

Clinical Perspectives

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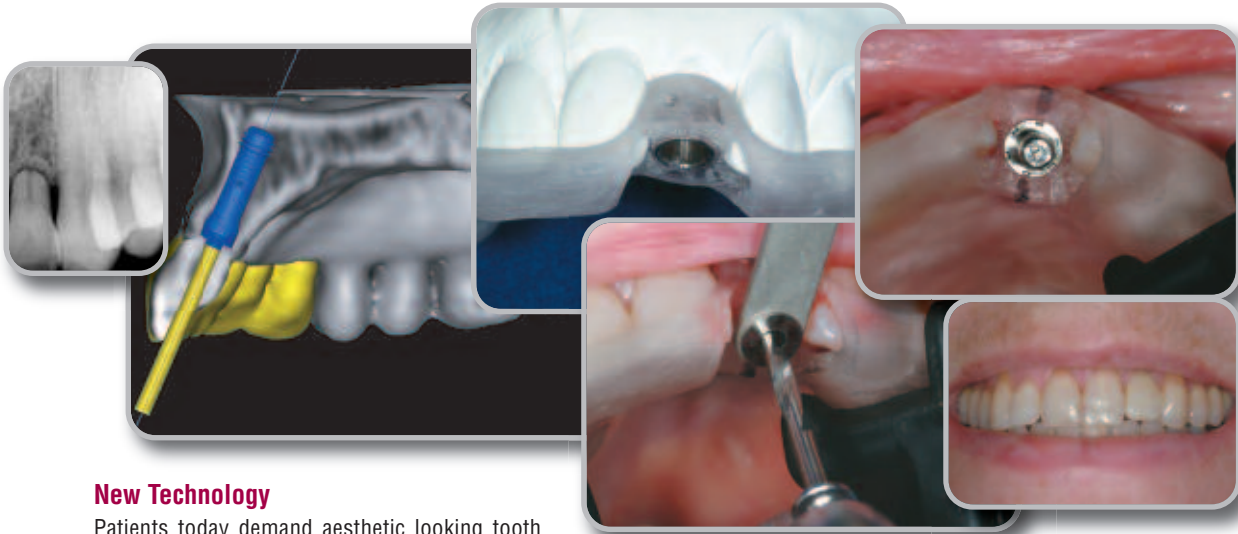
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Richard A. Meall, DDS, MS

Pär-Olov Östman, DDS

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The Navigator™ System For Minimally Invasive Computed Tomography Guided Surgery



New Technology

Patients today demand aesthetic looking tooth replacements with minimal treatment time and downtime due to post-operative discomfort and inconvenience. New technological advancements in implant designs and surface treatments have afforded clinicians with the opportunity to provide implant therapy to patients to meet these demands, including the ability to perform less invasive procedures and leave the office with tooth-colored, implant-supported restorations on the same day as implant placement. Computed Tomography (CT) guidance technology with CT planning software has dramatically transformed conventional methods of dental implant treatment planning, surgery, provisionalization and definitive restoration, ultimately providing more consistent and predictable surgical and restorative outcomes.^{1,2,3} With the growing acceptance and availability of three-dimensional imaging, clinicians can now better manage and utilize diagnostic information, thereby potentially resulting in greater predictability of treatment outcomes. The ability to accurately preplan the surgery and restoration extraorally and later transfer this information to the oral cavity has numerous advantages.

Introducing the Navigator System

In response to clinicians' growing interest in dental implant placement utilizing the benefits of Computed Tomography (CT), BIOMET 3i developed the Navigator System. By using this system in conjunction with CT planning software and surgical guides provided by other suppliers, clinicians will be able to enhance treatment planning and improve the accuracy of placing BIOMET 3i Implants. The system is open architecture, thus compatible with leading planning software. CT guidance technology allows clinicians to measure more precisely the locations of anatomic structures and the dimensions of underlying bone as well as to ascertain bone densities in order to plan and perform cases. The ability to fabricate an accurate surgical guide with precise surgical

instrumentation provides clinicians with the ability to plan and implement implant placement even in clinical situations such as; where there is limited bone height above the inferior alveolar canal, under the maxillary sinus, or in areas of limited space between teeth or convergent root apices. The system allows clinicians to place dental implants in predetermined locations with proper hex orientation. Additionally, the information derived from the CT scan affords the opportunity to fabricate a master cast using the CT surgical guide with implant analogs matching what was planned in the software. It is on this master cast that an aesthetic, functional, laboratory processed provisional restoration can be prefabricated for immediate seating at the time of implant placement with minimal chairside adjustment.

The *Clinical Case Presentations* to follow demonstrate the use of the Navigator System For CT Guided Surgery in various clinical situations such as; single tooth replacement in the aesthetic zone, partially edentulous and edentulous patients. Each of these case presentations are representations of the individual clinician's experience in clinical practice and may not be indicative of other cases due to varying patient and clinician scenarios.

REFERENCES:

1. Rosenfeld AL, Mandelaris GA, Tardieu PB. Prosthetically directed implant placement using computer software to ensure precise placement and predictable outcomes. Part 1: diagnostics, imaging, and collaborative accountability. *Int J Periodontics Rest Dent.* 2006 Jun;26(3):215-21.
2. Rosenfeld AL, Mandelaris GA, Tardieu PB. Prosthetically directed implant placement using computer software to ensure precise placement and predictable outcomes. Part 2: rapid-prototype medical modeling and stereolithographic drilling guides requiring bone exposure. *Int J Periodontics Rest Dent.* 2006 Aug;26(4):347-53.
3. Rosenfeld AL, Mandelaris GA, Tardieu PB. Prosthetically directed implant placement using computer software to ensure precise placement and predictable prosthetic outcomes. Part 3: stereolithographic drilling guides that do not require bone exposure and the immediate delivery of teeth. *Int J Periodontics Rest Dent.* 2006 Oct;26(5):493-9.

CT Guided Single Tooth Replacement In The Aesthetic Zone: A Case Presentation

Clinical Treatment By Alan L. Rosenfeld (USA)†



INITIAL PATIENT PRESENTATION

A 44-year-old female patient presented with advanced root resorption in the maxillary lateral incisors (Figure 1). The left lateral incisor tooth #10 was symptomatic with class III mobility and therefore indicated for extraction. The patient desired an immediate fixed restoration to replace the hopeless tooth, which would not compromise the adjacent

natural teeth and would result in minimal inconvenience. The consultation included a treatment plan for an implant-supported restoration with CT guided implant surgery and immediate placement of a fixed provisional restoration. The nature of this technology predetermines the precise location of the implant and provides the ability to fabricate an immediate provisional restoration prior to surgery.



