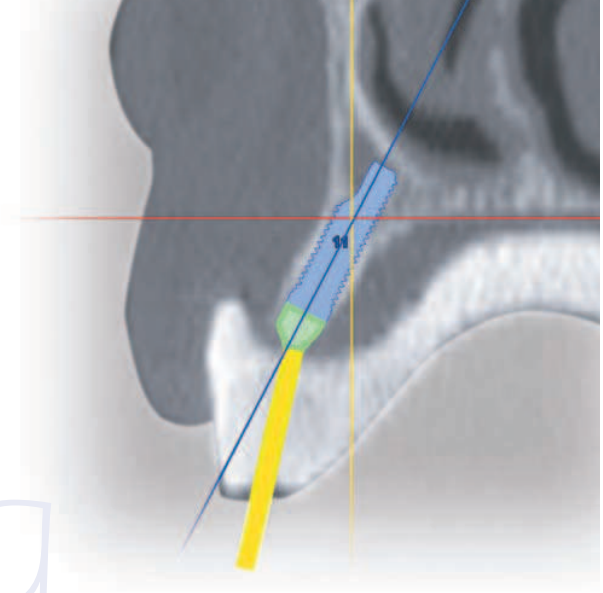
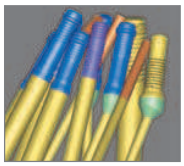


planning

CT guided implant treatment: Techniques for successful planning and execution

Harold S. Baumgarten, DMD



As the immediate loading of dental implants has been demonstrated to yield functional and aesthetic results, computed tomography (CT) technology and software have improved clinicians' abilities to plan and implement implant placement. Accurate surgical guides can be fabricated, and using precise surgical instrumentation, implants can often be placed without raising a flap.[1-3] Patients can leave the office with aesthetic, fixed provisional restorations. This article presents a case in which CT technology and planning software were utilized to restore an edentulous maxilla.

Key Words: computed tomography (CT), planning, immediate provisionalization

Introduction

Patients today demand aesthetic replacements for their missing teeth, with shorter treatment times and minimal downtime or inconvenience. They often are not satisfied with treatment plans that include the use of removable prostheses; even briefly.

In the realm of implant dentistry, the immediate placement of a prefabricated, aesthetic provisional restoration can enable clinicians to meet these heightened expectations. But meticulous pretreatment planning by the entire implant team is essential, with the surgeon, restorative dentist, and laboratory technician each providing input during the planning stage to avoid many potential pitfalls. Furthermore, a number of requisites must be fulfilled in order to predictably facilitate this type of therapy.

The single most important predictor of success for immediately placed implants is high primary stability. Factors that enable the surgeon to achieve this include the patient's bone quality, the drilling protocol employed, the precision with which osteotomy sites are prepared, the macro-geometry of the implant design, and the micro-geometry of the implant surface.

When implants are placed optimally with high initial mechanical stability, that stability quickly begins to decrease as a result of bone relaxation and remodeling.[4]

Minimizing this effect can protect the implants from overloading in the early phase of healing. In this case, the author selected implants (NanoTite™ Implants, BIOMET ***3i***) with a complex surface topography, which renders the implant a bone-bonding surface by the interlocking of the newly formed cement line matrix of bone with the implant surface.[5,6]

Conventionally restored two-stage implants exhibit remodeling of crestal bone to about the level of the first thread. This decreases the amount of supporting bone around the implant. Platform switching may help to minimize this remodeling and provide bone and soft-tissue support.

Once the team has planned for high primary stability, rapid osseointegration, and minimal crestal bone loss, the number and location of each implant can be precisely determined by using computed tomography (CT) planning software. However, studies have revealed discrepancies between the actual size of the jaw and its depiction in CT scans.[9,10] Potential technique errors in the surgical procedure may also cause implants to be placed in locations different from what was planned.[7,8,11]

The following clinical presentation demonstrates the step-by-step process for planning an accurate, minimally invasive, CT guided surgery with the immediate placement of a fixed prefabricated provisional restoration.

