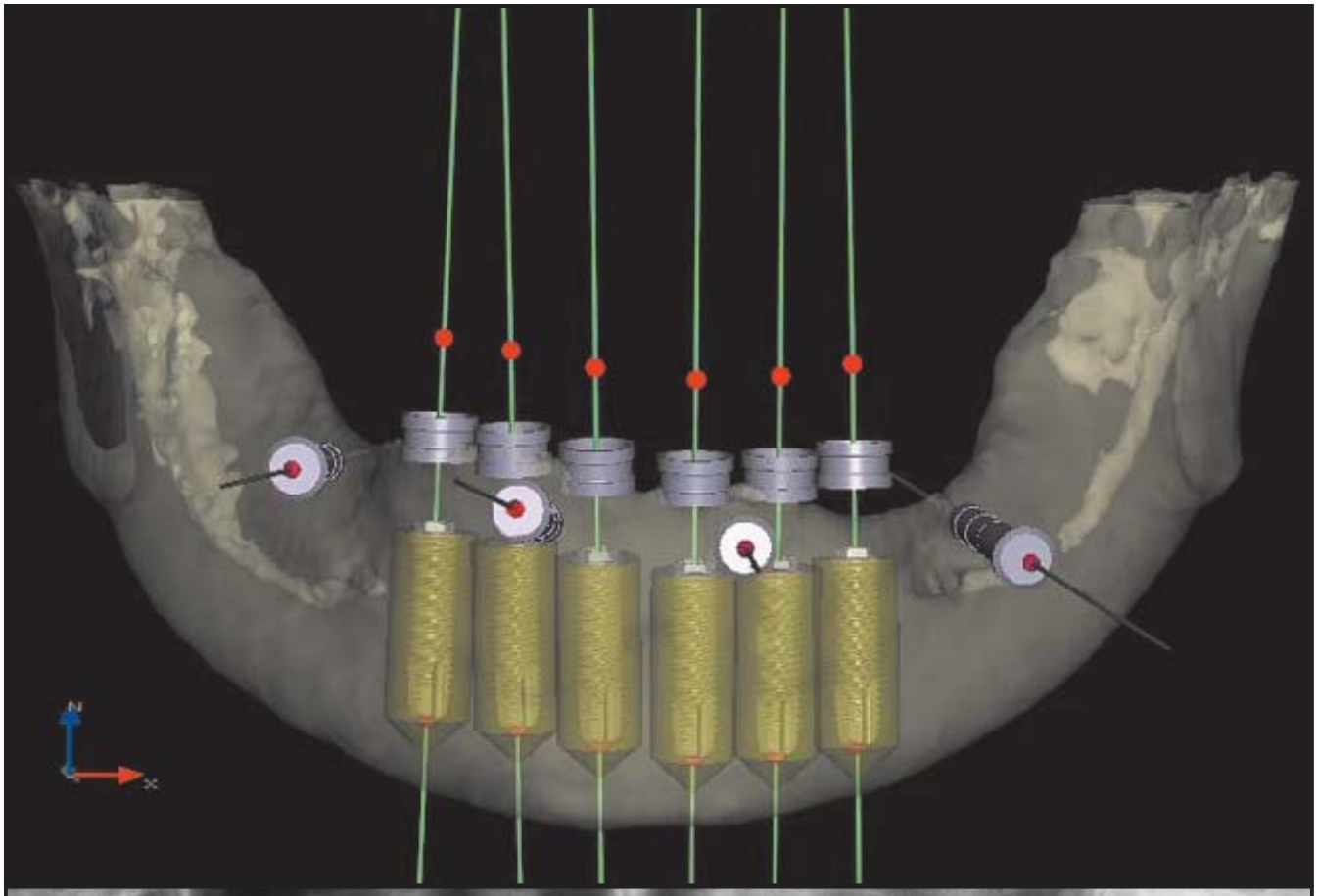

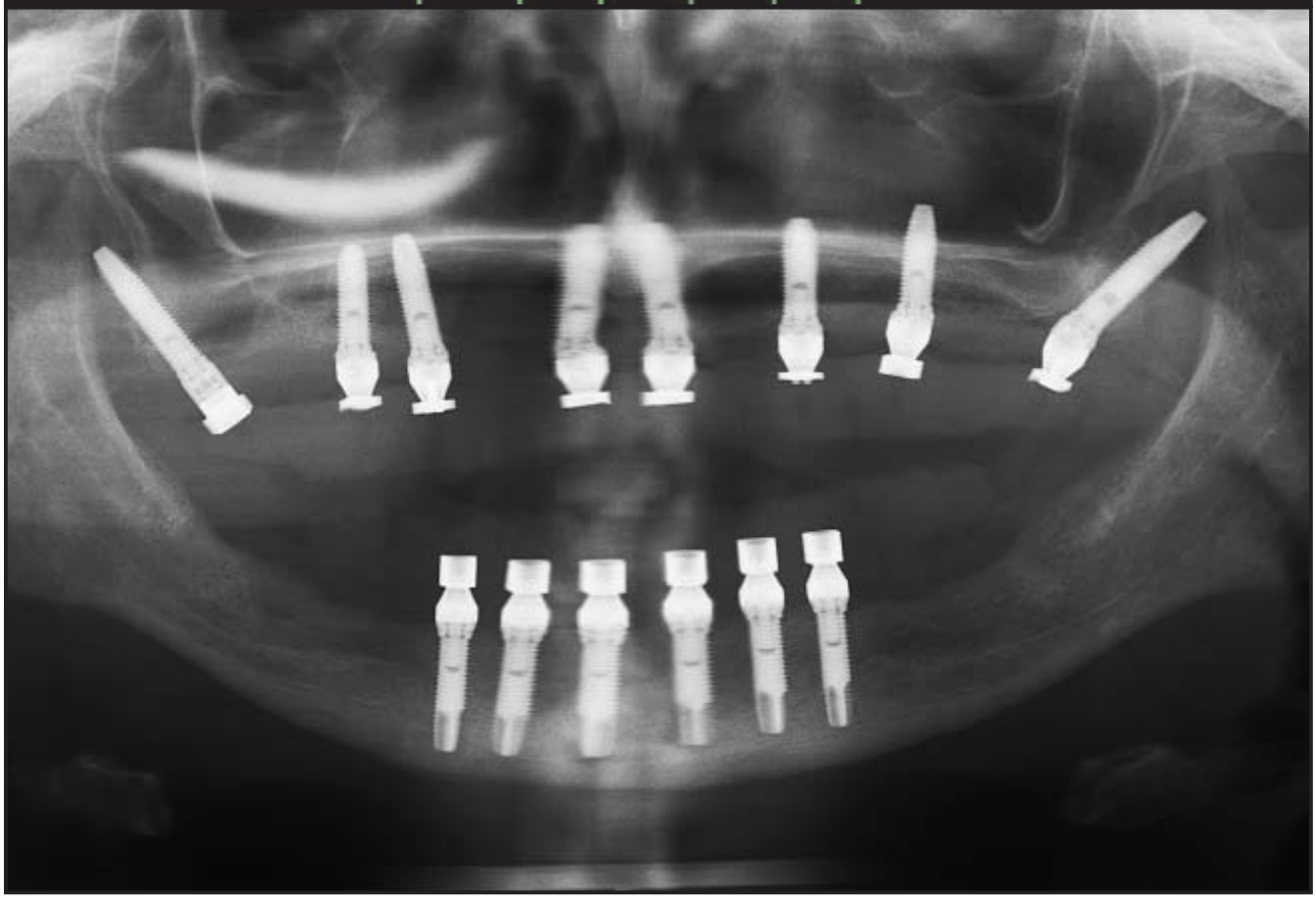

A Protocol for Immediate Placement of a Prefabricated Screw-Retained Provisional Prosthesis Using Computed Tomography and Guided Surgery and Incorporating Planned Alveoplasty

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Computer-aided design/computer-assisted manufacture technology is changing the way clinicians are planning treatment and delivering dental implant therapy. Although the current technology is impressive and successful clinically, there are limitations in the design that prevent all patients from benefiting immediately from this computer-designed modality. This article describes a unique prosthetically driven protocol that will allow the delivery of a prefabricated screw-retained all-acrylic prosthesis immediately after an alveoplasty with the immediate placement of dental implants. (Int J Periodontics Restorative Dent 2011;31:49–55.)