DIAGNOSIS

- Advanced root resorption of the maxillary lateral incisors, teeth #'s 7 and 10
- Hopeless prognosis for tooth #10 due to advanced progressive mobility
- Adequate bone quality and quantity for implant placement
- Healthy periodontium with moderate gingival recession
- Adequate interocclusal clearance with the opposing natural dentition

TREATMENT PLAN

- Fabrication of diagnostic casts
- Referral for Computed Tomography (CT) study compatible with SimPlant Planner or Pro (Materialise Dental, Inc.)
- Evaluation of interradiacal spacing issues via placement of a virtual implant (Figures 2-4).
- Order computer generated surgical guide
- Removal of tooth from diagnostic cast (Figure 5), and retrofit cast with an implant laboratory analog
- Fabrication of a laboratory processed provisional restoration
- Extraction and immediate placement of a 4mm diameter x 13mm length NanoTite™ Certain® Implant in tooth site #10 using the surgical guide and immediate provisionalization of the implant with the prefabricated laboratory processed provisional restoration
- Implant level impression three months post tooth extraction and implant placement; placement of definitive abutment and crown



Fig. 1

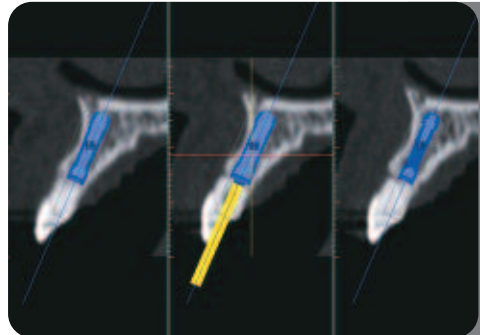


Fig. 2

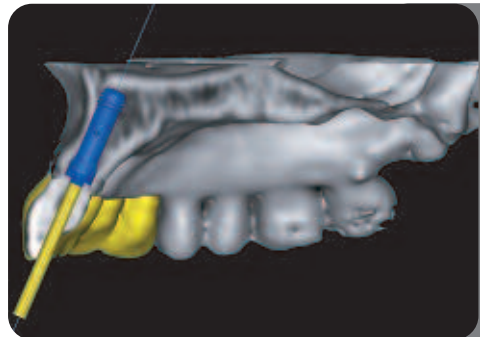


Fig. 3

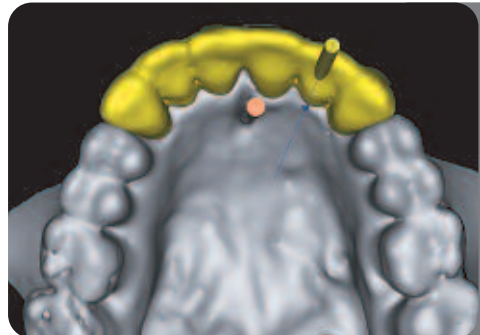


Fig. 4

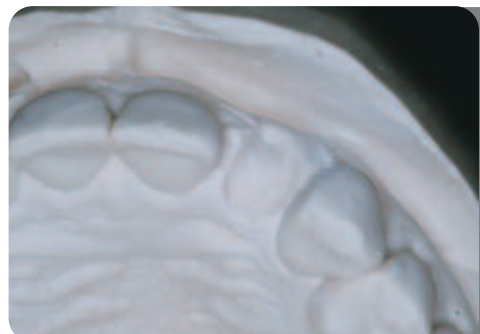


Fig. 5



Fig. 6a

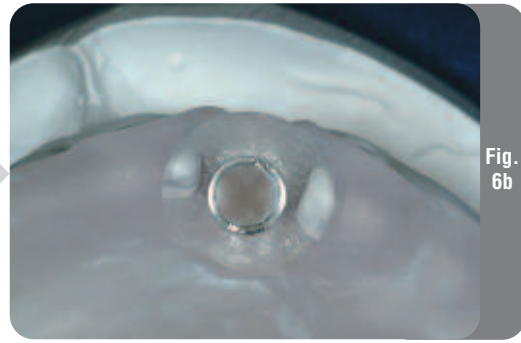


Fig. 6b



Fig. 7a

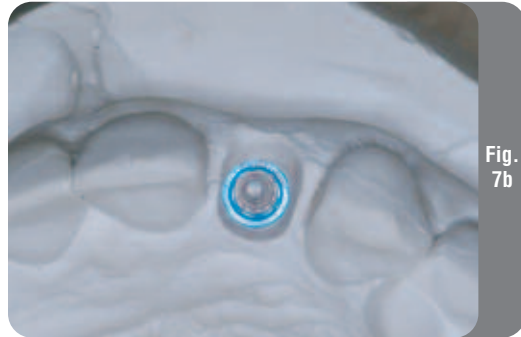


Fig. 7b



Fig. 8a

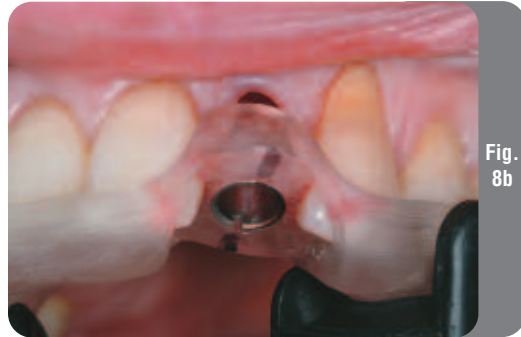


Fig. 8b



Fig. 9a

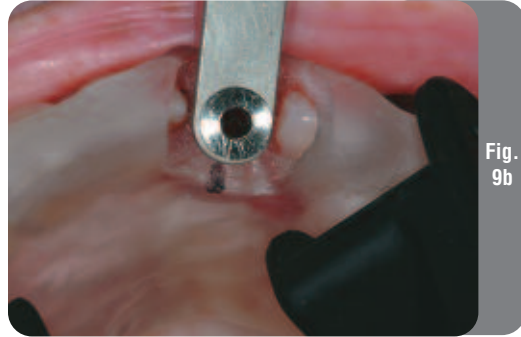


Fig. 9b



Fig. 10a



Fig. 10b

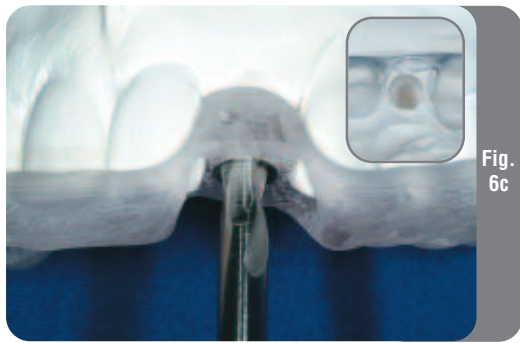


Fig. 6c



Fig. 7c

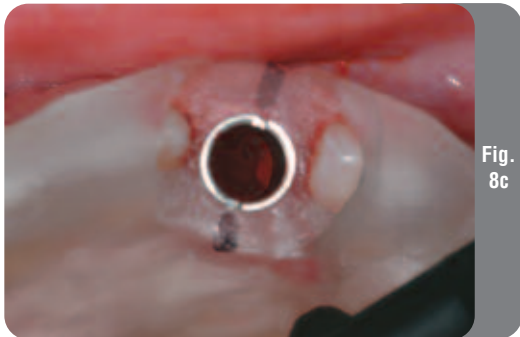


Fig. 8c



Fig. 9c



Fig. 10c

PRESURGICAL TREATMENT

Upon acceptance of the treatment plan for extraction, immediate implant placement and provisionalization, the patient was sent for a CT study. A CT scan was obtained with 1mm thick axial sections and the occlusal plane at a zero degree gantry angle, following the radiographic protocol of Materialise Dental, Inc. (Glen Burnie, Maryland). The CT data was placed onto a CD, which was then processed using SimPlant Pro Interactive CT Planning Software from Materialise Dental, Inc. A virtual implant was placed into the reformatted images. The relationship of the planned implant position to the bone and adjacent natural teeth can be seen in Figures 2-4. A surgical guide was fabricated by Materialise Dental, Inc., which incorporated a master tube designed specifically for the Navigator™ System For CT Guided Surgery. The position of the master tube in the guide corresponded to the preplanned implant position.

FABRICATION OF A PROVISIONAL RESTORATION

Initially, the maxillary left lateral incisor tooth was removed from the original diagnostic cast (Figure 5). The computer generated surgical guide was retrofitted onto this cast (Figures 6a, 6b). A hole was created in the diagnostic cast (Figure 6c) to accept the implant laboratory analog. An appropriate diameter and length analog mount was selected from the Navigator Laboratory Kit based on the information provided by Materialise Dental, Inc. The implant analog was attached to the analog mount and the thumb screw was tightened approximately two turns. The analog/analog mount assembly was placed through the master tube and the rotational positioning pins were engaged into the notch in the master tube to establish the proper alignment of the hex from the cast to the mouth (Figure 7a). The thumb screw on the analog mount was hand tightened into the analog. The analog was secured in the cast with stone using the surgical guide to accurately position the analog. After the stone hardened, the thumb screw of the analog mount was loosened and the surgical guide was removed leaving the analog in the cast (Figure 7b). A Certain® Titanium Implant Temporary Cylinder was selected for fabrication of a screw-retained provisional restoration. The cylinder was placed into the analog in the cast (Figure 7c). A screw-retained acrylic resin provisional crown was then fabricated by adding acrylic resin to the cylinder, shaped with optimal contours and polished. The provisional restoration was fabricated without occlusal contacts (Figure 8a).

