



Overdenture Implants

A Simplified and Contemporary Approach to Planning and Placement

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Disclosure: Dr. Scherer is a clinical consultant to ZEST Anchors, Biomet 3i, Keystone Dental, and 3M ESPE.

INTRODUCTION

Implant overdenture treatment is safe, predictable, and effective. It has maintained its popularity throughout the years,

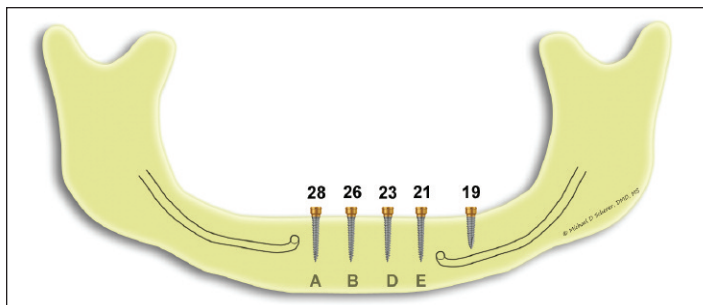


Figure 1. Mandibular implant positions are based upon interforaminal regions (A, B, D, E) corresponding to teeth Nos. 28, 26, 23, and 21. In many clinical situations, insufficient bone exists to place implants posterior to the mental foramina (**left**) limiting distribution of implants. In some clinical situations, sufficient bone exists in the first molar region (**right**), giving wider distribution of implants.

even with the advent of new technology and a growth in the number of patients desiring fixed prostheses. Many practitioners might say, "Why bother learning more about implant overdentures? It's so simple!" Well, certainly on the surface, diagnosis and treatment planning for implants to retain and/or support an overdenture is fastidious and simple. However, implant overdenture treatment, amazingly, is still performed without regard to a few simple measurements and basic precautionary steps to ensure surgical and restorative success. The biggest challenge is not the fact that new technology is carving away at the dental landscape; the challenge remains in the hands and minds of the clinicians. Does the clinician feel comfortable or confident in implementing technology? For some, the reality of a digital world is an uncomfortable one, but for most, this approach is welcomed. The latest approaches to digital treatment planning do not need to be difficult—the key is to make it a straightforward process. Integrating a contemporary approach to treatment planning, and placing dental implants for implant overdenture therapy, is a simple addition into a clinician's normal routine.

Implant Overdenture Positions

Implant positions for implant overdenture therapy are varied and seemingly arbitrary; many base their evidence upon empirical information without evidence-based dental theory. The obvious comment many make is "I put them where the bone was!" yet it results in a less than favorable prosthetic outcome.

To enhance physical properties, such as antero-posterior stability and retention, implants should be placed to maximize anterior and posterior distance between implants.¹⁻² Maximizing implant distribution, number, and parallelism between

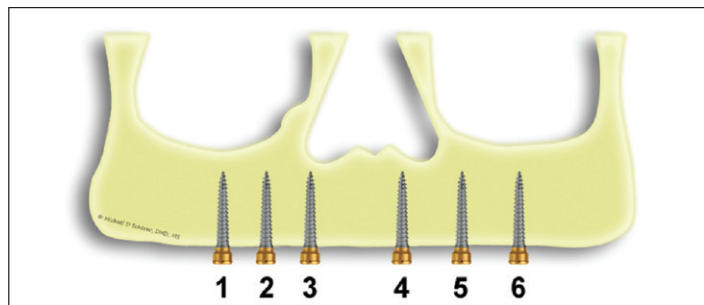


Figure 2. Maxillary implant positions are based upon bone availability. In maxillary edentulous ridges, insufficient bone may exist as the midline or sinus walls are approached (**left**). If bone volume allows, placement of implants farther apart gives a wider distribution of implants (**right**).

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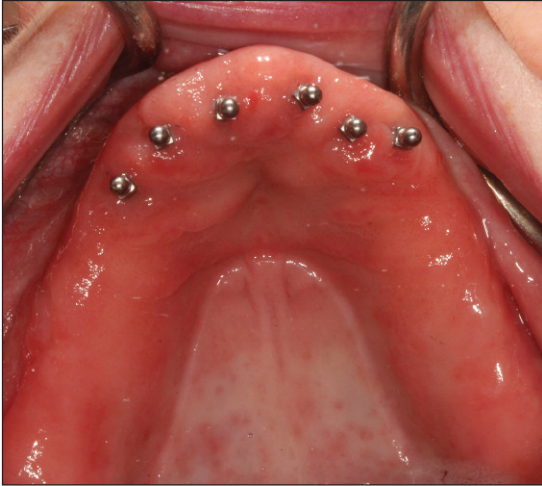


Figure 3. Multiple prosthetic problems result from implants placed with a narrow distribution and poor angulation, including the following: generalized edema of soft tissues, hypertrophy, ulcerations, candidiasis, and a burning sensation.

