
Before


After


Before


After

Mini Implants for the Masses:

Four Applications of Small-Diameter Implants

by Timothy F. Kosinski, DDS, MAGD

Implant therapy is an optimal treatment option for edentulous patients, addressing several of the challenges that can arise when edentulism is treated with conventional dentures, including problems with prosthetic retention and stability, bone resorption and functional difficulties. Implant-retained overdentures help to elevate the patient's quality of life by dramatically improving retention, stabilizing the denture to improve chewing and speech function, minimizing bone loss, eliminating the need for denture adhesives, and minimizing the sore spots that can result from denture movement.[1,2] Yet many of the edentulous patients who could benefit most from implant therapy cannot receive conventional-diameter implants due to medical complications, anatomical limitations or financial reasons.[3] A majority of edentulous patients are of the age where the minimum amount of bone needed to place conventional-diameter implants is often not present. Additionally, many older patients suffer from medical contraindications that prevent them from undergoing the surgery necessary to place conventional-diameter implants. With many of these patients also facing economic challenges, affordable small-diameter implants can provide an excellent alternative.

Small-diameter, or mini, implants are typically regarded as dental implant fixtures that are less than 3.0 mm in diameter.[4] The surgical protocol for mini implants is minimally invasive, in most situations. They can be used to retain new or existing conventional dentures, which are anchored to the heads of the mini implants via a simple and time-tested O-ring retention system. In addition to long-term stabilization of dentures, mini implants allow for immediate loading in the presence of primary stability and appropriate occlusal loading, meaning that patients can benefit immediately from the increased retention, esthetics and function offered by implant-retained overdentures.

Mini implants act like the root of a tooth to help retain overdentures. With a self-tapping threaded design, Inclusive® Mini Implants (Glidewell Laboratories; Newport Beach, Calif.) are fabricated from titanium and can be used for provisional and long-term applications. They are offered in 2.2 mm, 2.5 mm and 3.0 mm diameters and 10 mm, 13 mm and 15 mm lengths. The integral self-tapping mechanism allows the implant to advance easily through the medullary bone. The body of the implant connects to the prosthetic head with a parallel-sided form. This design contributes to the initial stability of the denture on the implants. This is quickly accomplished by applying a soft lining material to the patient's existing denture, which can typically serve as the temporary prosthesis until completion of the healing phase and delivery of the final denture. Once the implants are engaged into the bone, the existing denture is relieved around the prosthetic heads of the implants. The soft liner allows for increased retention and denture stability. Ultimately, O-rings are incorporated into the final overdenture, which provide long-term stability via retention to the metal balls of the implants.

Where to best put small-diameter implants to use has been a common question. Flap procedures are sometimes contraindicated for patients with significant medical issues, such as those taking blood thinners. Because these implants can often be placed with a flapless surgical technique using small amounts of local anesthetic, the

procedures are relatively atraumatic to the patient. However, it is important to realize that the patient's anatomy must be understood.[5] A full realization of bone quality, quantity and anatomic limitations is crucial in ensuring a successful outcome.

When treating an edentulous patient with implant dentistry, the goal is to improve the form and function of the patient's denture while mitigating the compromised situations presented by edentulism. Because small-diameter implants provide clinical flexibility and address common medical, anatomical and financial limitations, they offer an effective and affordable edentulous solution that expands treatment to the multitude of patients who otherwise could not receive implant therapy.

As demonstrated in the four cases that follow, which employ the Inclusive Mini Implant System to restore edentulous arches for patients with varying degrees of dental and physical health, mini implants are indicated for a wide variety of applications. Collectively, these cases illustrate how mini implants bring about optimal results and expand the availability of implant therapy to patients who can benefit from this treatment in life-changing ways. Furthermore, they show how advancements in dental technology and clinical methodology allow clinicians to approach treatment confident of an esthetic, functional and predictable outcome.

Four Applications of Mini Implants

Case 1: Noninvasive, Flapless Surgery

The first case demonstrates the surgical placement of mini implants using a flapless technique. The patient was an 80-year-old with existing maxillary and mandibular complete dentures and a history of congestive heart failure and heart bypass surgery. The instability of the patient's maxillary and mandibular dentures had decreased his quality of life to the point where he could not enjoy meals with his family.