SURGICAL TREATMENT

The maxillary left lateral incisor (tooth #10) was carefully extracted using periostomes. The surgical guide was placed over the adjacent teeth (Figure 8b, 8c). A Cortical Punch/Countersink Drill was used per the surgical protocol (Figure 9a), to establish a flat crestal bone profile and introduce a 2mm pilot osteotomy channel for insertion of the 2mm drill. The drill positioning handles and twist drills with drill stops were selected from the Navigator Surgical Kit using the drill sequence instructions from Materialise Dental, Inc. to prepare the osteotomy. The twist drills used were 2mm and 3.25mm for placement of a 4mm diameter implant (Figures 9b, 9c). A surgical guide pin was placed into the prepared osteotomy with and without the surgical guide in place, to assess the implant platform position and axial inclination of the proposed implant position (Figures 10a, 10b). The proper diameter and length implant mount was selected from the kit and placed into the internal interface of the implant according to the instructions received. A 4mm diameter x 13mm length NanoTite™ Certain Implant was placed with the rotational positioning grooves on the implant mount aligned with the grooves in

the surgical guide master tube to transfer the proper alignment of the hex from the master cast to the mouth (Figure 10c). The implant mount was removed by loosening the retaining screw (Figure 11) and then gently elevating the mount from the master tube. The surgical guide was then removed (Figure 12). To allow proper seating of the prefabricated provisional restoration, a 4/5mm hand bone profiler was used to shape the coronal aspect of the crestal bone surrounding the implant (Figure 13).

The prepared provisional restoration was tried in and found to fit with minimal adjustment. There were no centric, eccentric, working or balancing side contacts following the principals of immediate non-occlusal loading. A periapical radiograph was taken to verify complete seating of the provisional restoration into the internal interface of the implant. The provisional crown was secured with a titanium abutment screw, which was hand-tightened. The screw access opening on the lingual aspect of the provisional restoration was sealed with a cotton pellet and composite resin (Figure 14). The patient was dismissed with instructions to maintain a soft diet including avoidance of challenging foods. Soft tissue healing was uneventful during the weeks immediately following implant placement and immediate provisionalization (Figure 15). Three months post placement, radiographic verification confirmed excellent implant/bone contact without radiolucency. At a later date, the provisional crown will be removed and an implant level impression made for fabrication of an all-ceramic single tooth restoration.

The patient was pleased with the aesthetic outcome of the provisional restoration and reported no discomfort following extraction and implant placement.

CLINICAL OVERVIEW

This clinical case illustrates the principles of collaborative accountability, which implies that all members of the team work with a presurgically determined prosthetic plan. The CT technology along with the concept of stereolithography facilitated atraumatic, flapless, immediate extraction and implant placement surgery within the context of a defined prosthetic outcome. The implant hex position was transferred from the laboratory to the patient through the use of the Navigator™ System For CT Guided Surgery. This enabled the delivery of a precise provisional restoration with optimal contours at the time of tooth extraction and implant placement which allowed for guided soft tissue healing. CT guided surgery allowed control of multiple surgical and restorative parameters with the context of narrow interradicular space while preserving the delicate nature of the gingival tissues. Clearly the most important aspect of the patient's treatment was to conduct presurgical consultation in an atmosphere of forthright disclosure.