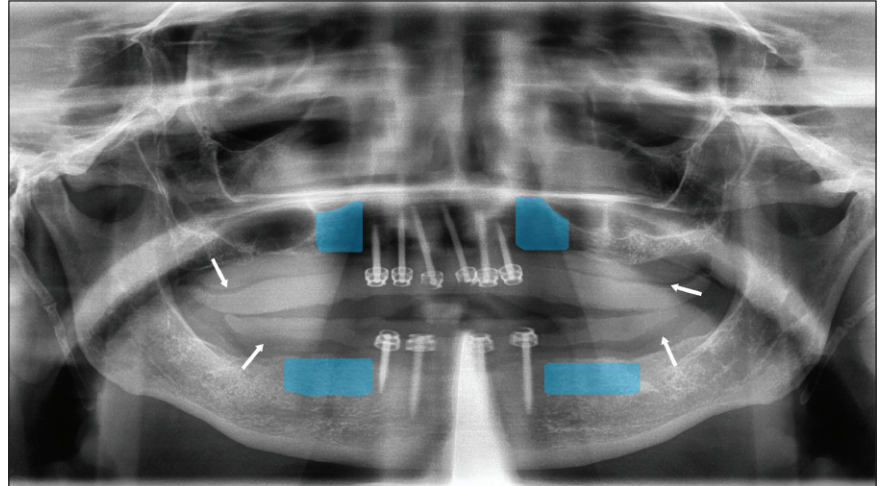


Figure 4. Panoramic radiograph of the patient in **Figure 3** showing sufficient bone distal to the implants in both the maxillary and mandibular arches (blue shaded area). White arrows indicate antero-posterior rocking of the complete denture due to poor adaptation and limited distribution of implants.

implants results in a restoration with less antero-posterior movement, greater lateral stability, and enhanced patient satisfaction. Adequate bone volume and the presence of critical anatomical structures, such as nerves, vascular structures, or sinus cavities, can limit the number and distribution of implants.

Implant positions for the mandibular arch are often limited to the anterior, interforaminal portion of the mandible. This is typically compounded by years of denture or partial denture use resulting in substantial posterior ridge resorption. As a result, implants are placed in positions in the anterior mandible (A, B, D, E) representing teeth positions Nos. 28, 26, 23, and 21, respectively (**Figure 1, left**). For 2 implant overdenture restorations, optimal implant positions are at A (No. 28) and E (No. 21), allowing for maximum anterior-posterior (A-P) distribution. For 4 implant overdenture restorations, implants should be placed at the premolar and lateral incisor positions (Nos. 21, 23, 26, and 28). In the opportunity where posterior bone volume permits the placement of a shorter, wider dental implant, an implant placed in the first molar region (No. 19 or No. 30 tooth positions) results in optimal implant distribution (**Figure 1, right**). If feasible to place implants in the first molar region, the ideal position for the anterior implants is in the lateral incisor positions (Nos. 23 and 26). By placing implants in the first molar and the lateral incisor regions, the clinician can best enhance the A-P distance between implants, resulting in maximum stability of the prosthesis.

Implant positions for the maxillary arch are limited by

sinus walls, arch shape, and bone angulation. Ideally, 4 to 6 widely spaced implants should be placed (**Figure 2, right**). Distinctly different from that of the mandibular arch, implant position in the anterior maxilla is limited due to angulation of the residual bone. In compromised situations, the anterior maxilla is a high-risk place for implant placement, and posterior implant positions should be considered (**Figure 2, left**). Additionally, the placement of 2 implants in the edentulous maxilla is contraindicated due to a multitude of factors, including bone density and overload, soft-tissue impingement, angulation, antero-posterior rocking, and accelerated attachment wear. The ideal position of dental implants for overdentures should be as parallel as is possible; however, one should not sacrifice antero-posterior distribution because of a slight angulation of implants. Contemporary implant abutments and housings allow for up to 40° of angulation between implants to accommodate divergent bone volumes (LOCATOR [ZEST Anchors]). Ideally, implants should be placed as widely distributed as possible to enhance retention and stability of the overdenture (**Figure 2, right**).