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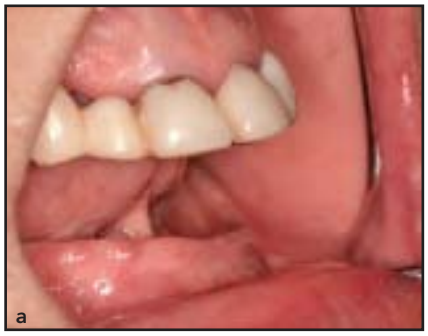
A specific protocol called Teeth in an Hour (TIAH) requires a dual computed tomography (CT) scanning technique.[1–6] The precision of computer-guided implant prosthodontics is directly proportional to the intimate fit of the removable prosthesis in the patient at the time of CT scanning. The stereolithically constructed surgical template is generated from a three-dimensional (3D) reconstruction of the removable prosthesis used in this dual CT scanning technique. The precision of implant placement with this protocol can be accurate to 0.1 mm or less, thereby allowing for the placement of a prefabricated screw-retained prosthesis.[7]

The TIAH protocol is so heavily dependent on the characteristics of the removable prosthesis (eg, overall geometry, fit to tissue, tooth position and arrangement) that it limits the number of immediate candidates for the procedure. Many patients will require preprosthetic surgery, such as extractions, grafting, alveoplasty, or soft tissue modifications, to transition them to candidacy for TIAH. There is also a limitation in the hardware that prevents implant placement to the desired clinical depth.



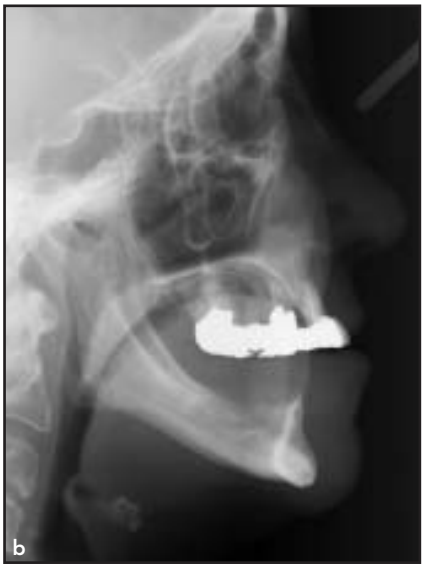


Fig 1 (a) *Clinical view and* (b) *lateral cephalometric radiograph identifying the "knife-edged" mandibular ridge.*

This clinical technique report will describe a modified TIAH protocol that allows for the preplanning of alveoplasty and, therefore, the placement of implants to any desired depth. This modified technique does not maintain a flapless protocol, but it still allows for the fabrication of a laboratory-processed screw-retained all-acrylic provisional prosthesis prior to the surgical procedure. It also allows for both surgical procedures to occur at the same time.

Technique

Patient

By way of protocol example, a 65-year-old Caucasian woman presented with eight teeth in the maxilla supporting a failing fixed porcelain-fused-to-metal prosthodontic restoration with compromised function and esthetics. Her chief complaint, however, was her 3-year-old ill-fitting mandibular complete removable denture. Clinically, it was apparent that the mandibular anterior ridge was "knife-edged," with little volume in the top 10 to 14 mm (Fig 1a). This appearance was confirmed by a lateral cephalometric radiograph (Fig 1b) and further evaluated using 3D images obtained by the Procera planning software (Nobel Biocare).

The treatment plan was to perform an alveoplasty of the mandibular ridge, place six implants anterior to the mental foramina, and deliver a prefabricated screw-retained all-acrylic prosthesis all in a single procedure.

Problem

In the current TIAH protocol (NobelGuide powered by Procera, Nobel Biocare), there is a limitation in the hardware that prevents the clinician from placing the shoulder of an implant more than 6.5 mm beneath the intaglio surface of the removable prosthesis. Stainless steel sleeves (3.5 mm tall) are embedded into the surgical template, based on the virtual position of the implant relative to the removable prosthesis. These sleeves guide the instruments to prepare the osteotomy site and to place the implant. The occlusal portion of these sleeves is always 10 mm from the shoulder of the implant. This dimension, illustrated virtually in Fig 2, cannot be altered because the twists drills, counterbores, screw taps, and