Fig. 1.1

Fig. 1.2

Fig. 2.1

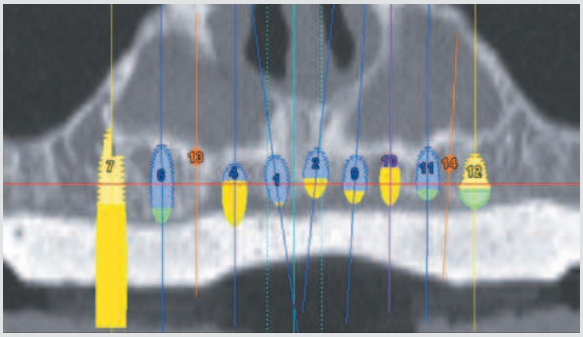


Fig. 2.2

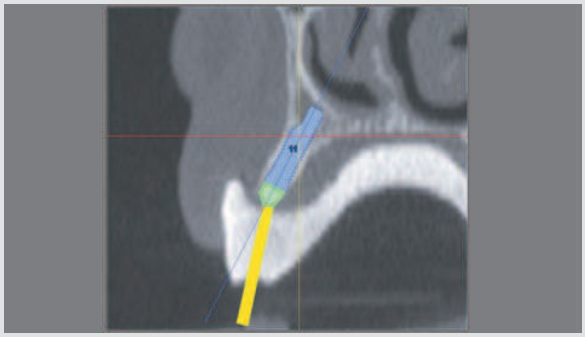


Fig. 3.1

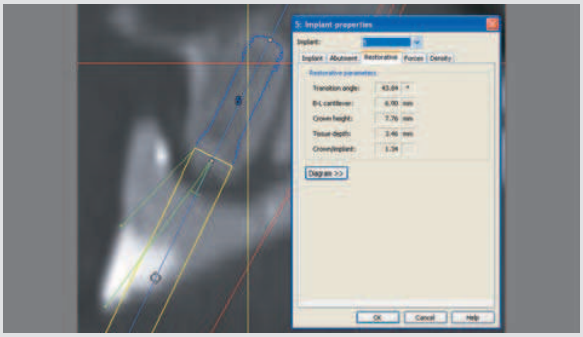


Fig. 3.2

Fig. 4.1

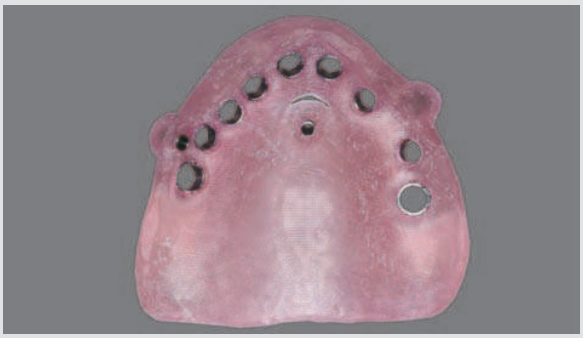


Fig. 4.2

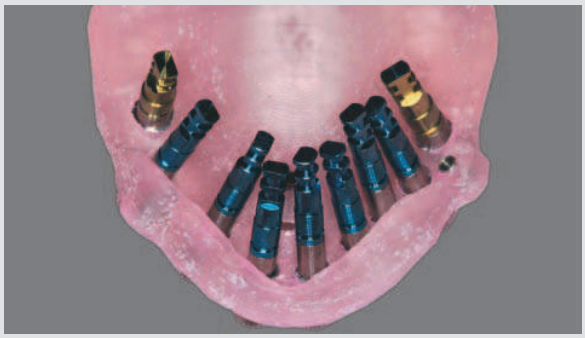


Fig. 5.1

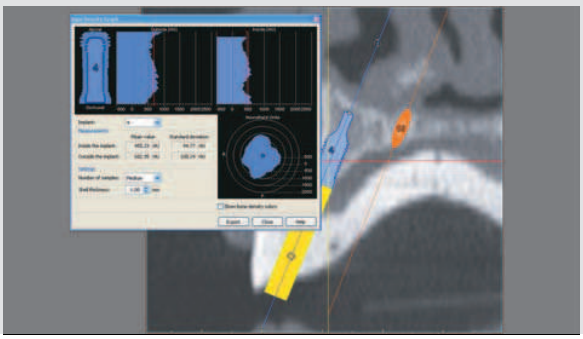


Fig. 5.2

Fig. 1.3

Fig. 2.3

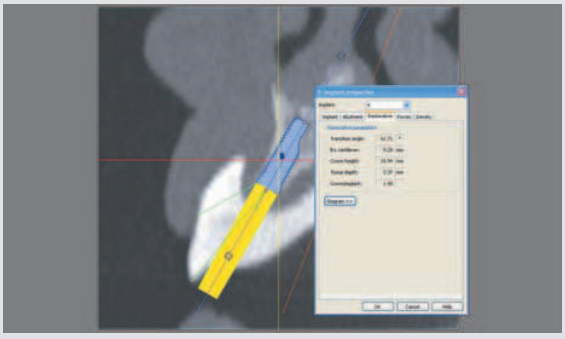


Fig. 3.3

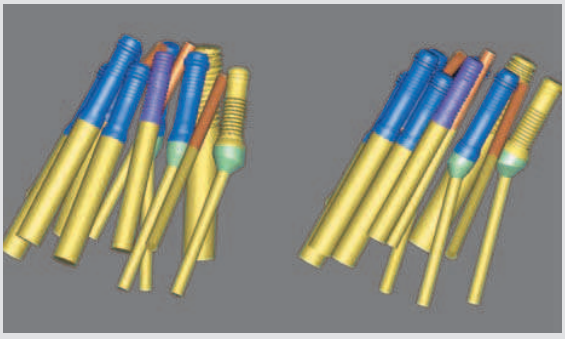


Fig. 4.3

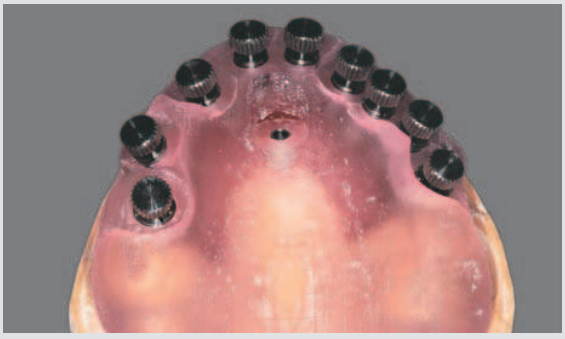
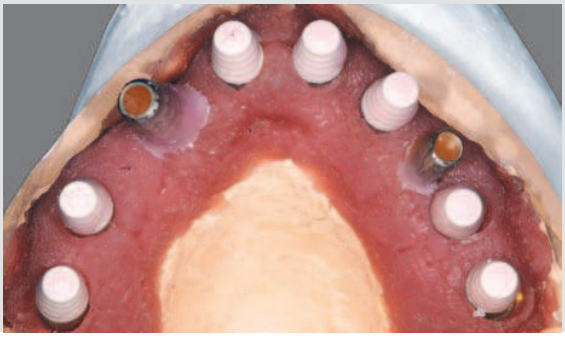


Fig. 5.3



Clinical Presentation

[Figs. 1.1-1.3] The diagnosis for this 58-year-old male patient included failing maxillary dentition with significant alveolar resorption. After extraction of the hopeless teeth in the maxilla, socket preservation was performed to preserve ridge width and height (Fig. 1.1). The complete denture that was satisfactory with regards to fit, aesthetics, and phonetics was duplicated in a mixture of 30% barium sulfate and cold-cure acrylic resin (Fig. 1.2). At the CT scanning appointment, this duplicate denture/scanning appliance was placed intraorally with the intaglio surface of the denture in intimate contact with the soft tissues of the edentulous ridge. The accurate placement of the scanning appliance is critical to capturing an image that can be used to generate a surgical guide. Figure 1.3 illustrates a scanning appliance that was dislodged during the scanning process. Note the presence of an air space between the scanning appliance and the soft tissues of the maxilla.

[Figs. 2.1-2.3] An occlusal registration was made that later allowed the master cast to be poured into the guide to be articulated against the lower cast, using the scanning appliance. The CT scan was obtained, and data from the scan was processed using SimPlant Master Software (Materialise Dental, Inc., Glen Burnie, Maryland, USA). Virtual implants were then placed into the reformatted images. The relationship of the planned implant/abutment positions to the bone of the edentulous ridge can be seen in the panoramic view (Fig. 2.1). An oblique section illustrates the use of a 17-degree Angled Conical Abutment to redirect the screw access hole so that it passes through the occlusal surface of the planned restoration (Fig. 2.2). The relationship of the prosthetic seating surface of each implant to the gingival margin was also planned. Using the SimPlant Planner's Restorative screen, the transition angle, buccolingual cantilever, crown height, tissue depth, and crown-to-implant ratio were determined (Fig. 2.3).