Integrating Technology

Until recently, the fastest, simplest diagnostic method was to utilize a 2-D panoramic radiograph combined with ridge mapping and/or bone-sounding with calipers. Merging clinical diagnostic information meant using gross estimates and ultimately surgical experience to transfer the presurgical plan into the surgical procedure. Historically, these traditional

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clinical techniques were recommended for treatment planning, and placing narrow-diameter implants was fraught with challenges related to coordinating the proper surgical and prosthetic positioning of implants. Even with extensive presurgical planning, clinicians would find themselves “erring on the side of caution” during surgical procedures.

While it is understandable to be cautious, especially when using generalized clinical estimates, the ultimate results may confound with the desired prosthetic goals. **Figures 3 and 4** show a clinical example of narrow-diameter implant placement for a maxillary and mandibular overdenture. The clinical presentation illustrates a patient treated with narrow-diameter implants who was not satisfied with the stability of her maxillary denture. Freehand implant placement, without the use of a pilot guide or computerized-guided surgery, ultimately resulted in implant placement far anterior to where the implants should have been placed. In addition, the palate was removed, reducing the support and stability of the prosthesis, resulting in soft-tissue irritation (**Figure 3**). Having sufficient A-P spread of the implants by placing more posterior (**Figure 4, blue shaded area**) would have ensured less movement and rocking of the maxillary prosthesis (**Figure 4, arrows**).

Traditional methods for site assessment for implant treatment planning include the following: finger pressure assessment with ridge mapping (**Figure 5**), bone sounding, and the use of panoramic radiographs combined with metallic markers in proposed implant positions. While these methods can be effective as a diagnostic assessment, they are also subject to a high level of clinical variability and gross estimation. Additionally, this approach is cumbersome and uncomfortable for patients to endure, often requiring anesthesia during bone sounding procedures. Based upon these techniques, a clinician would need to make a generalized

assessment about bone width based upon experience and clinical judgment. This method may ultimately result in a clinician choosing a standard-diameter implant with a diameter that cannot be easily accommodated during surgical procedures when a narrow-diameter implant would otherwise be indicated. The axiom “Failing to plan is planning to fail” is a statement that resonates through clinical practices throughout the world. The new reality is that a contemporary dental mindset allows us to incorporate the latest technology that gives a superior amount of information without having to make it too difficult or complicated for everyday clinical use.

A Contemporary Approach

Incorporating CBCT into private practice has gained popularity as it allows for 3-D evaluation of bone volume and prosthetic volumes. Additionally, combined with the latest in dental implant planning software, optical scanning, and surgical guide production, the technology currently available to clinicians is astounding.

Utilizing the latest in CBCT, implant software, and optical imaging technology allows the clinician to rapidly assess the combination of bone volume and prosthetic volume analysis. CBCT imaging allows for visualization of critical anatomical structures and provides a superior amount of information compared to conventional panoramic radiography.³⁻⁶ Employing “crown-down” planning of implants is highly effective.⁶⁻⁸



Figure 5. Ridge mapping using bi-manual approach.

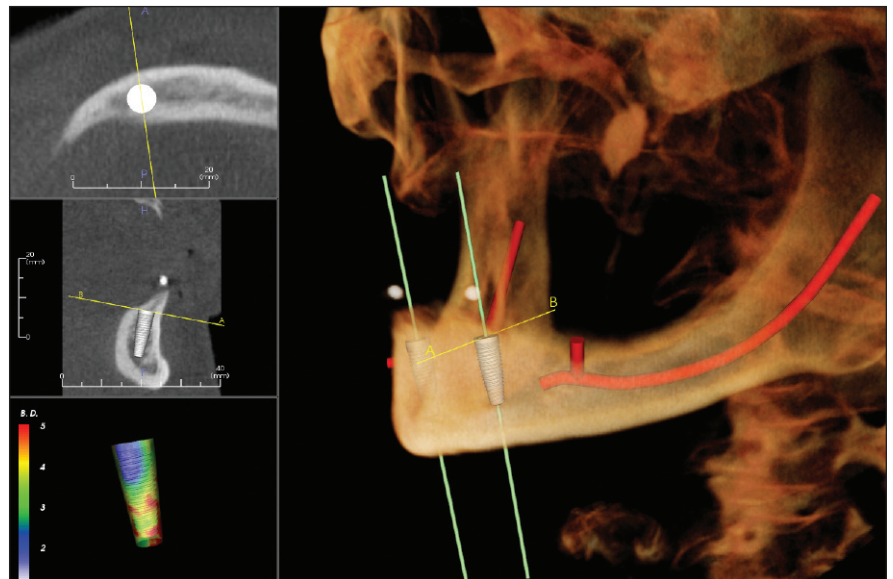


Figure 6. Software rendering of CBCT radiograph allows for virtual implant positions according to bone volumes only with insufficient restorative information (Invivo [Anatomage]).

