Three-Dimensional Treatment Planning with Surgical Guides and Mini Implant-Retained Dentures

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At no time in the history of dentistry has the blending of new technologies and concepts given rise to the sheer number of exciting possibilities we face today. For example, implant dentistry has benefited tremendously from the incorporation of 3-D Cone Beam Computed Tomography (CBCT) and the ability to mill a surgical placement guide. It is now possible to take a CBCT scan and, from the resulting data, virtually place mini dental implants in such a way as to maximize the available bone, increase parallelism and avoid vital structures (Figs. 1a, 1b). Planning a case in this virtual environment also reduces surgical and healing time because it allows the doctor to safely utilize a flapless procedure during the actual placement. What’s more, this digital treatment plan can be performed without requiring the doctor to leave his office. With a PC and an Internet connection, he can work through all details of the proposed treatment plan with a skilled digital technician via Web conference. There is no learning curve required to operate the software, as the assisting technician handles this on the doctor’s behalf, repositioning implants as directed with just a few mouse clicks. Adding this kind of technology to your armamentarium will help ensure a smooth surgical outcome and increase patient acceptance of a prosthetically driven treatment plan.

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Mini implants have been used successfully to improve the retention of dentures. With the average age of our population increasing as people continue to live longer, the need to improve patients’ lives with secure full dentures is growing. Many edentulous patients present with inadequate bone width for the placement of traditional implants, which can require 6 mm of bone or more in the buccal-lingual dimension. To reach the necessary bone width, these patients would have to undergo expensive, time-consuming bone grafting procedures. Even if grafting is not required, many elderly patients are dissuaded by the cost and trauma associated with implant surgery. A mini implant, however, can be placed in as little as 3 mm of buccal-lingual bone width. The single-stage placement protocol is simpler and less traumatic. Fewer office visits are required because mini implants allow for immediate loading in the presence of primary stability, which is facilitated by an auto-advancing design that compresses and condenses the surrounding bone rather than drilling it away. In addition, the narrow ridges for which mini implants are ideally suited often leaves them supported on both sides by high-density cortical plate. In terms of affordability, these smaller implants provide a cost-effective solution that enables more patients to move forward with implant therapy, due to the reduced number of parts needed in the surgical and the laboratory phases.

**CASE REPORT**

The patient in this case, a 55-year-old female, had had all her remaining maxillary and mandibular teeth extracted 11 months prior (Figs. 2a, 2b). At that time, she had received conventional maxillary and mandibular dentures. Her chief complaint was that these dentures were nonretentive and nonfunctional, becoming dislodged or falling out whenever she ate or spoke. Although the extractions were recent and she was not a denture wearer for a considerable amount of time, there was already excessive resorption noted in the mandible. Radiographically, bilateral pneumatization of the maxillary sinus was also noted (Fig. 3).

Prior to obtaining a CT scan, reline impressions were taken with Impregum® brand impression material (3M ESPE; St. Paul, Minn.), and the dentures were sent to Glidewell Laboratories (Newport Beach, Calif.) (Figs. 4a, 4b). From that set of impressions, upper and lower dual-scan appliances were fabricated (Figs. 5a, 5b). It is important to note here that the accuracy of each surgical guide depends greatly on the accuracy of the impression taken for each scan appliance. Any reduction in movement of the surgical guide will increase the accuracy and likely success of the final implant placement. Using the GXCB-500™ powered by i-CAT® (Gendex Dental Systems; Des Plaines, Ill.), three CT scans were taken — one of the patient with the scan appliances in the mouth, and one of each scan appliance by itself. From these scans,
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![Figures 4a, 4b: Maxillary and mandibular reline impressions](image1)

![Figures 5a, 5b: Upper and lower arch dual-scan appliances fabricated at Glidewell Laboratories](image2)

the Inclusive® Mini Implants (Glidewell Laboratories) selected for this procedure could be virtually placed utilizing Blue Sky Plan® software (Blue Sky Bio; Grayslake, Ill.).