Providing stability and retention to the patient's mandibular denture was determined to be the best option for restoring oral function. Because his cardiac condition was unstable — and required a steady regimen of blood thinners — the decision was made to keep the procedure as simple and noninvasive as possible, making mini implants the optimal choice. Radiography indicated adequate vertical height of bone for treatment with small-diameter implants. The facial-lingual bone width was determined using calipers, which penetrated the facial and lingual soft tissue and measured the amount of horizontal bone available, which was minimal, but sufficient for mini implants.

After determining proper positioning, the implants were placed with a flapless procedure to minimize trauma to the patient. The procedure was completed without complication and with little or no bleeding. The patient's existing denture was well fitting and thus functioned as a transitional appliance during the healing phase. Immediate stability was achieved following placement of the mini implants, and the patient's existing denture was relieved and relined to fit over the implants, serving the patient well as a temporary with improved retention.

After sufficient time had passed for healing of the soft tissue, a new denture was fabricated based on conventional denture techniques. The implants provided stability and retention to the patient's final mandibular overdenture that restored oral function for the patient to a level he hadn't experienced in years. This optimal outcome was made possible by mini implants, which allowed for the minimally invasive surgical procedure that was necessary in these circumstances, while accommodating the minimal bone thickness of the patient's mandibular arch.

Online

For information on all-inclusive mini implant overdentures, which offer a streamlined clinical workflow and everything needed to restore an edentulous arch, visit the Inclusive® Mini Implant Overdenture page under Dentist, then Services, then Inclusive Tooth Replacement Systems at www.glidewelldental.com.

Figure 1: *Preoperative panoramic radiograph illustrating a small amount of mandibular symphysis bone.*

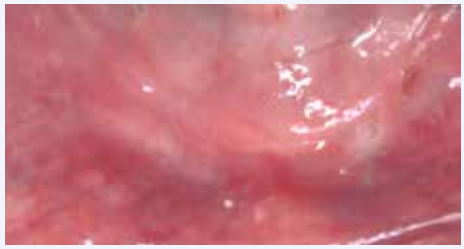

Figure 2: *The patient's mandibular ridge width and vestibule were minimal. Because of the patient's physical challenges and small amount of available bone, mini implants were chosen as the optimal treatment option.*

Figure 3: *To assist with the positioning of the mini implants, an indelible marker was used to apply markings intraorally at the appropriate locations for implant placement.*

Figure 4: *The patient's existing denture, which was well-fitting but minimally retentive, was used to pick up the indelible markings. This confirmed that the selected implant locations were well-positioned to stabilize the patient's existing mandibular denture.*

Figure 5: *A pilot drill was used to penetrate the soft tissue and the cortical plate.*

Figure 6: *The first Inclusive Mini Implant was transferred to the osteotomy site with the included tactile plastic carrier.*

Figure 7: *The implant was initially threaded into place using finger pressure.*

Figure 8: *A torque wrench was used to completely seat the implant into the mandibular bone.*

Figure 9: *The implant was torqued to approximately 35 Ncm, as measured by the torque wrench*

Figure 10: *All four mini implants were surgically placed, following the form of the mandibular arch. A postoperative periapical radiograph confirmed accurate placement of the implants.*

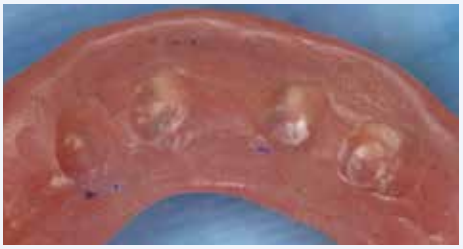

Figure 11: *The patient's existing mandibular conventional denture was relieved to fit over the four heads of the seated implants and serve as a temporary prosthesis until delivery of the final restoration.*

Figure 12: *COE-SOFT™ reline material (GC America; Alsip, Ill.) helped to immediately stabilize the existing denture.*

Figure 13: *A final impression was made with a custom tray to establish the ideal parameters for the final prosthesis. Upon delivery, the final implant-retained overdenture provided excellent stability and significantly improved the patient's ability to chew and speak effectively.*