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Sufficient visualization and orientation of tooth position, angulation, and space for implant components is essential during treatment evaluation for implant overdentures.⁹⁻¹⁰ Errors in treatment planning can be prevented by establishing a restorative plan prior to placing implants.

Traditional CBCT imaging techniques, for edentulous patients interested in implant stabilization, involve either referring to an imaging center or making a CBCT radiograph within the dental practice. After the radiograph is made, the images are processed into dental imaging software (Invivo [Anatomage]), and the implants are planned according to available bone within the virtual rendering of the bone volume (Figure 6). While this method of radiographic interpretation gives information regarding bone volume quality and quantity, it gives little information regarding the restorative plan. Alternatively, a radiographic template, such as a barium guide, can help with implant positions (Figure 7). This traditional method is effective; however, it requires 2 clinical appointments, first to make an impression of the denture, and a second to fit the radiographic guide to the soft tissues. Additional laboratory costs, associated with duplicating the denture into barium sulfate, are also required with this method.

A contemporary method of radiographic imaging has been previously described involving the use of soft-tissue and tooth separation techniques.⁸ These novel methods employ a simple, out-of-the-box concept that involves creating an air pocket around a complete denture to allow for visualization of the denture in the CBCT software.

This article presents 2 clinical case reports that aim to demonstrate this contemporary approach to treatment planning and placing dental implants for overdentures.

CASE 1

A Simplified, In-House Pilot Guide Approach

Many clinicians want a simplified, noncomputerized, guided-surgery approach to facilitate implant positioning during surgical procedures. Additionally, these same clinicians may feel that computerized guided surgery greatly adds to complexity and, due to the additional steps, delays surgical treatment. However, these same clinicians may also acknowledge the greatly enhanced diagnostic information available with CBCT imaging and utilize it on a routine basis. Often, the biggest challenge to clinicians using CBCT images for diagnosis is visualizing restorative plans, soft-tissue profiles, and transferring the virtual implant placement to surgical procedures. Incorporating a *radiopaque* vinyl polysiloxane (VPS) impression material (Green-Mousse [Parkell]) on the intaglio surface of the complete denture with a CBCT scan greatly en-



Figure 7. Barium sulfate and acrylic resin duplicate of the patient's maxillary denture gives adequate radiographic interpretation of restorative outline but requires 2 appointments and a laboratory expense.



Figure 8. Edentulous mandibular arch with a narrow anterior ridge.



Figure 9. Radiopaque VPS (Green-Mousse [Parkell]) placed on intaglio surface of complete denture, cotton rolls applied, and a CBCT scan made with soft-tissue separation.

hances this visualization.

An edentulous patient presented, desiring implants to help retain his loose lower complete denture (Figure 8). In conjunction with Andrew Ingel, DMD, and the University of Nevada, Las Vegas Implant Overdenture 101 curriculum, the patient was accepted into a surgical educational program and planned for four 2.9-mm narrow-diameter implants (LODI [ZEST Anchors]). A reline impression was made of the edentulous ridge using a radiopaque VPS impression material, and cotton rolls were placed to separate the cheeks and tongue from the outside cameo denture surface (Figure 9). A CBCT scan was made of the patient, and the images were processed. Upon completion of the processing, the radiopaque VPS was removed and a clear duplicate of the complete denture was fabricated for use as a surgical guide.

The patient's CBCT Digital Imaging and Communications in Medicine (DICOM) files were imported using the planning software (Invivo), and then evaluated for bone volume and densities. The mandibular nerve was traced to enhance

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visualization and to ensure a safety zone around this critical structure. Virtual implants were planned in teeth positions Nos. 19, 23, 26, and 30 to achieve ideal distribution of implants to enhance retention and stability of his overdenture prosthesis. Visualization of the tooth position was achieved by utilizing unique visual thresholding controls within the planning software to enhance the bone volume at the same time as the denture surface (Figure 10). In this particular software package, thresholding is considered “brightness” adjustment in conjunction with the “bone” rendering module. The “brightness” changes the way the software is interpreting the images from the patient’s CBCT scan; increasing this value increases the amount of visual information reported to the software, giving the feeling that “more is visible.” Additionally, with simple mouse controls, the image is rotated around to see the green lines, indicating the long axes of the dental implants in relation to the patient’s complete denture (Figure 11). Once satisfied with the placement of the implants in relation to the bone volume and restorative outline, the occlusal surface of the denture was visualized in the software at a perpendicular angle to the occlusal plane (Figure 12). Having the occlusal surface visualized in this orientation gives the clinician the opportunity to see the green long axes of the proposed virtual implants in relation to the patient’s denture. The acrylic resin duplicate of the patient’s denture was placed onto a commercially available drill press and a surveyor table to allow for free tilting of the guide. A 1.6-mm drill was used to prepare a hole through the guide, corresponding to the positions and long axes of the proposed implant positions indicated by the 3 CBCT images made of the patient wearing the complete denture (Figure 13). Using the information from the CBCT scan images, the clinician can best approximate the bucco-lingual tilt of the implants (Figure 10), the A-P angulation (Figure 11), and the implant positions in relation to denture tooth anatomy (Figure 12).