Restorative Treatment By: Joseph Silberman, DMD, Evanston, Illinois

†Dr. Rosenfeld received his dental degree from the University of Illinois, College of Dentistry in Chicago, Illinois. He then completed a General Practice Residency at Michael Reese hospital in Chicago, Illinois and attended the University of Pennsylvania in Philadelphia, Pennsylvania for specialty training in periodontics. Dr. Rosenfeld is a Professor of Clinical Periodontics at the University of Illinois, College of Dentistry and maintains a private practice, with an emphasis on implant dentistry and osseous surgery, in Park Ridge and Oakbrook Terrace, Illinois.

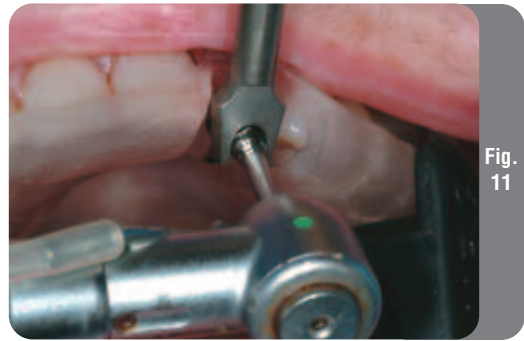


Fig. 11



Fig. 12



Fig. 13



Fig. 14



Fig. 15

CT Guided Reconstruction Of A Partially Edentulous Mandible: A Case Presentation

Clinical Treatment By Richard A. Mecall (USA)†



INITIAL PATIENT PRESENTATION

A 68-year-old male patient presented for replacement of the missing teeth in the mandibular right posterior quadrant (teeth #'s 28, 29 & 30) secondary to failed endodontic treatment, caries and a periodontal lesion (Figure 1). The patient reported difficulty during mastication and desired a fixed restoration to replace the missing teeth. A fixed partial prosthesis previously had replaced these teeth. Radiographic examination revealed a localized infrabony defect on the mesial aspect of the remaining root tip of tooth #28 and close proximity between the mandibular alveolar canal and the root apex. This type of pathology is generally an indication for bone augmentation and modification of the osteotomy (Figure 2). Due to the long term loss of the missing teeth, the lack of mesial-distal space compromised optimal implant diameter and subsequently the biomechanical stability of an implant-supported prosthesis. The consultation included a treatment plan for an implant-supported restoration with CT guided surgery to provide a laboratory processed provisional restoration, which could be delivered at the time of implant placement.

DIAGNOSIS

- Partially edentulous mandibular right quadrant (missing teeth #'s 28, 29 & 30)
- Limited mesial-distal space for implant placement
- Limited bone height above the inferior alveolar canal in tooth site #30
- Adequate soft tissue dimension
- Adequate interocclusal clearance with the opposing natural dentition

TREATMENT PLAN

- Removal of retained root #28 and bone augmentation of the localized infrabony defect in the mandibular right quadrant
- Fabrication of diagnostic casts and diagnostic wax up (Figure 3) for construction of a CT scan appliance (Figure 4)
- Referral for a Computed Tomography (CT) study
- Evaluation of surgical bone volume and anatomic structures in proposed implant sites via placement of virtual implants (Figures 5, 6a)
- Order computer generated surgical guide and a stereolithographic cast
- Fabrication of a laboratory provisional restoration supported by PreFormance® Posts
- Placement of Certain® Implants in tooth sites #29 and 30 using the surgical guide and immediate provisionalization of the implants with the prefabricated provisional restoration
- Implant level impression three months post implant placement for fabrication of a definitive implant-supported restoration