Next, a Web conference was scheduled with the Inclusive Digital Treatment Planning team. At the time of the actual conference session, the restoratively driven treatment plan was mostly complete. Vital structures, placement paths and parallelism of the implants had already been identified. The Digital Treatment Planning team saves the doctor valuable time by completing most of the tedious tasks in advance. In this case, I confirmed the final implant positions and, with the approved plan, the surgical guides were milled.

For the retention of a maxillary overdenture, it is recommended that six mini implants be placed in the premaxillary region. To retain a mandibular overdenture, no fewer than four mini implants should be placed anterior to the mental foramina. The smaller number of implants required in the mandible is due to the increased bone density...
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Figure 6: Maxillary surgical guide in place

Figure 8: First Inclusive Mini Implant hand-tightened into place

Figure 7: A 1.5 mm diameter pilot drill used to depth

Figure 9: Inclusive Mini Implants rotated to depth using the Inclusive Mini Implant Handpiece Driver

compared to that found in the maxilla. In this case, it was decided that 1.5 mm diameter guide sleeves would be used for the 2.2 mm diameter Inclusive Mini Implants to be placed in the mandible. Due to the softer bone of the maxilla, it was decided that 1.5 mm sleeves would also be used for the thicker, 2.5 mm diameter Inclusive Mini Implants placed there. In denser bone, I would have asked for 1.7 mm diameter sleeves for use in the maxilla.

Even though the placement of mini dental implants is relatively simple and straightforward, a common argument against placing them is that the surgery is performed “blind.” Critics contend that by not raising a flap, as is the recommended protocol when placing mini implants, the doctor cannot accurately gauge the proper insertion path. With a CT scan, however, all of the patient’s anatomy and soft tissue anomalies can be factored into the digital treatment plan. This digital treatment plan is not merely a “best guess”; rather, it provides a true representation of the anticipated clinical outcome. The surgical guide used to translate the virtual outcome to a physical outcome is precisely fabricated by a computer-controlled milling station, and the guide sleeves are placed to tight tolerances. As a result, the opportunity for error during placement is significantly reduced.

The patient was draped, and a clean operating environment was established. A preoperative rinse with Peridex® (3M ESPE) was performed prior to local infiltration with
Cook-Waite Lidocaine® HCl 2% and Epinephrine 1:100,000 (Kodak Dental Systems; Rochester, N.Y.). The upper surgical guide was inserted and stabilized by both the doctor and assistant (Fig. 6). Once a confirmed fit was verified, the 1.5 mm diameter pilot drill was introduced into the guide sleeve (Fig. 7). The guide sleeve orients the pilot drill in the correct trajectory. The top of the sleeves are set at 9 mm from the top of the implant, and this vertical distance must be accounted for when determining proper drill depth. The recommended procedure for unguided site preparation is to drill to a depth that is approximately one-half the length of the implant, plus the tissue depth. In this case, the six mini implants to be placed in the maxilla were each 10 mm in length, so half of that length (5 mm) plus the tissue depth (approximately 2 mm) accounted for 7 mm of drill depth. Adding the 9 mm length for the guide sleeves necessitated an overall drill depth of 16 mm. Each Cortical Bone Drill included with the Inclusive Mini Implant System has depth markings at 10 mm, 13 mm and 15 mm, so drilling to 16 mm meant drilling just past the last mark on the drill.

The drilling process was conducted at 1250 RPM under copious irrigation using the MD 20 Dual Motor System (Nouag USA; Lake Hughes, Calif.). For the best chance of long-term implant success, it is important to minimize tissue damage and thermal trauma to the bone. Because Inclusive Mini Implants are self-tapping, only a single pilot drill is required; no additional finishing bits or bone formers are needed. The implant will follow the path created by the pilot drill and compress and condense the bone to help achieve immediate primary stability. In certain cases, it is possible to engage both cortical plates for even greater stability. All six pilot holes were made following the same process, and the surgical guide was removed. A periodontal probe was used to confirm that all pilot holes in the cortical bone did not perforate in the buccal-lingual dimension.