The surgical guide was placed on the edentulous ridge and complete tissue adaptation was confirmed. The patient was anesthetized and long axes of the proposed implant positions were marked using a periodontal probe. The guide was removed and a bleeding point confirmed the proper implant position on the edentulous ridge. The guide was placed back onto the ridge and the 1.2-mm pilot drill was used through the holes in the surgical guide until it reached a firm stop on the surgical guide, corresponding to 8 mm of penetration through the edentulous ridge (Figure 14). During the laboratory surgical guide preparation, a slightly larger 1.6-mm surgical drill was used to create the pilot drill holes, giving the clinician slightly more tolerance to the drilling sequence, minimizing any binding of acrylic resin with the drill during the initial step in osteotomy

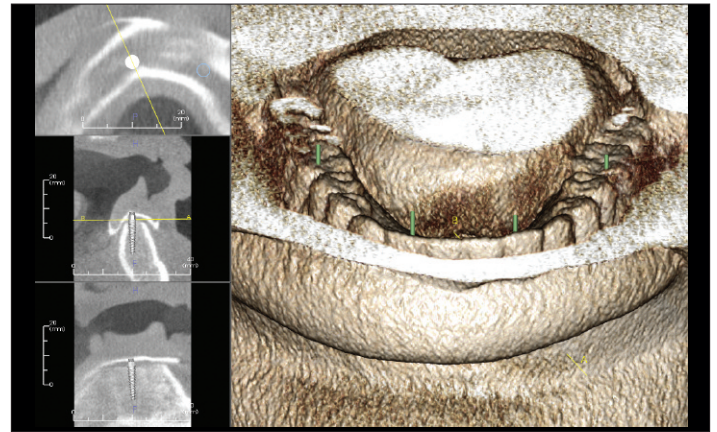


Figure 10. Virtual implants are placed according to bone volume and tooth position within computer software.

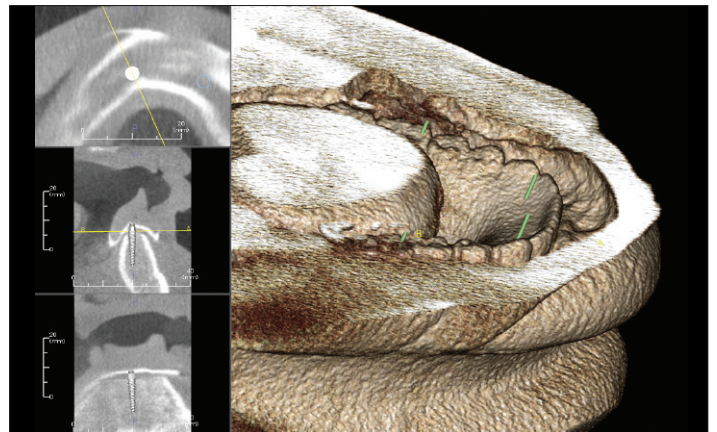


Figure 11. The software is manipulated to visualize the anterior-posterior tilt of the implants in relation to the patient's denture.

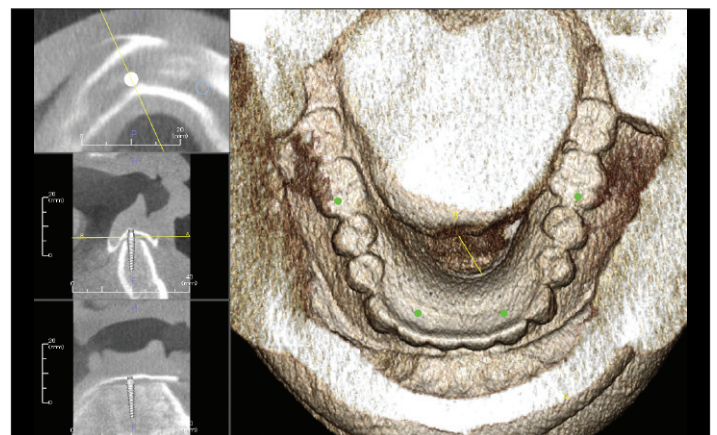


Figure 12. The software allows a perpendicular orientation of the occlusal surface of the denture, giving the clinician visualization of the proposed implant positions in relation to the anatomical structures of the denture.