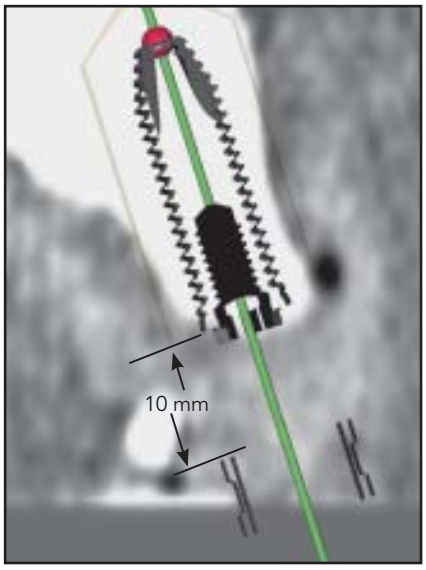


Fig 2 *Relationship of the stainless steel surgical template sleeve to the implant in a cross-sectional view from the Procera planning program.*

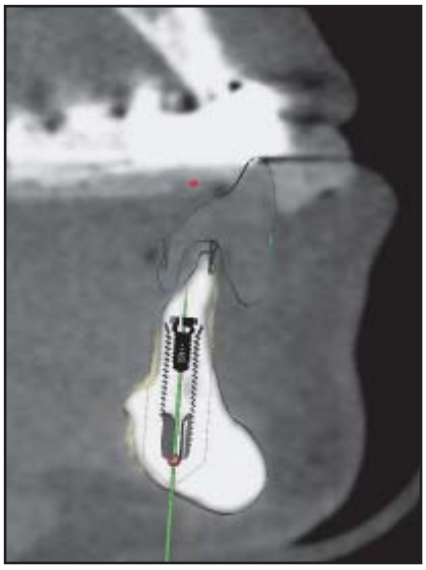


Fig 3 *Cross-sectional view of the virtual implant position in the anterior mandible with the shoulder of the implant in the intended position, which shows the stainless steel surgical template sleeve impinging on the crestal bone.*

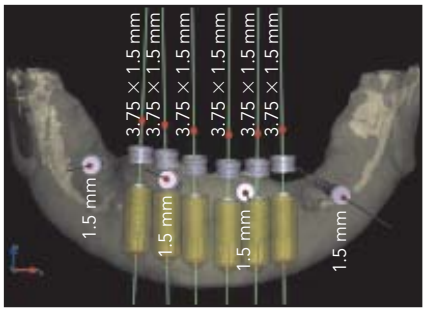


Fig 4 *Frontal view of the final virtual implant placement used to create the primary surgical template. Five of six surgical template sleeves are impinging on the bone. Four anchor pins were positioned, all subosseous to the implant template sleeves.*

implant mounts are all 10 mm longer to accommodate the surgical template dimension and to ensure proper delivery of the implant to the desired predetermined position.

Figure 3 illustrates that at the intended position of the implant, the surgical template would not be able to be positioned in the same fashion as the removable denture because the stainless steel surgical template sleeve would collide with the patient's hard and soft tissue anatomy. When the stainless steel surgical template sleeve impinges on the soft tissue anatomy virtually, it prevents the surgical template itself from being delivered to its proper position, which results in inaccurate positioning of the implant compared to what was planned previously.

After placing all six implants virtually in positions acceptable to the authors of this report, it was determined that five of six implants could not be physically placed with any accuracy using the traditional TIAH protocol (Fig 4). Subsequently, it would not be possible to deliver a prefabricated screw-retained provisional prosthesis.

Presurgical procedures

There is nothing preventing the virtual surgeon from placing the implants subosseous (Figs 3 and 4). The only time a virtual plan is rejected by the manufacturer is if the surgical template sleeves collide with one another, thereby making it impossible for the surgical template to be fabricated.

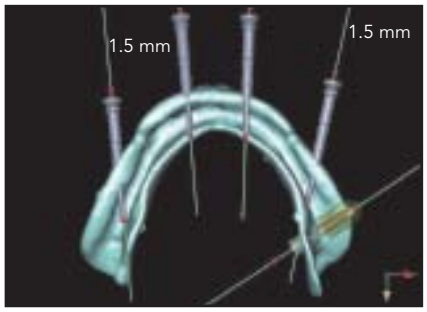


Fig 5 *Intaglio view from the Procera planning program for the secondary surgical template. The single implant was positioned away from the occlusal table, and the surgical template sleeve associated with that implant did not impinge on the mucosa.*

