DENTISTRY TODAY®
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IMPLANTS

# Success With Screw-Retained Zirconia Bridges, Part One

## *Treatment Planning Concepts*

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### INTRODUCTION

When a patient presents with the need for full-arch tooth replacement supported by dental implants, it is important for all members of the team to understand the various fixed or removable prosthetic alternatives. Factors that can affect the treatment plan include the available bone, type of bone quality, adjacent vital structures, pathology, the number of potential implants, smile-line, and aesthetic demands.

Once a patient has been informed about the choices, and it is determined that a fixed implant-supported option is possible, the alternatives become more defined. One such option is the zirconia, implant-supported, screw-retained bridge. This treatment choice offers advantages of retrievability, ideal aesthetics, reduced susceptibility to chipping, strength, and more. Part one of this 2-part article series will review the background, justification, and treatment planning steps for a clinician to implement a full-arch, zirconia, implant-supported, screw-retained bridge. Part 2 of this 2-part series will illustrate the recommended surgical and prosthetic steps for success with the zirconia, implant-supported, screw-retained bridge.

**Figure 1.** The Prettau full-contour zirconia implant bridge.

### Background: Full-Arch Prosthetic Alternatives

When treatment planning a screw-retained implant restoration, the material options are acrylic, ceramometal, or zirconia.

When monolithic (full contour) yttrium-stabilized zirconia is used (Figure 1), there is a substantially reduced susceptibility to chipping as compared to the other options. The literature shows that polished monolithic zirconia offers less occlusal wear to the opposing arch than feldspathic porcelain. The longevity of success for screw-retained zirconia bridges for the prosthesis and implant survival has proven success, as reported in the literature. With the advancements in zirconia technology, full-contour zirconia can rival the aesthetics of zirconia with porcelain on the facial surface of the teeth (Figure 2).

**Figure 2.** Closeup showing facial aspect of the Prettau full-contour zirconia bridge.

Acrylic hybrid bridges have a substantial record of chipping and prosthetic failure throughout time (Figure 3).[1] This is due to the weak mechanical bond to a metal core, and the weak nature of acrylic as a mate-

rial. By definition, a hybrid bridge is a metal bar with acrylic denture teeth.[2] When a cast metal structure is used for a hybrid bridge, casting distortion could cause stress on implants, problems with surrounding bone, and screw fatigue issues.[2] If a CAD/CAM titanium metal core is used, there are issues with the acrylic attaching to the titanium because of a reduced chemical bond.[3] It is often seen that entire teeth de-bond from the prosthesis or pieces of acrylic teeth break away with hybrid bridges (Figure 4). The screw-access holes in hybrid bridges are notorious for acrylic chipping due to occlusal forces. These screw-access holes are also often dark in color and unaesthetic due to shadow from the metal core of the hybrid bridge. Another disadvantage is the inherent porosity of acrylic that attracts plaque, which may lead to peri-implant issues.

PFM screw-retained bridges, due to the ceramic material, are difficult to repair. If a cast metal core has stress on it, the porcelain can de-bond from it. The same problems of casting distortion are present as with any cast metal super-structure of an implant-supported screw-retained bridge. Any hybrid bridge has the inherent issues of stress on the implants and prosthetic abutments and screws.

The long-term success of zirconia screw-retained implant restorations has been proven in the dental literature since Zirkonzahn (Zirkonzahn) originated the milled screw-retained implant-supported zirconia. Zirkonzahn was the first and only company worldwide to create an entire dedicated system of a specific zirconia material, milling machines, sintering ovens, and scanning machines (Figures 5 and 6). The system also includes specific stains, glazes, porcelains, and laboratory treatment for zirconia (Figure 7). While other companies have started to imitate Zirconzahn's success, they do not have a proven long-term track record for full-arch implant-supported prostheses.

An implant-supported screw-retained zirconia implant restoration is fabricated through CAD design and the CAM and milling. This CAD/CAM process negates casting distortion and its resultant problems (Figure 8).[4] Another advantage of zirconia as an implant restorative material is its ability to splint dental implants in a very rigid manner due to zirconia's high modulus of elasticity. The success of adjacent dental implants has been shown to be improved through rigid splinting.[5] Zirconia has the advantage of offering reduced plaque retention as compared to acrylic alternatives. The hygienic nature of zirconia can improve success of the supporting dental implants.[6]

One important caveat that must be appreciated when planning for a zirconia implant-supported restoration is the thickness of the material. If the CAD/CAM zirconia framework is too thin, it will be susceptible to potential fracture. The authors have