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preparation. Based upon average soft-tissue thicknesses of 2 to 3 mm, approximately 6 mm was prepared into the bone crest, giving the ideal depth for marking the site and using a rotary tissue-punch procedure. The initial penetration of the pilot drill within the bone was intentionally made short, giving the opportunity to verify and/or correct the parallelism among the 4 implants without having to arbitrarily enlarge the osteotomy. The guide was removed and surgical procedures were completed. Using directional indicators placed in the osteotomies prepared with the assistance of the guide to ensure parallelism, a series of drills was used to prepare the final osteotomies, sequentially increasing the diameter until fully prepared. The implants were placed and abutments placed on the implants (Figure 15). A simplified yet complete armamentarium is also critical to increase office efficiency with prosthetic procedures (Figure 16). Having the right instruments to facilitate attachment of the denture housings to the denture after implant placement is critical, and this makes a frustrating 2-hour procedure no more than 30 minutes and stress-free. Using a contemporary denture recess preparation kit (Denture Prep & Polish Kit [ZEST Anchors]) and an attachment processing resin with minimal shrinkage and easy application (Chairside APM [ZEST Anchors]) simplifies final prosthetic conversion of the denture into an overdenture (Figure 17).

This simplified version of an “in-house pilot guided surgery” provides 2 important aspects of surgical guidance. First, it provides a location for the implants on the edentulous ridge; second, it provides pilot holes for all 4 implants at the same angulation. While the remainder of the surgical procedure is completed without the use of the guide, the precision and distribution of implant placement is superior to that of a traditional approach without the use of a guide. Emphasis must be advised that this produces a pilot drill guide and relies upon the clinician preparing the initial osteotomy with this guide, completing the additional sequential osteotomies by freehand. This method uses the virtual plan to allow for a free-form control of the clinician during implant surgical procedures to best approximate the implant positions with the assistance of the “in-office pilot guide” created by transferring angulation and implant positions from the CBCT plan to the guide.

CASE 2

A Simplified, Computerized Guide Approach

While the simplified, noncomputerized guided surgery is beneficial, many clinicians want to be able to utilize computerized guided surgical techniques to facilitate implant procedures. These clinicians utilize the computerized guide to be able to provide a precise, flapless approach to implant

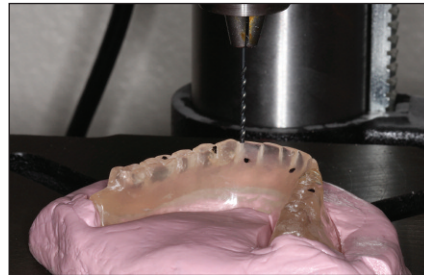


Figure 13. Holes are prepared through a clear duplicate of the patient's denture using a 1.6-mm drill corresponding to the implant positions and angulation in the virtual plan, illustrated in **Figures 10 to 12**.

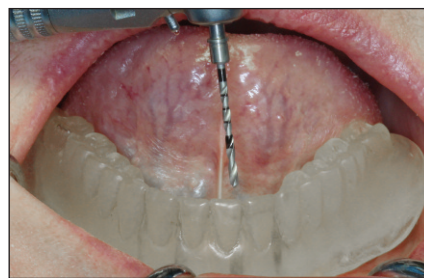


Figure 14. Initial osteotomy is prepared using the pilot drill through the holes in the clear surgical guide. The guide is removed, final osteotomy holes are prepared, and implants are placed (LODI [ZEST Anchors]).

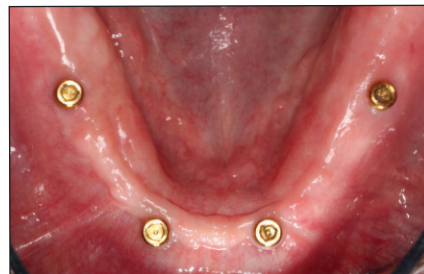


Figure 15. The abutments (LOCATOR [ZEST Anchors]) were placed on the implants.



Figure 16. A simplified yet complete armamentarium with efficient organization of denture preparation materials (Denture Prep & Polish Kit [ZEST Anchors]) and an attachment processing resin (Chairside APM [ZEST Anchors]) greatly facilitates prosthetic conversion.