Case 2: Palateless Maxillary Denture

In the second case, mini implants were placed to stabilize a palateless maxillary complete denture. The patient was a 55-year-old female with no significant health issues. She was apprehensive of dental treatment. In previous treatment provided by another clinician, her nonrestorable maxillary teeth were extracted, and a conventional complete denture was fabricated. This prior treatment was difficult for the patient to tolerate because the palate of the denture provoked her gag reflex. Additionally, the patient's vertical height of bone and short lip line made the labial flange of the denture obtrusive. After a year of wearing the conventional denture, the patient required a better solution for her edentulous maxillary arch.

Financial constraints made conventional-diameter implant placement and restoration prohibitive for the patient. Using her existing, well-made conventional denture as the basis for a mini implant-retained overdenture was a cost-effective option that promised better function and stability.

The decision was made to place small-diameter implants in the patient's atrophic maxilla to support a palateless maxillary overdenture. The patient's sinuses were relatively large, making placement of posterior implants impossible. The premaxillary bone was adequate to accept four small-diameter implants and allowed for proper parallelism to create draw for an implant-retained overdenture. This allowed for removal of the labial flange, thus improving esthetics and function.

Figure 1: *Preoperative panoramic radiograph of edentulous maxillary arch.*

Figure 2: *Intraoral view of edentulous maxilla illustrating excellent vertical bone height.*

Figure 3: *After determining the appropriate position for the mini implants, a pilot drill was used to penetrate the cortical plate of bone.*

Figure 4: *Proper length of the selected implant was verified.*

Figure 5: *The first Inclusive Mini Implant was hand-threaded into the osteotomy site.*

Figure 6: *A torque wrench was used to tighten the implant into position to approximately 35 Ncm, indicating excellent initial stability.*

Figure 7: *The fully seated maxillary mini implant.*

Figure 8: *Subsequent implants were placed parallel to the previously placed implant.*

Figure 9: *The four maxillary implants in final position.*

Figure 13: *An indelible marker was used to help indicate where to relieve the patient's existing denture to accept the soft reline material.*

Figure 17: *Because of the retention provided by the mini implants, the final prosthesis did not require an anterior labial flange, resulting in much-improved esthetics under the maxillary lip.*

Figure 10: *Occlusal view of the four implants ideally placed in the maxillary arch.*

Figure 14: *The markings were transferred to the maxillary denture to help ensure that the existing prosthesis was relieved in accordance with the locations of the seated implants.*

Figure 18: *Occlusal view of the final maxillary overdenture, which was palateless and implant-retained, providing superior retention while resolving the gag reflex issue the patient had experienced prior to implant treatment.*

Figure 11: *Postoperative panoramic radiograph of implants in position.*

Figure 15: *A palateless maxillary overdenture was fabricated using conventional denture techniques and incorporated O-rings for retention.*

Figure 19: *Retracted view of the final maxillary implant-retained overdenture in position.*

Figure 12: *The patient's existing maxillary denture, which was esthetic and stable, was modified to seat over the implant heads and was used as a temporary prosthesis.*

Figure 16: *Healing of the soft tissue surrounding the mini implants after about three months of integration.*

Figure 20: *The retention exhibited by the mini implant-retained overdenture addressed the functional and esthetic challenges of this case, accommodating the high smile line of the patient, who was extremely satisfied with the final restoration and can now wear her denture with comfort.*

Case 3: Guided Surgery

The third case involves the stabilization of a 60-year-old female patient's complete mandibular denture using cone beam computed tomography (CBCT) diagnosis, digital treatment planning and fabrication of a precise surgical guide to optimize positioning of the implants. The patient's maxillary arch had been restored with an implant-retained overdenture several years prior. She wore a conventional mandibular denture that offered little stability or retention. Restoring her mandibular arch with conventional-diameter implants presented financial concerns for the patient. Additionally, the patient's mandible exhibited bone resorption that would have made placement of conventional-diameter implants difficult without bone grafting. Given these factors, a treatment plan was developed for the placement of four mini implants assisted by CBCT scanning, virtual implant placement and the fabrication of a surgical guide.