One at a time, the Inclusive Mini Implants were removed from their sterile packs and glass vials and hand-tightened with the attached carrier until they were difficult to turn (Fig. 8). The Handpiece Mini Implant Driver attachment was then used to gently rotate each mini implant to depth (Fig. 9). Final seating was verified at 35 Ncm using the Torque/Ratchet Wrench included in the Inclusive Surgical Instrumentation Kit.

The same process was repeated for the mandible using the lower surgical guide (Fig. 10). In this case, the Inclusive Mini Implants were 13 mm in length, so the pilot drill was taken to a depth of approximately 18 mm, or almost to the hub. The overall length of the pilot drill from cutting tip to shank is approximately 20 mm. Once again, final seating was verified at 35 Ncm to ensure primary stability (Fig. 11).
Following successful placement of all mini implants, Blu-Bite HP bite registration material (Henry Schein; Melville, N.Y.) was injected onto the intaglio surface of the dentures to help indicate where the dentures would need to be relieved to allow for passive fit over the mini implant heads (Figs. 12a, 12b). An NTT® Universal Cutter pear-shaped bur (Axis Dental; Coppell, Texas) was used to help create the appropriate-shaped spaces (Figs. 13a–13d). The acrylic bur is 2.9 mm wide and cuts a hole that is just the right size for the O-ball head of the mini implant. With a few circular strokes, you can easily widen the hole to accommodate the full O-ring Housing, which is approximately 3.5 mm tall and 4.75 mm wide.

Once the majority of acrylic was removed, Dr. Thompson’s Color Transfer Applicators (Great Plains Dental Products; Kingman, Kan.) were used to mark the tops of the O-balls. Any marks that transferred to the dentures indicated additional acrylic that had to be removed to ensure a completely passive fit (Figs. 14a, 14b).

A soft reline was performed chairside using COE-SOFT™ reline material (GC America; Alsip, Ill.) to stabilize the existing denture during the healing phase. This gives the mini implants a chance to osseointegrate fully before more stressful loads are placed upon them. In a few weeks, a new set of Inclusive Mini Implant Overdentures will be fabricated,
with the O-ring Housings built in. Had the patient been satisfied with the esthetics of her existing mandibular denture, we could have performed a chairside pickup of the O-rings during the same visit, using a hard reline material like Triad DualLine" (Dentsply; York, Pa.). With regard to the maxillary denture, it is preferable to perform a soft reline in order to assure proper osseointegration. Even so, this should take a matter of weeks, rather than months, as in the case of most traditional implants.

A postoperative CT scan was then taken. The cross-sectional slices demonstrate the implants in almost the exact positions proposed by our digital treatment plan. They confirm our preoperative goals of taking full advantage of the available bone while keeping the implants as parallel as possible (Fig. 15). Had we attempted this case without the use of a digitally milled surgical guide, these goals would have been far more difficult to achieve.

CONCLUSION

The Inclusive Mini Implant System, particularly when used in concert with Digital Treatment Planning services, represents an ideal opportunity for general practitioners to become involved in implant dentistry. In today’s repressed economy, offering this kind of valuable, inexpensive treatment enables cost-conscious patients to enjoy the many benefits of secure, retentive dentures. The use of CBCT, digital planning and surgical guides helps to reduce clinician stress, save chairtime and ensure a predictable outcome. The flapless technique allows for minimal patient discomfort and a greater chance for immediate loading — aspects that improve overall client satisfaction. These simplified protocols and conservative procedures are made possible by integrating advanced technology and new materials into everyday implant dentistry.

REFERENCES


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Figure 15: Postoperative CT scan showing parallelism of the maxillary and mandibular implants.