Figure 17. Final prosthetic appearance of the patient's denture. Note the wide distribution of implants and abutments. Retention and stability in this clinical situation is extremely favorable.

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placement while ensuring maximal A-P distribution of implants while maintaining safety around critical anatomy. As previously mentioned, the maxillary sinus and mandibular nerve are 2 structures that may interfere with implant placement procedures. Use of a computerized guide allows for the wide distribution of implant placement, greatly enhancing retention and stability of the prosthesis.

A patient presented with an edentulous maxillary arch and desired implants to help provide enhanced stability for his maxillary complete denture (Figure 18). This patient had a challenging presentation because he had an extremely flat and broad maxillary arch and was on several medications that reduce salivary flow. He had been through several reline procedures of only moderate success and no longer wished to use denture adhesives. The patient was planned for four 2.9-mm narrow-diameter implants (LODI [Zest Anchors]). A reline impression was made of the edentulous ridge using a radiopaque VPS (Figure 19). A CBCT scan was made of the patient with cotton rolls on the buccal aspect of the denture and with instructions for the patient to keep his tongue away from his denture's palatal slope during the scan. The denture was removed and a CBCT was made of the denture alone. The images were processed and the radiopaque VPS was digitally scanned using an intraoral scanner (True Definition [3M ESPE]). The VPS was removed and the denture returned to the patient.

The patient's CBCT DICOM files were imported into a computer planning software (Invivo) and virtual implants were initially planned in positions according to ideal bone volumes. The plan files were uploaded to a central server (Anatomodel [Anatomage]) for fusion of the CBCT image with the intraoral scan of the radiopaque VPS. The processed image was downloaded and virtual implant positions were slightly modified to correspond with teeth positions Nos. 4, 7, 10, and 13 (Figure 20). In the implant-planning software, multiple controls exist to be able to turn on or off the "virtual layers" of the denture and soft-tissue renderings. This allows for ultimate

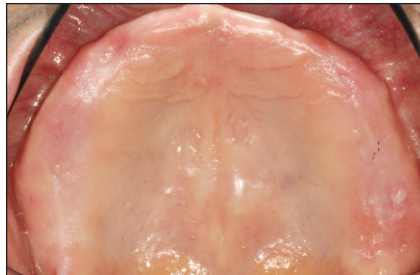


Figure 18. A patient with an extremely broad and flat maxillary arch opposing natural dentition wished for enhanced stability of his denture.



Figure 19. Radiopaque VPS is placed onto the intaglio surface of the denture and cotton rolls are placed buccal to the denture. A CBCT scan is made of the patient wearing the denture. A second CBCT scan is made of the denture alone.

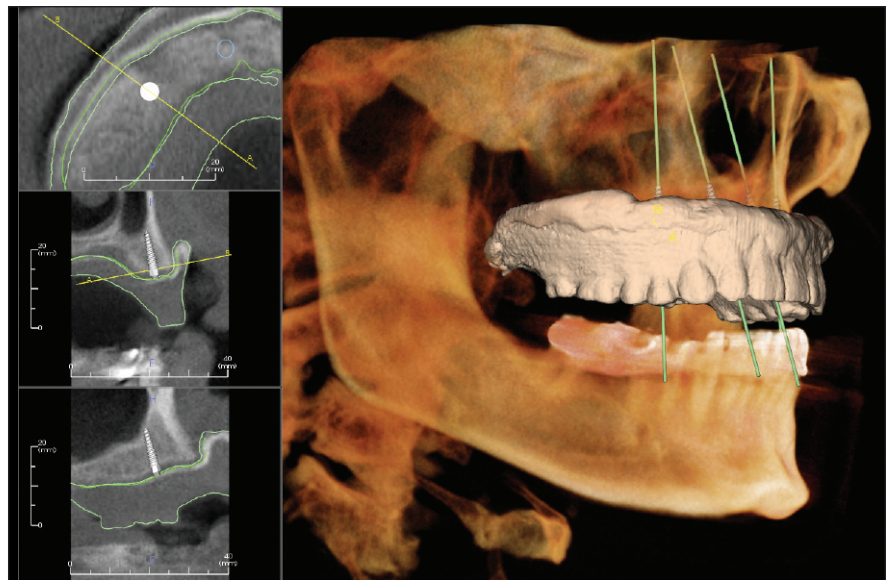


Figure 20. Computer software plan with virtual implants in tooth positions Nos. 4, 7, 10, and 13 with virtual overlay of denture and soft tissues.