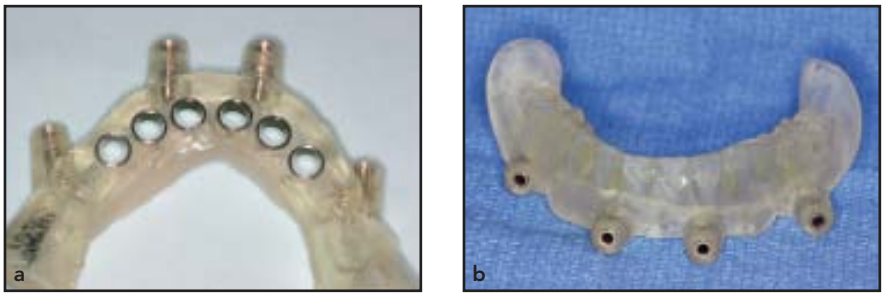


Fig 6 (a) *Occlusal view of the primary surgical template and* (b) *frontal view of the secondary surgical template. Both templates were checked for flashes of the stereolithic material that surrounds the surgical template sleeves for both the implants and anchor pins.*

The first and most important step of this modified protocol is to complete a virtual surgery on the computer that meets all the medical and clinical aspects for implant placement. Once this is accomplished, a minimum of three anchor pins should be positioned to stabilize the surgical template during placement of the implants in a fully edentulous patient (Fig 4). The anchor pins must be positioned more subosseous than the intaglio position of the surgical template sleeves; otherwise, it is not possible to maintain a high level of stability and accuracy with the surgical template in the future stages of this procedure. The surgical template should be ordered as normal through the Procera software system. No stereolithic duplicate of the patient's removable denture is required in this protocol.

After ordering the surgical template, the virtual planning program was reopened for the same patient. After loading, the virtual plan that was used to order the surgical template appeared. Being careful not to alter the position of the anchor pins, all planned implants were deleted, leaving only the anchor pins in view. The goal was to order a secondary surgical template that contained only the anchor pin sleeves in the same position as in the primary surgical template. One problem, however, was encountered—the manufacturer will not produce a surgical template without at least one implant in the virtual plan. To overcome this manufacturing hurdle, a single implant of any type was virtually placed away from the surgical area, ensuring that the stainless steel sleeve accompanying that implant would not impinge on the soft tissue anatomy of the patient (Fig 5). It is ideal to virtually place the implant away from the occlusal table so that the secondary surgical template can also act as the stereolithic duplicate of the patient's removable prosthesis, which, from a laboratory perspective, is critical to the successful production of the screw-retained prosthesis. The secondary surgical template was then ordered independently.

When the two surgical templates arrived from the manufacturer (Figs 6a and 6b), they were sent to the laboratory along with the antagonist model and the occlusal registration that was used at the time of CT scanning. The implant-level master cast was retroengineered from the primary surgical template, as described previously in the literature.[6] It is important to apply an adequate thickness of gingival material in the area of the anticipated alveoplasty when the master cast is poured so

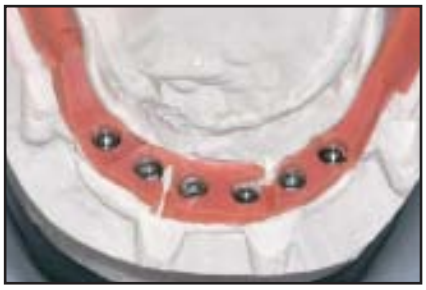
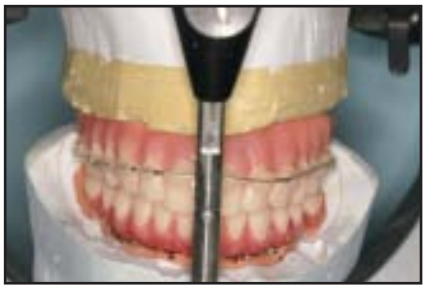


Fig 7 (left) *Modified soft tissue model on the implant-level master cast. The soft tissue model was modified to accommodate a transmucosal abutment with a 1-mm collar.*

Fig 8 (right) *Frontal view of the laboratory-processed screw-retained all-acrylic prosthesis articulated against the maxillary immediate denture.*