Fig. 1

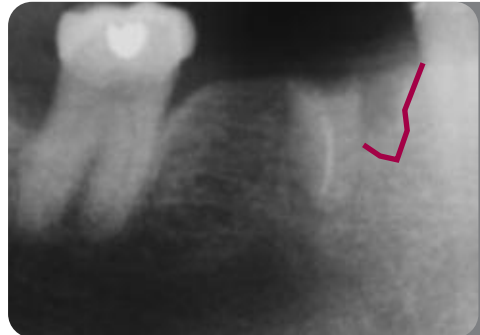


Fig. 2

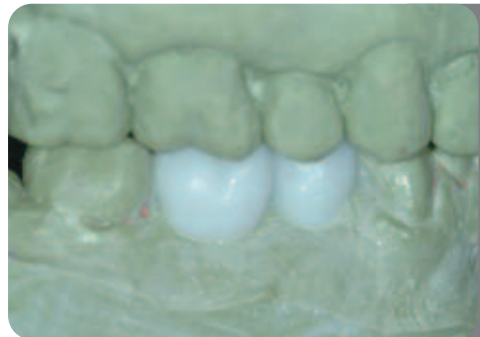


Fig. 3

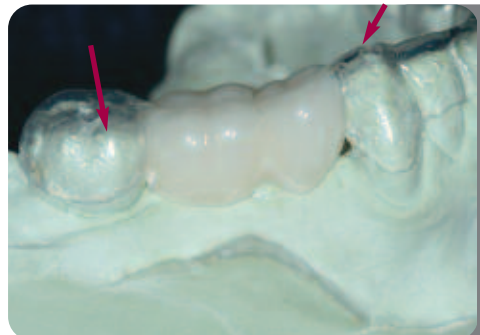


Fig. 4

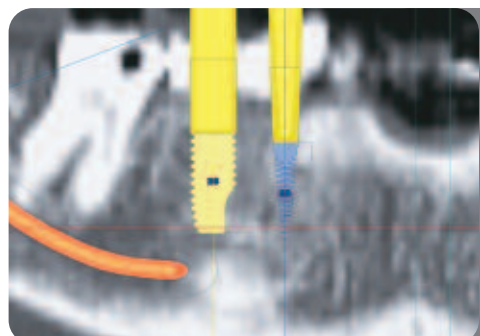


Fig. 5

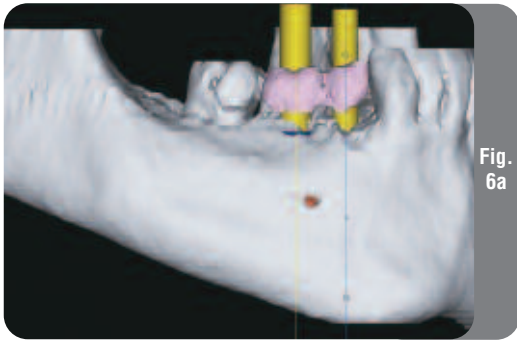


Fig. 6a

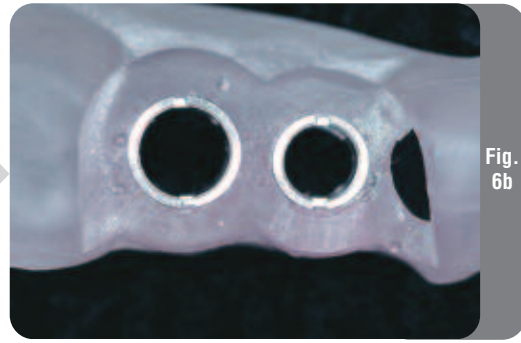


Fig. 6b

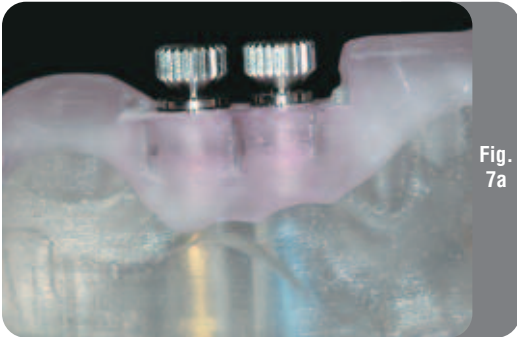


Fig. 7a



Fig. 7b



Fig. 8a



Fig. 8b



Fig. 9a



Fig. 9b

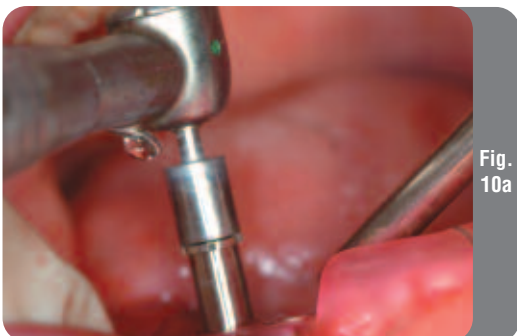


Fig. 10a



Fig. 10b

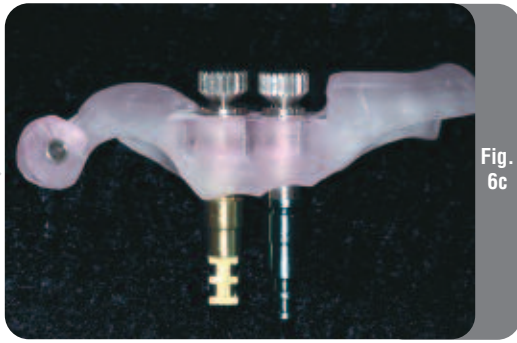


Fig. 6c



Fig. 7c



Fig. 8c



Fig. 9c



Fig. 10c

PRESURGICAL TREATMENT

Upon acceptance of the treatment plan and prior to fabrication of the scan appliance for the CT study, the patient was seen for treatment of the localized infrabony defect with bone augmentation at the time of root removal. This was completed prior to implant placement so that the implant platform depth could be predictably managed at the time of placement. From the diagnostic wax up, a CT scan appliance was constructed using a vacuum formed template and bis-acrylic resin (Protemp™ 3 Garant™ Temporization Material, 3M, St. Paul, Minnesota). Inspection windows were placed on the occlusal aspects of the adjacent teeth to confirm accurate seating of the appliance (Figure 4).

A CT scan was obtained with 1mm thick axial sections and the occlusal plane at a zero degree gantry angle, following the protocol of Materialise Dental, Inc. (Glen Burnie, Maryland). The CT scan output was placed onto a CD, which was then processed using SimPlant Pro Interactive CT Planning Software from Materialise Dental, Inc. (Figures 5, 6a). Virtual implants were placed into the reformatted images to determine the optimal implant locations. The relationship of the planned implant positions to the alveolar nerve and bone can be seen in Figure 5. Review of the CT scan using the planning software suggested the mandibular inferior alveolar nerve was 2mm from the planned implant position in tooth site #30. Since the twist drill length, including the drill tip, is longer than the implant, an adequate margin of safety was planned near the vital anatomic structure. Once the implant treatment plan was completed, a tooth-borne surgical guide was fabricated by Materialise Dental, Inc., which incorporated master tubes designed specifically for the Navigator™ System For CT Guided Surgery (Figure 6b). A stereolithographic cast was also ordered from Materialise Dental, Inc.

FABRICATION OF A PROVISIONAL RESTORATION

To fabricate a provisional restoration for immediate placement at the time of implant placement, appropriate diameter and length analog mounts were selected from the Navigator Laboratory Kit. Holes were created in the stereolithographic cast to accept the implant laboratory analogs. The implant analogs were attached to the analog mounts and the thumb screws were tightened approximately two turns. The analog/analog mount assemblies were placed through the master tubes and the rotational positioning pins were engaged into the notches in the master tubes to establish the proper alignment of the implant hexes from the cast to the mouth (Figure 6c). The thumb screws on the analog mounts were hand-tightened into the analogs. The analogs were secured in the cast with stone using the surgical guide to accurately position the analogs (Figure 7a). After the stone hardened, the thumb screws of the analog mounts were loosened and the surgical guide was removed leaving the analogs in the cast (Figure 7b). PreFormance® Posts, consistent with the restorative seating platforms of the planned implants, were selected for use as interim abutments. The provisional abutments were placed into the analogs in the cast and prepared only to locate the margins in the desired location (Figure 7c). A two-unit fixed acrylic resin provisional restoration was then fabricated by flowing acrylic resin into a vacuum formed template of the scanning appliance and seating it over the prepared posts (Figure 8a). The provisional restoration was contoured, polished and placed back onto the posts. The occlusal contacts were removed using the articulation (Figure 8b).