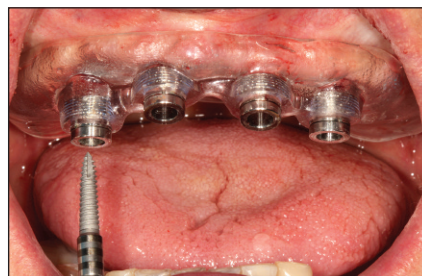


Figure 21. Osteotomies are prepared and implants (LODI) placed through the guide.



Figure 22. Final implant positions with abutments in place (LOCATOR).

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control of the proposed implant positions both on the virtual soft-tissue model in relation to the denture outline (Figure 20).

The verified, final surgical plan was uploaded to the central server with instructions to process the computerized surgical guide. The guide was received and complete tissue adaptation was confirmed. After anesthetic was placed, complete osteotomy preparation was completed through the surgical guide. The guide was kept in place and implants were placed through the guide (Figure 21). The guide was removed and abutments were placed, verifying final implant positions (Figure 22).

The computerized guided surgical approach to implant placement gives ultimate control of implant position, trajectory, and depth. Also, implants can be placed through the guide, minimizing the chance of minute deviations from the virtual surgical plan due to hand movement during implant placement with self-tapping implants. The precision of implant placement using a computerized guide is superior to that of all other approaches and gives a very reliable implant position in relation to critical structures. Ultimately, this results in a clinician being able to place implants widely distributed around the arch, enhancing both the retention and stability of the prosthesis and patient satisfaction.

CLOSING COMMENTS

Many clinicians view treatment planning and placement for implant overdentures as less difficult and safer than that of single implants. From this author's experience, single-implant procedures are less technique sensitive than implant overdenture therapy because edentulous patients have a high degree of bone anatomy variability and restorative challenges. While seemingly simple, proper planning and surgical procedures can be a confusing and challenging to clinicians.

This article introduced some of the challenges associated with improper implant placement for overdentures and aimed to dispel the notion that precise implant placement with either an in-house pilot guide or a computerized surgical guide is too cumbersome for most clinicians to incorporate into practice. Through the use of a simplified, contemporary digital approach, treatment

planning is simple, effective, and gives enhanced patient safety. Furthermore, the surgical procedures can also be simplified, giving the ability for more clinicians to incorporate implant overdentures effectively into their practices. ♦

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POST EXAMINATION QUESTIONS

1. To enhance physical properties, such as antero-posterior stability and retention, implants should be placed to maximize anterior and posterior distance between implants.
a. True b. False
2. For 2 implant overdenture restorations, optimal implants positions are at A (No. 28) and E (No. 21), allowing for maximal anterior-posterior distribution.
a. True b. False
3. Implant positions for the maxillary arch are limited by sinus walls, arch shape, and bone angulation. Ideally, 2 to 4 widely spaced dental implants should be placed.
a. True b. False
4. Utilizing the latest in CBCT, implant software, and optical imaging technology allows the clinician to rapidly assess the combination of bone volume and prosthetic volume analysis.
a. True b. False
5. A contemporary method of radiographic imaging has been previously described involving the use of soft-tissue and tooth separation techniques. These novel methods employ a simple, out-of-the-box concept that involves creating an air pocket around a complete denture to allow for visualization of the denture in the CBCT software.
a. True b. False
6. The author uses a simplified version of an "in-house pilot guided surgery" that provides 2 important aspects of surgical guidance. First, it provides a location for the implants on the edentulous ridge; second, it provides pilot holes for all 4 implants at the same angulation.
a. True b. False

Overdenture Implants: A Simplified and Contemporary Approach to Planning and Placement

7. **The computerized guided surgical approach to implant placement gives ultimate control of implant position, trajectory, and depth.**
 - a. True
 - b. False
8. **From this author's experience, single implant procedures are much more technique sensitive than implant overdenture therapy.**
 - a. True
 - b. False



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ANSWER FORM: VOLUME 34 NO. 8 PAGE 54

Please check the correct box for each question below.

1. ☐ a. True ☐ b. False

5. ☐ a. True ☐ b. False

2. ☐ a. True ☐ b. False

6. ☐ a. True ☐ b. False

3. ☐ a. True ☐ b. False

7. ☐ a. True ☐ b. False

4. ☐ a. True ☐ b. False

8. ☐ a. True ☐ b. False

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Please complete the following activity evaluation questions.

Rating Scale: Excellent = 5 and Poor = 0

Course objectives were achieved. _____

Content was useful and benefited your clinical practice. _____

Review questions were clear and relevant to the editorial. _____

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How much time did you spend reading the activity and completing the test? _____

What aspect of this course was most helpful and why? _____

 What topics interest you for future *Dentistry Today* CE courses?