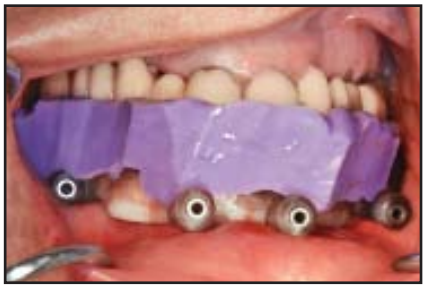
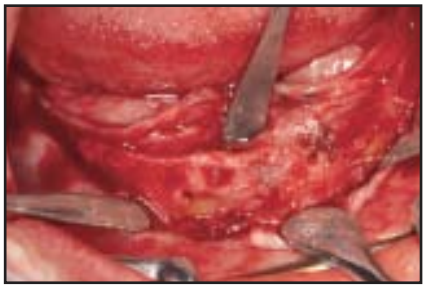


Fig 9 (left) *Placement of the polyvinyl siloxane index between the secondary surgical template and the existing maxillary dentition. This registration was made in the laboratory prior to fabrication of the screw-retained prosthesis.*

Fig 10 (right) *Reflected tissue flaps exposing the "knife-edged" ridge and the osteotomies for the four anchor pins.*

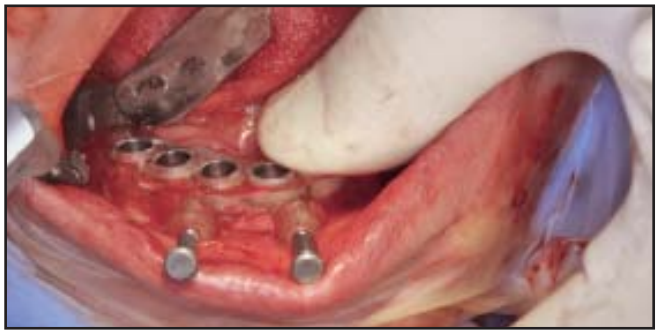


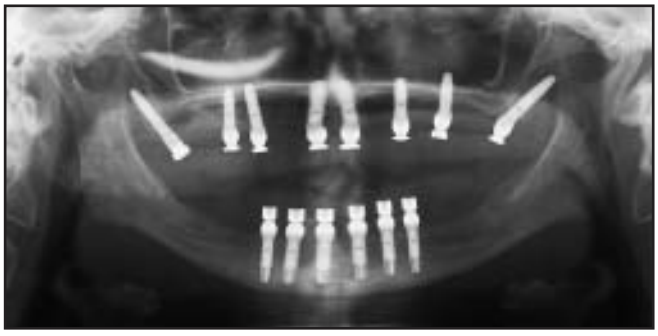
that the prosthesis will more closely approximate the gingival level following surgery. The excess soft tissue replication material (Gingifast Rigid, Zhermack) was removed from the master cast so that approximately 1.5 mm of soft tissue material was above the shoulder of the implant replicas (Fig 7). The stone on the master cast was not modified; therefore, the fit of both surgical templates adapted precisely to the borders of the flanges.

The secondary surgical template was then secured onto the master cast with the anchor pins. Using the occlusal registration from the time of CT scanning, the master cast was articulated against the antagonist cast. In this patient, an immediate complete denture was constructed for the maxillary arch, which was to be placed after the mandibular surgery was completed. Therefore, the laboratory technicians built the prefabricated screw-retained prosthesis against an ideal maxillary plane of occlusion developed in the immediate denture. Transmucosal abutments (Esthetic one, Nobel Biocare) with a 1-mm collar height were placed on the implant-level master cast to bring the prosthetic platform at or just beneath the crest of the gingiva. The screw-retained all-acrylic prosthesis was constructed following the tooth position displayed on the secondary surgical template (Fig 8). A polyvinyl siloxane index (Regisil 2x, Denstply) was fabricated between the patient's current maxillary dentition (ie, what will exist on the day of the mandibular treatment) and both the primary and secondary surgical templates. To maintain accuracy of the provisional acrylic prosthesis to be delivered at the time of surgery, the restoration was fastened securely and stored on the master cast. The abutments that were placed on the master cast to fabricate the provisional prosthesis were removed and sterilized for use following implant placement.