SURGICAL TREATMENT

The surgical guide was placed over the adjacent teeth (Figure 8c). The soft tissue punches, drill positioning handles and twist drills with drill stops were selected from the Navigator™ Surgical Kit using the drill sequence instructions from Materialise Dental, Inc. to prepare the osteotomies. The appropriate sized soft tissue punches were used for each implant site (Figure 9a) to remove the soft tissue over the planned implant sites. A cortical punch/countersink drill was used next to prepare the bone crest and pilot the osteotomy. The twist drills used were 2mm and 3.25mm diameters (Figures 9b, 9c) for placement of a 4mm diameter implant in the premolar site and 2mm, 3.25mm and 4.25mm diameter drills were used for placement of a 5mm diameter implant in the molar site. The proper diameter and length implant mounts were selected from the kit and placed into the internal interface of the implants according to the instructions received. A 4mm diameter x 11.5mm length Certain® Implant was placed in the premolar site and a 5mm diameter x 11.5mm length Certain Implant was placed in the molar site (Figure 10a). The rotational positioning grooves on the implant mounts were aligned with the grooves in the surgical guide master tubes to transfer the proper alignment of the hexes from the master cast to the mouth (Figure 10b). The implant mounts were removed by loosening the retaining screws and then gently elevating the mounts from the master tubes. The surgical guide was then removed (Figure 10c).

The prepared interim abutments were placed into the internal interface of the implants and secured with titanium abutment screws, which were hand tightened (Figure 11). The fixed provisional restoration was tried in and found to fit with only minimal adjustment (Figure 12). There were no centric, eccentric, working or balancing side contacts following the principles of immediate non-occlusal loading. A periapical radiograph was taken (Figure 13). The provisional restoration was cemented to the prepared PreFormance® Posts with 3M™ ESPE™ Durelon™ Carboxylate Luting Cement (3M, St. Paul, Minnesota) and screw-retained. The access openings were sealed with a cotton pellet and composite resin. The patient was dismissed with instructions to maintain a soft diet. The patient was seen two weeks post surgery (Figure 14). Soft tissue healing was uneventful. The patient returned three months later (Figure 15) for definitive impressions and fabrication of the definitive restorations, demonstrating excellent soft tissue healing.

CLINICAL OVERVIEW

This clinical case demonstrates the use of computed tomography guided implant surgery in an area with anatomic limitations. The treatment plan provided for the placement of two implants with immediate provisionalization, predictability and precision. All decision making occurred prior to surgery and the surgical guide became the conduit between prosthetic evaluation, implant treatment planning and the final restoration.

†Dr. Mecall received his dental degree from the University of Illinois, College of Dentistry, in Chicago, Illinois and a Master of Science degree from the University of Iowa, in Iowa City, Iowa, where he studied bone physiology. He completed his residency in periodontology and year-long fellowship in orthodontics at The University of Iowa College of Dentistry. Dr. Mecall maintains a private practice, specializing in periodontics in Las Vegas, Nevada.



Fig. 11



Fig. 12

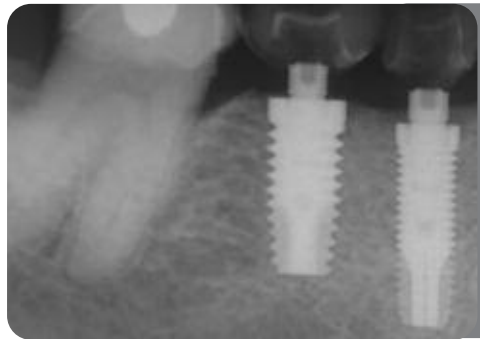


Fig. 13



Fig. 14



Fig. 15

CT Guided Reconstruction Of The Edentulous Maxillae: A Case Presentation

Clinical Treatment By Pär-Olov Östman (SWEDEN)†



INITIAL PATIENT PRESENTATION

A 70-year-old male patient had been seen at the dental clinic regularly for 10 years. During the last seven years, the patient was diagnosed and treated for severe periodontitis. During this time, implant therapy was presented to the patient who did not have any interest due to anxiety about the surgical procedure. Ten months before committing to implant therapy, an acute periodontal infection around the two maxillary central incisors (Figure 1) led to the necessity to extract all the natural teeth in the maxillae, followed by placement of an immediate denture (Figure 2). Wearing the removable appliance was not acceptable to the patient and therefore he requested a new treatment plan which would provide him with a fixed restoration supported by dental implants. The treatment plan accepted by the patient included a CT guided implant procedure, with immediate placement of a fixed provisional prosthesis on the same day as implant placement.

DIAGNOSIS

- Edentulous maxillae (six months)
- Adequate bone quality and quantity for implant placement, without the need for grafting prior to implant placement
- Adequate implant restorative and soft tissue dimension
- Adequate interocclusal clearance with the opposing natural dentition
- Adequate capacity to open the mouth for placement of a CT surgical guide

TREATMENT PLAN

- Denture duplication/fabrication of CT scanning appliance
- Referral for a Computed Tomography (CT) study
- Evaluation of surgical bone volume and anatomic structures in proposed implant sites via placement of virtual implants (Figures 3-5)
- Order tissue supported computer generated surgical guide
- Fabrication of a master cast and bite registration
- Fabrication of a laboratory processed provisional restoration with Conical Abutments and QuickBridge™ Provisional Components on the master cast
- Placement of 4mm diameter NanoTite™ PREVAIL® Implants using the surgical guide
- Placement of Conical Abutments, QuickBridge Temporary Cylinders and QuickBridge Caps for fabrication of an interim fixed prosthesis
- Abutment level impression two months post implant placement and placement of a definitive fixed hybrid prosthesis