[Figs. 3.1-3.3] Changing the implant view from "Opaque" to "Outline" made it easier to locate critical landmarks (Fig. 3.1). Failure to properly plan the ideal subgingival position of the restorative seating surface of the implant can result in the unaesthetic display of titanium components in the provisional phase of treatment (Fig. 3.2). It is possible to plan implant locations that will adequately fit into the existing alveolar bone while not allowing for a common path of insertion of a fixed restoration. To avoid this, the implants can be digitally paralleled (Fig. 3.3).

[Figs. 4.1-4.3] The treatment plan was sent to Materialise electronically, and a surgical guide incorporating Master Tubes designed specifically for the Navigator™ System (BIOMET ***3i***), was fabricated (Fig. 4.1). Appropriate diameter and length Implant Analog Mounts were then selected from the Navigator Laboratory Kit. These correspond to the Implant Mounts used to place the implants through the Master Tubes in the surgical guide. The Implant Analog Mounts were mated with the appropriate analog and inserted into the Master Tube. Great care was taken to ensure that the rotational positioning pins on the Analog Mounts were engaged with the notches of the Master Tubes to enable the transfer of alignment of the analog and implant hexes from the cast to the oral cavity (Fig. 4.2). Once all the analogs were positioned within the surgical guide, the guide was beaded and boxed, and a soft-tissue cast was poured (Fig. 4.3).

[Figs. 5.1-5.3] The soft-tissue cast was placed into the CT Scanning Appliance and articulated with the occlusal registration that was previously obtained. The prescribed straight and angulated Conical Abutments were then placed in the appropriate positions on the master cast. Screw retention was planned for two of the implant locations, while the remaining implant positions were to receive QuickBridge® Components[12] as retentive elements. The decision as to which implants would have screw retention was based on a digital bone-density analysis. Using the SimPlant Planner Software, a bone-density graph is displayed that includes the mean and standard deviation of Hounsfield Units around each implant. As one moves the implant in the software to idealize its position, the bone density graph updates itself in real time (Fig. 5.1). The QuickBridge Titanium Cylinders were placed onto the Conical Abutments and tightened (Fig. 5.2). QuickBridge Caps were snapped onto the QuickBridge Titanium Cylinders. Undercuts in the Caps and the Temporary Cylinders were waxed out, and the cast was then duplicated and articulated (Fig. 5.3).