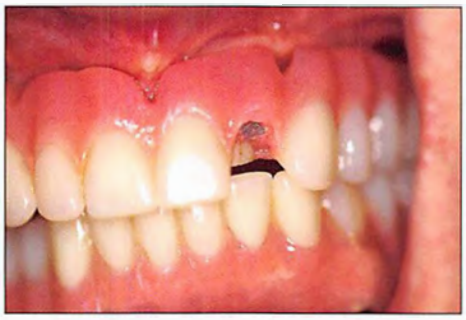

**Figure 3.** Hybrid bridge failure showing maxillary denture tooth de-bonding from metal framework.

**Figure 4.** Hybrid bridge failure showing mandibular denture tooth de-bonding from metal framework.

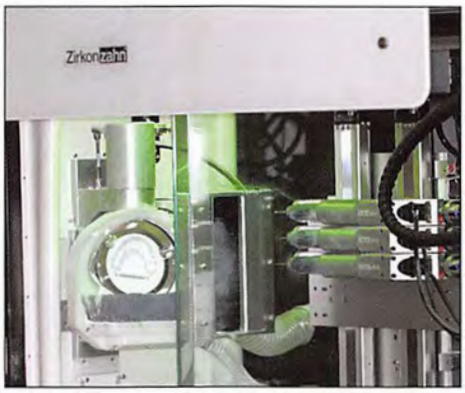


**Figure 5.** Zirkonzahn's specific 5-axis zirconia milling machine for Prettau zirconia.

**Figure 6.** Zirkonzahn's specific sintering oven for Prettau zirconia.

**Figure 7.** Zirkonzahn's specific stains for Prettau zirconia.

**Figure 8.** CAD/CAM zirconia framework with titanium interfaces that connects it to the implants.

**Figure 9.** Alveoloplasty being performed to obtain a 12.0-mm prosthetic space.

**Figure 10.** Example of zirconia FP3 prosthesis showing aesthetic artificial gingiva.

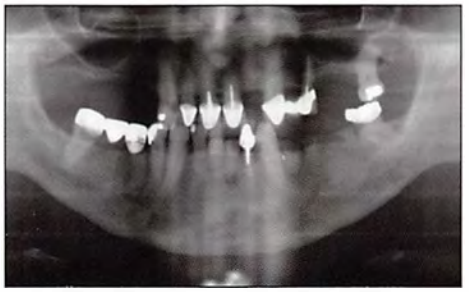

**Figure 11.** Panoramic radiograph showing teeth with a questionable long-term prognosis.

**Figure 12.** Image of a patient who was frustrated with trying to save teeth via conventional dental treatment.

**Figure 13.** Xerostomia patients could be good candidates for a full-arch zirconia implant bridge.

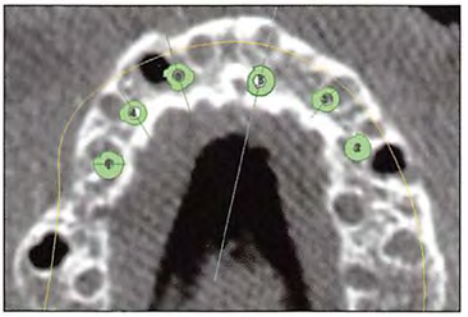

**Figure 14.** CBCT axial view showing proposed implant positions.

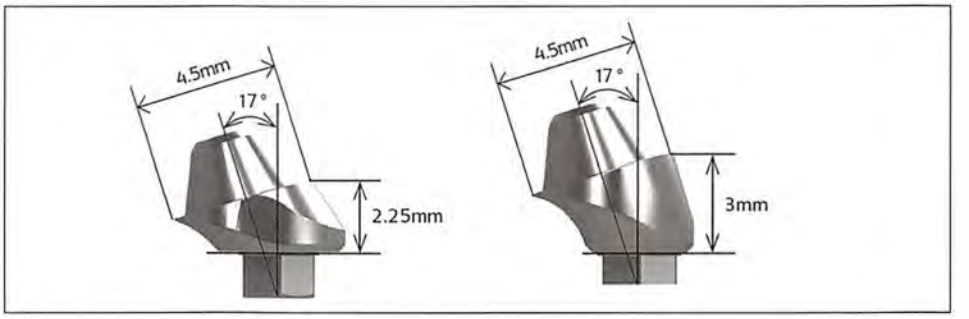


**Figure 15.** Examples of 17° multiunit abutments to redirect a screw hole.

found that a minimum of 12.0 mm of prosthetic thickness measured from the occlusal table to the implant platform is adequate.[4] In order to ensure that 12.0 mm of prosthetic height is achieved, it may be necessary to reduce the alveolar crestal bone through adequate alveoloplasty at the time of surgery (Figure 9). Adequate vertical space can also be accomplished through an increase in vertical dimension of occlusion (VDO), or via modification of the opposing arch. Reducing alveolar crestal bone allows an FP3 prosthesis based on the Misch Classification.[2] An FP3 prosthetic design has increased prosthetic space, which requires an area of "pink" artificial gingiva to close the vertical space. An advantage of the FP3 prosthesis is that the pink gingival area can be controlled based upon the patient's smile-line, and can result in a very aesthetic appearance, and will maintain itself without the possibility for recession (Figure 10).