When circumstances require, CBCT diagnosis allows visualization of the patient's available bone in three dimensions and virtual placement of the implants prior to any surgical intervention. CBCT scanning has quickly become an important tool in the diagnosis and treatment of implant cases and the positioning and placement of dental implants, especially when the surgical site is compromised or the experience of the practitioner is limited. Conventional radiography does not always provide a precise understanding of the patient's underlying anatomy. Potential risks involved in surgical placement are minimized when vital anatomy and bone contours are clearly understood.

Surgery was performed using a precise surgical guide fabricated using CBCT technology and digital treatment planning. The procedure was less invasive and more predictable because there was no need for a full-thickness flap procedure. The flapless approach is obviously more comfortable for the patient and allows for improved postoperative healing.

To create the scan appliance needed for CBCT scanning and surgical guide fabrication, the patient's existing denture was duplicated. This can be accomplished when the existing denture is well-fitting and esthetic, with properly positioned teeth. The scan appliance, or radiographic guide, was placed in the patient's mouth during the CBCT scan, which allows the clinician to visualize the ideal position of the prosthetic teeth in a three-dimensional model. The 3-D image was analyzed, and the placement of the implants was virtually planned and simulated using treatment planning software. The surgical placement of the implants was performed using the surgical guide to help direct the drills to the ideal predetermined positions.

Immediate stability was established upon placement of the implants. The patient's existing denture was modified to serve as a stable transitional prosthesis. After approximately three months of integration, O-rings were processed into a new mandibular overdenture, and delivery of the final restoration achieved the stability, retention and function the patient had been sorely lacking prior to implant therapy.

Although the placement of mini implants is a relatively simple procedure, the clinician must understand the patient's anatomy, including the quantity and quality of the bone, as well as the location of critical landmarks such as the inferior alveolar nerve. When visual inspection and conventional radiography do not offer an adequate understanding of the underlying anatomy, a soft-tissue flap can be reflected. If a flapless surgical approach is selected, CBCT scanning and digital treatment planning can be used to visualize the underlying anatomy in a virtual setting.

Figure 1: *The atrophic mandibular bone would have made placement of conventional-diameter implants difficult without invasive grafting procedures.*

Figure 2: *Because the patient's conventional mandibular denture was well-fitting and esthetically acceptable, it was duplicated to create the scan appliance.*

Figure 3: *A radiographic guide was fabricated by duplicating the patient's existing denture and placing several radiopaque markers (points filled with gutta-percha) in three planes.*

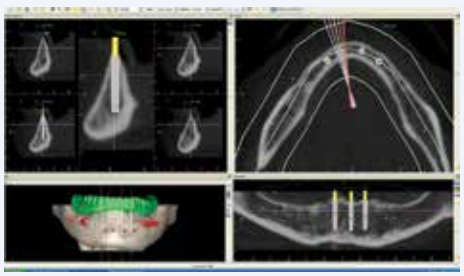

Figure 4: *The completed preoperative CBCT scan allowed for the precise virtual placement of four small-diameter implants in the patient's edentulous mandible.*

Figure 5: *A stable surgical guide was fabricated by the laboratory using CBCT scanning and digital treatment planning technology. This allowed for precise positioning of four mini implants in the edentulous mandible.*

Figure 9: *This flapless procedure resulted in ideal positioning of the implants with little or no bleeding during surgical placement.*

Figure 13: *Impression copings were snapped onto the mini implant O-ball heads intraorally.*

Figure 6: *A pilot drill was used to penetrate the dense cortical plate and establish each predetermined implant length.*

Figure 10: *The subsequent implants were placed with ease, adhering precisely to the predetermined positioning established via digital treatment planning.*

Figure 14: *An accurate impression was made, including impression copings that conveyed the positions of the implants to the laboratory, allowing for fabrication of a master cast with implant analogs.*

Figure 7: *Each Inclusive Mini Implant included a plastic carrier for transferring the implant to the osteotomy site and for initial hand tightening.*

Figure 11: *Immediate postoperative photograph of the four implants placed in the symphysis of the mandible.*

Figure 15: *The master cast was fabricated, incorporating a soft tissue model and embedded mini implant analogs.*