Fig. 1



Fig. 2

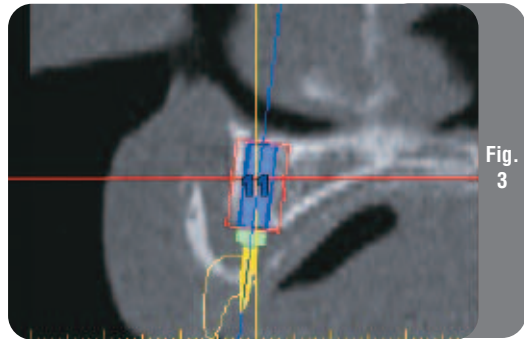


Fig. 3

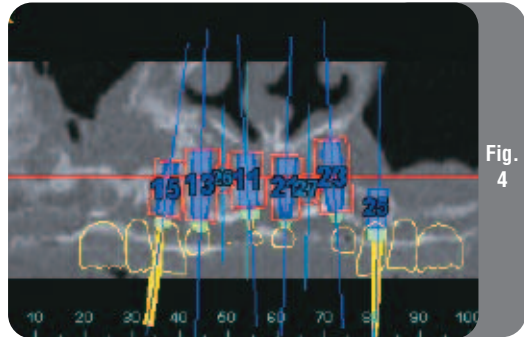


Fig. 4



Fig. 5

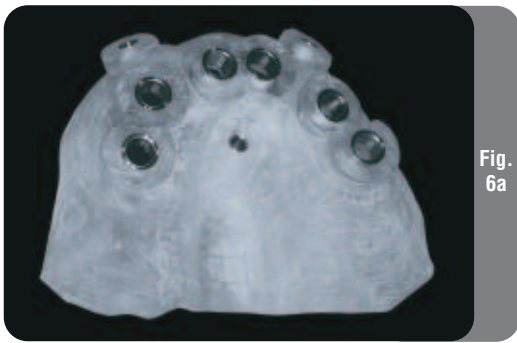


Fig. 6a

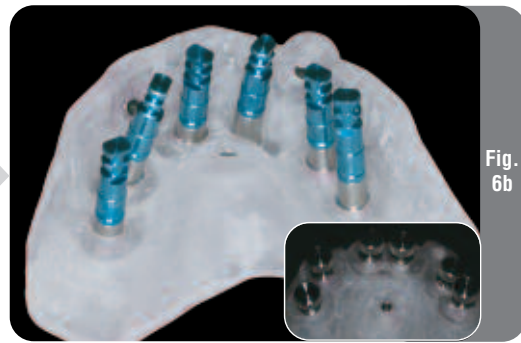


Fig. 6b



Fig. 7a



Fig. 7b

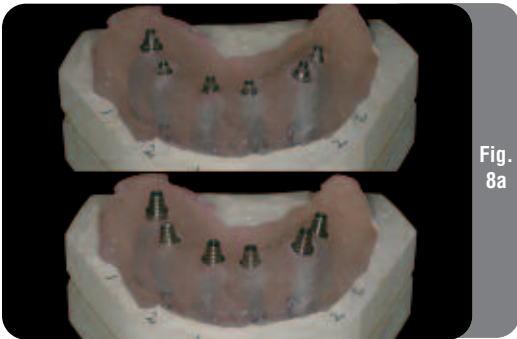


Fig. 8a



Fig. 8b



Fig. 9a



Fig. 9b

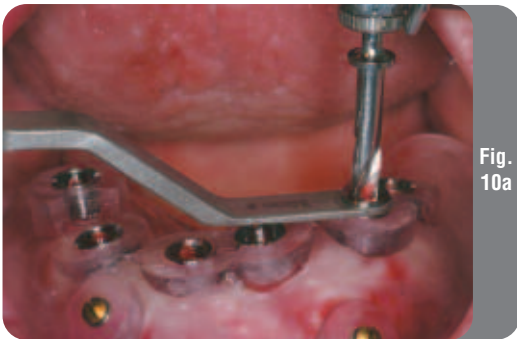


Fig. 10a



Fig. 10b

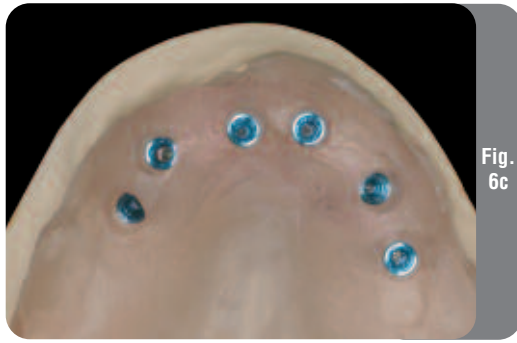


Fig. 6c



Fig. 7c



Fig. 8c



Fig. 9c



Fig. 10c

PRESURGICAL TREATMENT

Upon acceptance of the treatment plan, the denture was relined with ProTemp™ 3 Garant (3M, ESPE, St. Paul, MN, USA) to create a radiopaque border at the soft tissue level (Figure 2). The patient was sent for a CT study. A CT scan was obtained with 1mm thick axial sections and the occlusal plane at a zero degree gantry angle, following the radiographic protocol of Materialise Dental, Inc. (Glen Burnie, Maryland). The CT data was received electronically and processed using SimPlant Pro Interactive CT Planning Software from Materialise Dental, Inc. Virtual implants were placed into the reformatted images. The relationship of the planned implants to the surrounding bone and anatomic structures can be seen in Figures 3-5. A tissue-borne surgical guide was fabricated by Materialise Dental, Inc., which incorporated master tubes designed specifically for the Navigator™ System For CT Guided Surgery (Figure 6a). The position of the master tubes in the surgical guide corresponded to the preplanned implant positions. A stereolithographic cast was also ordered from Materialise Dental, Inc.

FABRICATION OF A PROVISIONAL RESTORATION

To fabricate a fixed provisional restoration for immediate placement at the time of implant placement, appropriate diameter and length implant analog mounts were selected from the Navigator Laboratory Kit. The implant analogs were attached to the analog mounts and the thumb screws were tightened approximately two turns. The analog/analog mount assemblies were placed through the master tubes and the rotational positioning pins were engaged into the notches in the master tubes to establish the proper alignment of the implant hexes from the cast to the mouth (Figure 6b). The thumb screws on the analog mounts were hand-tightened in the analogs.

At the dental laboratory, holes were drilled in the stereolithographic cast to accept the implant analogs. The implant analogs were positioned in the stereolithographic cast using the surgical guide and were fixated with acrylic resin (Figure 6c). The prosthesis was then placed on the master cast and articulated with the lower cast using the previously obtained bite registration (Figure 7a). The prosthesis on the master cast was then duplicated in stone and articulated using the bite registration. A vacuum formed template was made of the prosthesis (Figure 7b). The surgical guide was placed on the articulated master cast and an interocclusal record was made by a conventional wax index (Figure 7c), to be used intraorally to position the surgical guide. Conical Abutments of various heights (1-3 mm) depending on the soft tissue height were placed on the master cast (Figure 8a, top). QuickBridge™ Temporary Cylinders were placed onto the Conical Abutments and tightened (Figure 8a, bottom). QuickBridge Caps were snapped on the temporary cylinders. The retention grooves on the caps were blocked with wax. The vacuum formed template was then filled with self curing acrylic resin (ProTemp™, 3M ESPE, St. Paul, Minnesota) and placed on the master cast and allowed to set (Figure 8b). Using the shaping drill, indentations were created in the intaglio surface of the provisional prosthesis (Figure 8b insert) to allow a 1mm circumferential space for the QuickBridge Caps, which will eventually be picked up intraorally. The provisional restoration was placed back onto the articulated master cast and a bite registration was made to position the provisional restoration intraorally (Figure 8c). The provisional fixed prosthesis was then trimmed and polished (Figure 9a).