Surgical procedure

After administering local anesthetics, the secondary surgical template and corresponding polyvinyl siloxane index were placed in the patient's mouth against the maxillary dentition (Fig 9). After all anchor pin osteotomy sites were prepared, the pins were removed. The secondary surgical template was also removed and was not needed for the remainder of the surgery. A crestal incision and full flap elevation were performed, exposing the bone and anchor pin osteotomies (Fig 10). A Double Action Rongeur (Salvin Dental) was used to perform the





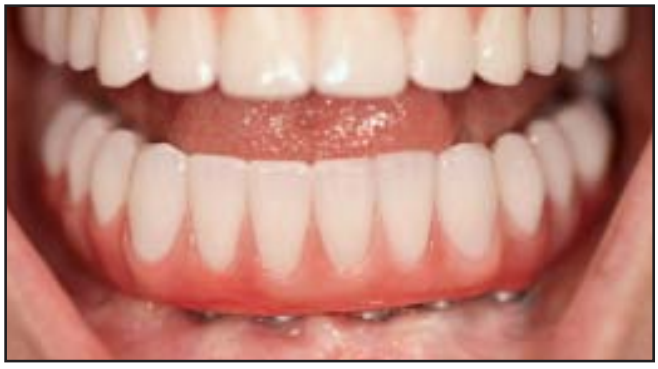


Fig 11 (top left) *Placement of the primary surgical template using the same four anchor pin positions and a polyvinyl siloxane index.*

Fig 12 (top right) *Postoperative panoramic radiograph with the screw-retained all-acrylic prosthesis in place.*

Fig 13 (left) *Clinical view of the mandible 3 months postoperative.*

alveoplasty rapidly, removing enough bone to allow the complete seating of the primary surgical template. However, the alveoplasty should not go all the way to the anchor pin osteotomies to prevent compromising the primary surgical template. Using computer-generated images from the Procera software (see Fig 4) provides a visual guide for the amount of alveoplasty required. This clearly indicates the relative position of the stainless steel surgical template sleeves to the position of the bone.

The primary surgical template was secured using the anchor pins (Fig 11). Then, the standard TIAH protocol for implant site preparation and implant placement was executed. Additional alveoplasty reduced the bone to the shoulder of the implants. The transmucosal abutments used on the master cast to create the screw-retained all-acrylic prosthesis were fastened to the corresponding implants in the patient. Excess mucosa was removed, and approximately 2 mm of tissue thickness remained when the flaps were closed.

Prosthetic procedure

The screw-retained all-acrylic prosthesis was then delivered. Prosthesis fit was checked clinically and radiographically (Fig 12). Figure 13 shows the clinical results 3 months postoperative.

Discussion

The TIAH protocol has elevated implant prosthodontics because it is a prosthetically driven system. Clinicians are now able to place implants with the final tooth position in mind and with a prefabricated prosthesis to connect immediately following implant placement. The original technology is expanding to include the use of osteotomes at the time of implant placement[8] or the delivery of definitive engaging custom abutments.[9] This report expands the horizon further by condensing two surgical procedures (alveoplasty and implant placement) into a single, 1-hour procedure. This technique can be modified to treat patients who

have teeth that need to be extracted with immediate implant placement and immediate prosthesis delivery.

An alternative solution to alveoplasty in "knife-edged" ridge patients is bone augmentation, which would require several months of healing alone prior to implant placement. All grafting procedures are invasive, generally requiring a donor site with its associated morbidity and potential surgical sequelae. It is also known that implants in grafted bone do not enjoy as high a success rate as implants placed in native bone.[10]

With any flap elevation procedure, it is expected that the mucosal tissue will swell slightly from surgical trauma. Therefore, after several months of healing, a gap may exist between the healed level of the mucosa and the intaglio surface of the screw-retained prosthesis. This space can be filled easily in the design of the definitive prosthetic solution.

One immediate improvement to this protocol would be to extend the buccal flange of the removable prosthesis as much as clinically possible to allow for mandibular anchor pin placement. In the current patient, the position of the anchor pins was acceptable for the result expected, but the surgical procedure would have been more efficient if the anchor pin osteotomies were placed closer to or below the intended level of the implant shoulder.

Conclusion

While this modified guided-surgery protocol is no longer a flapless procedure, it does allow two surgical procedures to be performed in the same clinical visit with the delivery of a prefabricated laboratory-processed screw-retained prosthesis. This technique diversifies the candidacy for patient treatment with this specific guided-surgery protocol.

Acknowledgments

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