Figure 8: *The implants were threaded into position parallel to one another. Note how the head of the fully seated implant extends through the tissue into the oral cavity.*

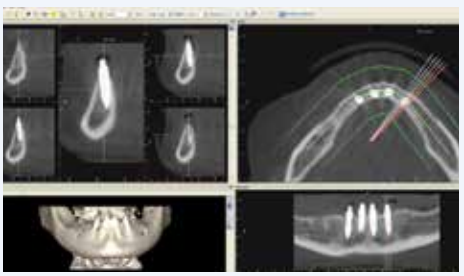

Figure 12: *Postoperative CBCT scan illustrates ideal positioning of the four implants.*

Figure 16: *Conventional stable record bases and occlusal rims were fabricated.*

Figure 17: *O-ring housings, which provide retention by attaching to the O-ball heads of the mini implants, were processed into the mandibular denture.*

Figure 18: *Occlusal view of the mandibular implant-retained overdenture in position. Full denture borders were created. This appliance is implant- and tissue-supported.*

Figure 19: *The patient was extremely pleased following delivery of the final implant-retained overdenture, which effectively restored function to her lower arch.*

Patients can benefit immediately from the increased retention, esthetics and function offered by implant-retained overdentures.

Case 4: Atrophic Mandible

The fourth case also involves the restoration of a mandibular arch with an implant-retained overdenture. However, in this case, the oral anatomy of the patient required the use of a full-thickness flap to visualize the bone morphology and optimize the positioning of the mini implants to ensure they were placed in as much bone as possible.

The patient was a 60-year-old female who suffers from Wilson's disease. Her symptoms included, but were not limited to, facial tremors and involuntary facial movements, which made wearing a conventional mandibular denture impossible. In situations where there is a minimal amount of bone, or where the clinician cannot be absolutely sure of the bone morphology, a flap should be raised to allow for exact placement of the implants at the correct angulation. Though a panoramic radiograph allows for adequate visualization of the vertical height of bone, the facial-lingual thickness is most easily determined by observing it when the soft tissue is elevated away.

It is crucial that clinicians exercise caution and fully understand the patient's underlying anatomy before surgically placing implants. Soft tissue can be deceptive. Without complete control of the situation, the implant may be placed farther to the lingual than the actual bone can accommodate, leading to potential trauma or related adverse effects.

After raising a flap to visualize the bone and facilitate proper positioning and angulation of the implants, the implants were placed without complication. The implants and surrounding areas were visually inspected and radiographs were taken to ensure proper positioning.

Following integration of the implants, a final impression was taken, which picked up the impression copings and accurately conveyed the positions of the implants to the laboratory. After approximately three months, the soft tissue surrounding the mini implants had healed. The final prosthesis was delivered and the O-ring retention system provided the stability and function the patient had lacked prior to implant therapy.

Though the minimal amount of bone thickness made this a challenging case, it is important to note that conventional-diameter implants could not have been placed due to the narrowness of the mandibular ridge, making mini implants the optimal option for long-term stabilization of the patient's lower denture.

Figure 1: *Preoperative panoramic radiograph illustrating adequate bone height in the anterior portion of the mandible.*

Figure 2: *Intraoral view of the patient's atrophic mandible.*

Figure 3: *A periodontal probe was used to verify minimal width of bone in the area being considered for dental implant placement.*

Figure 4: *Due to the narrowness of the mandibular ridge, a flap procedure was necessary, beginning with a crestal incision and two broad relieving incisions.*

Figure 8: *Following placement, accuracy of the implant's position was confirmed both visually and radiographically. When positioning of an implant is not ideal, the implant should be removed and repositioned.*

Figure 12: *An immediate postoperative panoramic radiograph confirmed that the implants were placed in proper position.*

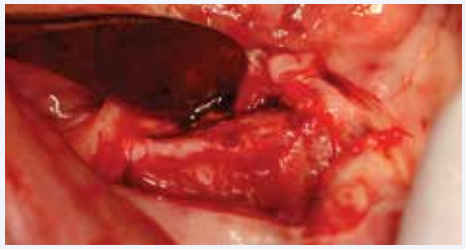

Figure 5: *The flap was elevated, revealing the narrowness of the bone and providing the visualization and access needed to ensure proper placement and angulation of the mini implants.*