SURGICAL TREATMENT

After the patient was anesthetized, the surgical guide was placed intraorally using the interocclusal record to confirm accurate placement (Figure 9b). The soft tissue punches, drill positioning handles and twist drills with drill stops were selected from the Navigator™ Surgical Kit using the drill sequence instructions from Materialise Dental, Inc. to prepare the osteotomies. The guide was fixated using 2mm diameter bone screws (BIOMET Microfixation, Jacksonville, Florida) (Figure 9c). The appropriate sized tissue punches were passed through the master guide tubes and rotated with the implant drilling unit set at a low speed until the bone crest was felt. Preparation of the osteotomies was done through the master guide tubes using the appropriate drill positioning handles and twist drills with stops (Figure 10a). The cortical punch/countersink drill was used first in tooth sites #6 and #11 to shape the bone crest and perforate the cortical plate to pilot the twist drill. The twist drills used were 2mm and 3mm diameters for placement of 4mm diameter implants. The 3mm diameter drill was used due to the presence of soft bone in the edentulous maxillae. The proper diameter and length implant mounts were selected from the kit and placed into the internal interface of the implants according to the instructions received. The implants were placed first in tooth sites #6 (Figure 10b) and #11 for bilateral fixation of the surgical guide. The remaining osteotomies were prepared followed by placement of the additional four implants. All of the six implant sites received 4mm diameter NanoTite™ Certain® Implants placed through the guide tubes, using the drilling unit on slow speed. The implant position and lengths placed were as follows: tooth site #4 received an 11.5mm length implant; tooth site #6, a 15mm length implant; tooth site #8, an 11.5mm length implant; tooth site #9, a 13mm length implant; tooth site #11, a 15mm length implant; and tooth site #13 received an 8.5mm length implant. Final seating of the implants was accomplished using a hand ratchet to ensure that the positioning grooves on the implant mounts were aligned with the rotational positioning grooves on the master tubes, to transfer the proper alignment of the hexes from the master cast to the mouth (Figure 10c).

The bone screws were removed from the surgical guide, followed by removal of the implant mounts by loosening the retaining screws and gently elevating the mounts from the master tubes. The surgical guide was removed from the mouth. Following evaluation of initial implant stability by radio frequency analysis (RFA), manual bone profilers were used to shape the bone coronal to the implant prosthetic seating surfaces. The Conical Abutments were placed into the implants and secured with abutment screws, which were tightened to 20Ncm of torque (Figure 11, top). QuickBridge™ Temporary Cylinders were placed onto each abutment and hand tightened (Figure 11, bottom). QuickBridge Caps were snapped onto the QuickBridge Temporary Cylinders intraorally (Figure 12).

The provisional restoration was tried-in to ensure an absence of binding over the caps for complete seating, then was removed and the intaglio surfaces were filled with acrylic resin. The provisional restoration was then seated and the patient was brought to centric occlusion using the interocclusal record while the acrylic resin set. After setting of the acrylic resin, the restoration was removed. The QuickBridge Caps were picked up in the restoration. The voids around the caps were filled with cold cure

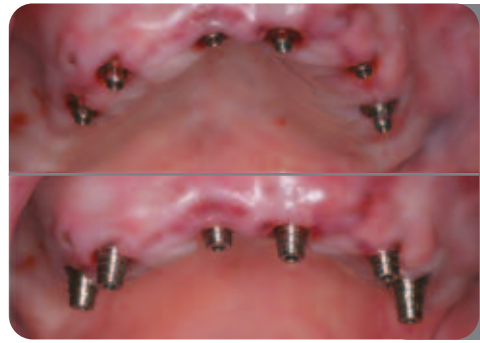


Fig. 11



Fig. 12



Fig. 13



Fig. 14



Fig. 15

acrylic resin and the excess acrylic was removed (Figure 13). The completed interim prosthesis was resealed intraorally and found to fit with minimal adjustment necessary (Figure 14). Chlorhexidine gel 2% was placed into the caps and the restoration was snapped into place. The occlusion was verified by occlusion film. Care was taken to avoid lateral forces on the implants. A panoramic radiograph was taken to confirm implant/abutment/bridge junction (Figure 15). The QuickBridge™ Caps are made from PEEK (polyetheretherketone) and therefore are not visible on the radiograph. The patient was dismissed with instructions to maintain a soft diet and for optimal self care. The patient returned two months later for an abutment level impression and placement of the definitive fixed hybrid prosthesis.

CLINICAL OVERVIEW

This clinical case presentation demonstrates the use of computed tomography guided implant surgery in the edentulous maxillae. The treatment plan provided just what the patient desired; the precise placement of multiple implants using an atraumatic, flapless surgical protocol, followed by the immediate placement of an aesthetic, functional, prefabricated laboratory processed provisional restoration with QuickBridge Provisional Components. The simplicity of the QuickBridge Technique provided an efficient, cost effective means for fabrication of the provisional prosthesis. All decision making and the fabrication of the interim prosthesis occurred prior to surgery.

For additional case photographs and to view treatment videos of this particular case, visit www.biomet3i.com and click on *IN THE OPERATORY*.

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The Navigator™ System For CT Guided Surgery Product Information

Navigator Surgical Kit (SGKIT)



The Navigator Surgical Kit contains the required instrumentation to perform CT guided implant surgery, including:

- Tissue Punches
- Starter Drills
- Drill Positioning Handles
- Twist Drills
- Bone Taps
- Implant Staging
- Implant Mounts
- Bone Profilers

Navigator Laboratory Kit (SGLKIT)



The Navigator Laboratory Kit contains a variety of implant analogs of different diameters and lengths, which are placed through the master tubes in the surgical guide, for fixation of implant analogs into the master cast.



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