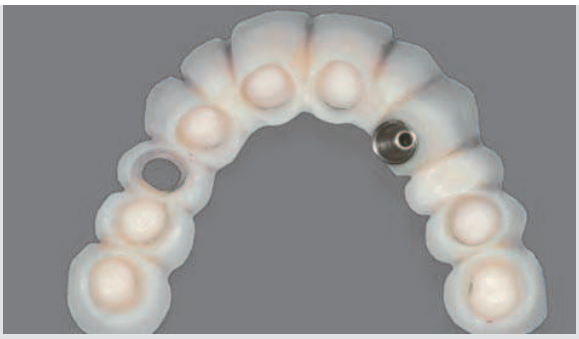


Fig. 6.1

Fig. 6.2

Fig. 7.1

Fig. 7.2

Fig. 8.1

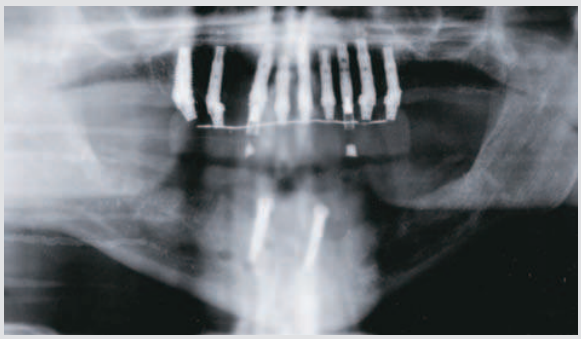


Fig. 8.2

[Figs. 6.1-6.2] The provisional restoration was then waxed on the duplicate cast, invested, and processed. One Conical Abutment Temporary Cylinder was incorporated into the provisional restoration in the laboratory using cold-cure acrylic resin (Fig. 6.1). To compensate for any technique or scanning error and ensure a completely passive fit of the provisional restoration, the second Conical Abutment Temporary Cylinder was to be incorporated into the provisional restoration intraorally after implant placement and before the pick-up of the QuickBridge® Caps. At the time of surgery, local anesthetic was administered and the surgical guide was placed and secured using 2mm-diameter bone screws (BIOMET Microfixation, Jacksonville, Florida, USA). The osteotomies were prepared with Tissue Punches, a Starter Drill, depth-specific twist drills of increasing diameters, and manual bone profilers. Note that the tissue punch is more easily used through the Master Tubes prior to fixating the surgical guide. This allows for easy removal of the soft-tissue plugs without having to pull these through the Master Tubes. The implants were then placed through the Master Tubes using the appropriate Navigator™ System Implant Mounts. Final positioning of each implant was accomplished using a hand ratchet to ensure the precise positioning of the timing notch on the Implant Mount relative to the timing notch in the Master Tube (Fig. 6.2).

[Figs. 7.1-7.2] The surgical guide was removed, and Conical Abutments were seated into the internal interfaces of the implants and tightened to 20Ncm of torque with a torque driver. QuickBridge Titanium Cylinders were placed onto each abutment and hand tightened. After being placed and secured with a retaining screw, the remaining Conical Abutment Temporary Cylinder was then luted intraorally to the prefabricated provisional restoration with cold-cure acrylic resin, using the wooden handle of the cotton-tipped applicator to keep the screw hole patent during the luting process (Fig. 7.1). This resulted in a perfectly passive restoration retained by two screws. The provisional restoration was then removed, and the QuickBridge Caps were snapped onto the QuickBridge Titanium Cylinders and picked up into the intaglio surface of the provisional restoration with cold-cure acrylic resin. Since all of the abutments employed fixed margins, the provisional restoration was trimmed and polished extraorally without the clinician having to remove abutments from the oral cavity (Fig. 7.2).

[Figs. 8.1-8.2] The completed provisional restoration was then snapped into position, retained with two retaining screws, and evaluated for even occlusal contacts and lack of occlusal interferences. The screw access openings were filled with cotton and Cavit (Fig. 8.1), and the patient was dismissed with post-operative and oral hygiene instructions. The position of the implants is seen in the post-operative panoramic radiograph (Fig. 8.2).

Using the Navigator™ System for CT Guided Surgery in this case made it possible to place multiple implants using a minimally invasive, flapless surgical protocol and then immediately deliver a prefabricated, laboratory-processed, provisional restoration with QuickBridge® Provisional Components. Planning the location of each implant in the SimPlant Planner Software enabled the team not only to identify where each implant should be placed but also to determine each implant's width, length, angulation, and subgingival position. Although the apices of the implants were in close proximity, the planning software and precision of the Navigator System's surgical instrumentation helped to prevent any impingement among them. Incorporating angulated abutments in the plan allowed for a common path of insertion and ensured that screw-access openings were appropriately located. The entire implant team worked in concert before surgery to decide the best strategy for the patient.

Clinical Relevance

Visualizing and planning a patient's implant therapy in three dimensions can make it possible for the implant team to place implants precisely using minimally invasive implant surgery, with reduced morbidity. When immediate loading is indicated, the computerized surgical plan may allow for delivery of a passive, precise, and aesthetic provisional restoration at the time of surgery.

Surgical Colleague: Alan M. Meltzer, DMD, MScD, Voorhees, New Jersey, USA.

Laboratory Colleague: Alfred D. Nelson, CDT, Amsterdam Dental Laboratory, Philadelphia, Pennsylvania, USA.

A treatment video of this case will be coming soon to www.JIRD-online.com.

Harold S. Baumgarten, DMD

Dr. Baumgarten received his dental degree, as well as Certificates in Periodontal Prosthetics and Periodontics, from the University of Pennsylvania, School of Dental Medicine. He is affiliated with the Academy of Osseointegration and the American Academy of Periodontology and is a Clinical Professor with the Department of Periodontics at the University of Pennsylvania. He maintains a private practice in Philadelphia, Pennsylvania.

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