Figure 9: *The second implant was placed parallel to the first.*

Figure 13: *Conventional denture techniques were used in the fabrication of the definitive prosthesis, including the determination of facial form with stable occlusal rims.*

Figure 6: *A pilot drill was used to penetrate the dense cortical plate. Great care was taken to ensure proper facial-lingual positioning of the osteotomy site.*

Figure 10: *All four mini implants in position. Again, note the narrow width of the existing bone. Without raising a flap for this procedure, it would have been difficult to properly place the implants.*

Figure 14: *After integration, impression copings were attached, snapping easily onto the heads of the mini implants.*

Figure 7: *The first mini implant was initially threaded into position using finger pressure and then tightened with a torque wrench to achieve complete seating.*

Figure 11: *Facial view of the parallel-positioned implants. The gingiva at the surgical site was sutured around the implants.*

Figure 15: *This lateral view of the seated impression copings illustrates the placement of implants along the arch of the ridge, which improves stability and retention.*

Figure 16: *Light-body polysiloxane impression material was injected around the impression copings.*

Figure 17: *A clean final impression was made, picking up the impression copings. Using a custom-fabricated impression tray provides a nice working model for the laboratory technician.*

Figure 18: *Laboratory analogs were used to mimic the positions of the implants in the patient's mouth.*

Figure 19: *After three months, the soft tissue had healed nicely around the small-diameter implants, and the final prosthesis was ready for delivery.*

Figure 20: *Conventional maxillary complete denture opposing the stable implant-retained mandibular overdenture. Mini implants restored function and dramatically improved quality of life for the patient, who otherwise would not be able to effectively wear a lower denture.*

Conclusion

Many patients who have been edentulous for several years lose both vertical and horizontal bone. This lack of a stable base makes wearing a conventional maxillary or mandibular denture unbearable or uncomfortable. As a result of the impaired oral function associated with bone resorption and prosthetic instability, many edentulous patients experience a decrease in their quality of life.

Traditional dental implant designs can be used in circumstances where there is adequate bone quantity and quality. The symphysis often offers stable bone in the mandibular anterior region, and the premaxilla anterior to the sinus cavities often provides enough bone for dental implant placement. However, many patients do not have adequate bone width to accept conventional endosseous implants, or the cost of such procedures is prohibitive to the patient. Small-diameter implants address these issues by providing increased stability and retention at a significantly reduced fee to the patient.

As demonstrated in the four cases presented here, the applications and benefits of mini implants provide an opportunity to significantly improve the quality of life for edentulous patients.

The applications and benefits of mini implants provide an opportunity to significantly improve the quality of life for edentulous patients.

Patients receive a stable and retentive denture that provides immediate function, improving speech and chewing capabilities while addressing many of the esthetic issues brought about by edentulism. This service is nothing short of life-changing for the countless patients who would otherwise be unable to experience the tremendous benefits of implant dentistry. **IM**

Acknowledgment: *The author would like to thank Dr. Ray Skowronski (Sterling Heights, Mich.) for the prosthetic work he performed on Case 3.*

REFERENCES

1. *Rossein KD. Alternative treatment plans: implant-supported mandibular dentures. Inside Dentistry. 2006;2(6):42-3.*
2. *Agliardi E, Panigatti S, Clericò M, Villa C, Malò P. Immediate rehabilitation of the edentulous jaws with full fixed prostheses supported by four implants: interim results of a single cohort prospective study. Clin Oral Implants Res. 2010 May;12(5):459-65.*
3. *Christensen GJ. Critical Appraisal. Mini implants: good or bad for long-term service? J Esthet Restor Dent. 2008;20(5):343-8.*
4. *Shatkin TE, Shatkin S, Oppenheimer BD, Oppenheimer AJ. Mini dental implants for long-term fixed and removable prosthetics: a retrospective analysis of 2514 implants placed over a five-year period. Compend Contin Educ Dent. 2007 Feb;28(2):92-9.*
5. *Jackson BJ. Effective denture stabilization in an atrophic mandible. Dent Today. 2012 Feb;31(2):130, 132-3.*