## Treatment Planning a Full-Arch Implant Prosthesis

The decision whether or not to save a tooth (or teeth), with respect to long-term prognosis, is multifactorial. It requires careful clinical and radiological evaluation of the remaining teeth, periodontal condition, caries risk assessment, and surrounding bone (Figure 11).[7] It is understood that patients may not immediately accept the loss of teeth through extraction; a subjective factor that is part of the patient's desire to save his or her existing teeth, or not. Many clinicians make heroic efforts to save teeth, despite their limited or hopeless long-term prognosis, leaving patients frustrated (Figure 12). Some patients, after being informed of the option to save teeth by different treatment modalities (such as periodontal therapy), now choose to extract teeth and have them replaced by dental implants. Therefore, the treatment alternatives presented to the patient must now include implant-supported restorations which may require the extraction of all remaining teeth in an arch to help preserve their remaining bone and to restore function and aesthetics. Comparing the financial cost of preserving key teeth and placing strategic implants, or extracting all remaining problematic teeth with an implant-supported restoration, is a subjective factor that requires an analysis of long-term risk versus benefits of treatment. A patient may not want to spend money to save teeth when full-arch dental implants may present with a better long-term and less problematic prognosis. Even if it costs less financially to save some remaining teeth, a patient may decide not to risk the chance of those teeth needing future dental services that might include both additional financial and time commitments.

Additionally, patients who present with xerostomia represent a multifactorial etiology, with causative factors related to pharmaceutical, aging, autoimmune, or radiation based causes.[8] Once xerostomia is a consideration in treatment planning for a patient, teeth become a more vulnerable option compared to implants with respect to decay (Figure 13). Thus, implants may be the treatment plan of choice.

Often, treatment plans that involve maintaining certain teeth may also require ancillary procedures such as sinus grafting, bone grafting, and soft-tissue procedures. These adjunctive procedures can add considerable cost and additional healing time to the treatment plan.

Another scenario when trying to save teeth and place implants might involve restoring natural teeth with full-coverage restorations for aesthetic and/or functional improvement. This cost and result can be directly compared to the aesthetic and functional results that can be achieved with a full-arch, implant-supported restoration.

Another consideration for the patient is the number of appointments needed for each proposed treatment scenario. A patient may opt for a shorter treatment scenario if it is a possibility, especially if one has a busy lifestyle. Patients need to be informed of the risks and benefits, long-term prognosis, and quality of life improvements that can be expected from each treatment modality.

When a full-arch reconstruction is

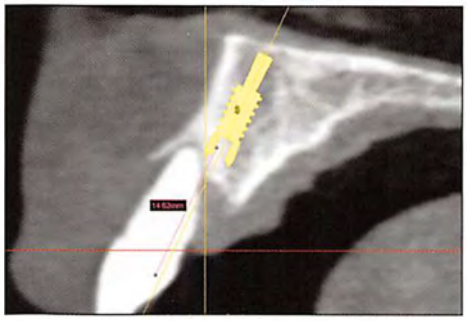

**Figure 16.** CBCT cross-sectional view showing how a CT scan can help orient the screw hole toward the cingulum.

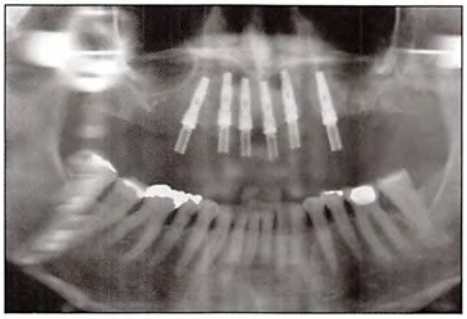

**Figure 17.** Panoramic radiograph of immediate screw-retained acrylic provisional at the time of implant placement.

**Figure 18.** Immediate loaded maxillary screw-retained provisional delivered at the time of surgery.

required, all fixed or removable treatment options should be given to the patient. Once a patient indicates that he or she does not want a removable prosthetic option, the fixed implant options of either screw- or cement-retained implant prostheses can be further explored and explained. When comparing available material alternatives for a full-arch, screw-retained, implant-supported restoration, the advantages of zirconia are: retrievability, the ability to cantilever, great aesthetics, low susceptibility to chipping when full-contour zirconia is utilized, improved plaque control, and a decreased risk of peri-implantitis secondary to cement remnants around implants.

