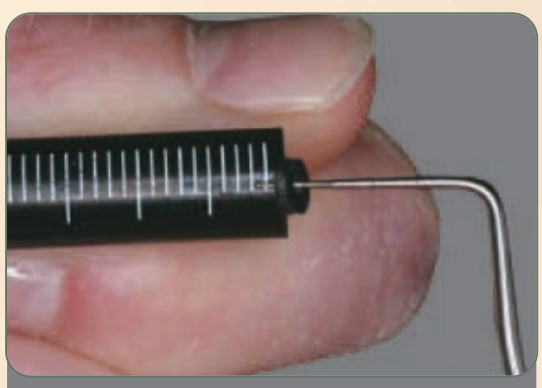

Fig. 6

Fig. 7

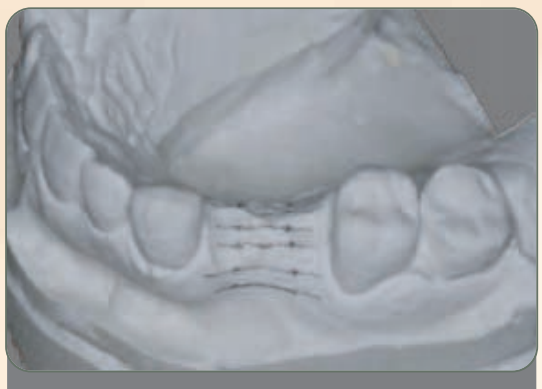

Fig. 8

Fig. 9

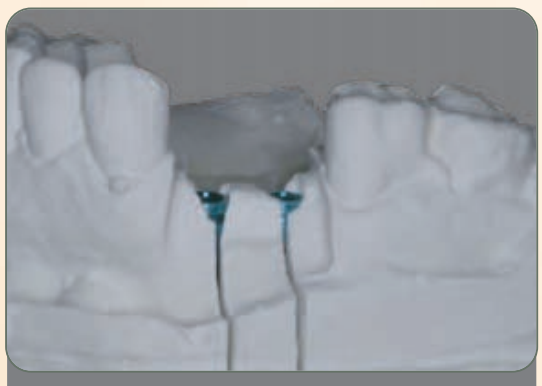

Fig. 10

Fig. 11

Fig. 12

...nt Treatment With The Navigator™ System

The undercuts on the Analog Mounts were blocked out with wax/silicone (Figure 13) and a cold-cure acrylic resin surgical guide was fabricated. The surgical guide was polished and placed onto the master cast to verify fit (Figure 14). The surgical guide was removed from the master cast and PreFormance® Temporary Cylinders were placed into the implant analogs and adjusted for occlusal clearance. Screw-retained acrylic resin provisional crowns were fabricated on the modified temporary cylinders (Figure 15).

Implant Placement And Provisionalization

The surgical guide was placed in a cold sterilization liquid for five minutes, per the manufacturer's recommended protocol. The surgical guide was then rinsed in sterile saline and placed intraorally to confirm accuracy of fit, stability, position of the Master Tubes and clearance with the adjacent natural teeth. The surgery was performed according to the protocol for the Navigator System. The Tissue Punch was used first, followed by the Starter Drill. The Starter Drill was used to perforate the cortical bone, shape the coronal aspect of the osteotomy and to pilot the 2mm diameter Twist Drill (Figure 16). Preparation of the osteotomies continued with the appropriate length 2mm diameter Twist Drill with stops guided through the corresponding Drill Positioning Handle, followed by the 2.75mm diameter Twist Drill (Figure 17) to create appropriate sized osteotomies for medium/soft (Type III) bone. NanoTite™ Certain® Implants (4mm diameter x 15mm length) were placed into the prepared osteotomies (Figure 18). The drilling unit handpiece was stopped approximately 1mm before the implants were fully seated. A hand ratchet was then used to manually tighten the implants to full depth and position so that the notches on the Master Tubes aligned with the notches on the Implant Mounts. This allowed for control of the hex timing of the internal connection of the implants. The torque applied to the implants was measured at 50Ncm. The Implant Mounts and surgical guide were then removed. The implants were judged stable enough to support the placement of the prefabricated provisional restorations. The provisional restorations were placed into the internal interface of the implants (Figure 19), secured with abutment screws and tightened. The occlusion was adjusted following a non-occlusally loaded protocol and a periapical verification radiograph was taken. The patient was instructed to maintain a soft diet and was prescribed antibiotics and chlorhexidine rinse for 10 days post-operatively.

Placement Of The Definitive Prosthesis

Twelve weeks post-implant placement and immediate provisionalization, the patient was seen for evaluation. Healing was uneventful (Figure 20). The provisional restorations were removed revealing healthy soft tissue surrounding the PreFormance Temporary Cylinders. Transfer Impression Copings consistent with the restorative seating surface diameter of the implants (4mm) were selected and seated into the internal interfaces of the implants (Figure 21). A closed-tray impression was made by first syringing light body impression material around the Impression Copings followed by filling the tray with heavy body polyvinylsiloxane impression material. The impression was sent to the dental laboratory, along with an impression of the opposing arch, shade selection and occlusal registration. ZiReal® Posts were selected as the definitive abutments. These were placed onto the master cast for modifications and Denzir all-ceramic crowns were fabricated. The provisional restorations were removed and the ZiReal Posts were seated and secured with Gold-Tite® Abutment Screws tightened to 20Ncm of torque (Figure 22). The all-ceramic crowns were tried-in and then cemented with Rely X (Figure 23). A periapical radiograph was taken (Figure 24) and the occlusion/articulation was confirmed. The patient was instructed on proper oral hygiene and released.

*For more information regarding Model-Based Surgery With The Navigator System, please refer to the BIOMET **3i** Model Based Navigator Manual, ART1082.*


Fig. 13

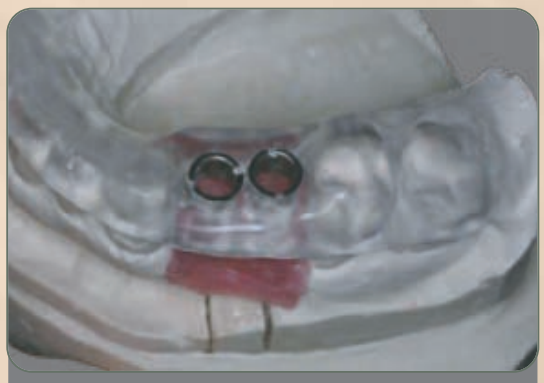
Fig. 14


Fig. 15


Fig. 16


Fig. 17


Fig. 18


Fig. 19


Fig. 20


Fig. 21


Fig. 22


Fig. 23


Fig. 24

Pär-Olov Östman, DDS, PhD, MD received his dental degree from the University of Umeå, Sweden. He received his PhD and MD degrees at the Department of Biomaterials, Institute for Surgical Sciences, Sahlgrenska Academy, Göteborg University, Göteborg, Sweden. He is head of "Team Holmgatan" private practice clinic in Falun, Sweden and Assistant Professor at the Department of Biomaterials, Institute for Surgical Sciences, Sahlgrenska Academy, Göteborg University, Göteborg, Sweden.