## Comprehensive Patient Examination

Treatment planning for a full-arch, implant-supported reconstruction requires a comprehensive patient evaluation, documentation of the patient's condition, and informed consents, and any necessary prescriptions. Good extra- and intraoral photographs allow for an objective assessment of the patient's lip-line, occlusal scheme, and the condition of existing restorations. This also offers sound medical-legal documentation.[9]

Charting the patient's existing restorations and periodontal condition is also an imperative step in the treatment planning process. This information allows the clinician to formulate alternative plans for treatment and decide with the patient the appropriate long-term solution. Charting information also helps the clinician have a discussion with the patient, with respect to the financial considerations of various treatment options. Other information—including temporomandibular joint (TMJ) status, oral cancer status, and medical history—is also critical to formulating a treatment plan. Information on the patient's psychological status as well as general expectations provides pertinent information in formulation of a treatment plan.

Once the information from a CBCT scan has been reviewed and all other charting and medical history information is obtained, the clinician can then present treatment plan options to the patient. This is part of the informed consent process, and as each option is presented, the pros and cons of each are reviewed. The advantages and disadvantages of the alternative implant-supported options need to also be presented and documented as part of the patient chart.[10]

A CT/CBCT scan is recommended to plan for the correct implant positions, to diagnose existing pathology, and to avoid iatrogenic damage to vital anatomy (Figure 14).[11] CBCT scans offer low radiation and interactive 3-D planning through many available software programs. Third-party diagnostic imaging services are now available for any clinician to gain access and assistance in treatment planning for an implant case; eliminating the need to purchase costly software or to have specific knowledge on how to use these programs.[12] A CT/CBCT scan can offer information for the clinician to achieve ideal implant positions to support the implant prosthesis. The surgical procedure can then be executed according to the plan with or without using a surgical guide according to the clinician's preference and experience. The correct restoratively driven planning objective for an implant-supported zirconia screw-retained restoration is to have the screw-access holes project from the implants through the envelope of the tooth in either the cingulum area for the anterior region, or the mid occlusal, or lingual aspect of the posterior teeth being replaced. If the screw-access hole is directed toward the facial of the anterior teeth, its emergence through the facial aspect of the tooth will be an aesthetic issue. An alternative is to redirect the screw-access hole lingually with a multiunit abutment (Figure 15). A CBCT scan and proper 3-D planning can offer the clinician significant guidance with regards to the correct implant position (Figure 16). Placing implants with interactive treatment planning software can help assess the bony receptor site in an attempt to place the implant in a lingual or palatal position. If the CBCT shows the need for bone reduction, this can be easily accomplished during the surgical intervention to allow for sufficient prosthetic space.

## Presenting the Options and Treatment Sequence

Presenting the treatment options, the sequencing of treatment, needed documentation, and financial options are an integral part of the treatment planning process. For a patient to accept treatment, the clinician or staff member must present these necessary steps in a confident and organized manner. The more organized and confidently delivered the presentation is, the more likely a patient will be to accept treatment. Many patients are overwhelmed with the process of having major oral reconstruction, and are reliant on the treatment facility to simplify the process while providing a level of comfort. It is recommended that an organized protocol be utilized when presenting treatment options, treatment sequences, financial options, and documentation. This organized protocol can consist of team (staff) roles for each presentation step, specific books or videos to explain options, and organized folders for the needed paperwork.[13] It is recommended to systemize and simplify the process as much as possible. This will be individualized for each office's situation, but should be repeatable, smoothly executed.

From a financial and communication perspective, there are many advantages to presenting an overall fee for a complex implant case. This adds simplicity for both the patient and for the provider presenting treatment. When one overall fee includes the

extractions, bone grafting, and the comprehensive surgical and prosthetic steps, the entire process is more scripted, and the authors have found an increased acceptance of full-arch treatment plans. Organized presentation steps are also important from a medical/legal standpoint and allow for a strong informed consent as part of the medical legal record of treatment and should be documented as carefully as possible.

### Concepts for the Provisionalization Step

An important aspect of treatment is how the case will be provisionalized. The choices to provisionalize a full arch during implant treatment will affect a patient's lifestyle in many ways. Speech, eating, and confidence levels will all be affected, depending on the choice of how an implant restoration case is provisionalized. When a full arch is being reconstructed, it can be provisionalized either by immediately loading the implants, submerging the implants in a 2-stage manner with a transitional removable prosthesis, or utilizing certain stable teeth in a temporary manner to support a provisional restoration until the implants integrate.

Using teeth to support a provisional while implants integrate in a 2-stage manner offers advantages and disadvantages. The advantage of utilizing teeth for support is that the implants can integrate without pressure from masticatory load, especially in softer bone. The disadvantages are that utilizing teeth to support a provisional restoration can interfere with the amount of alveoloplasty that can be done during surgery. Another disadvantage in saving teeth for provisional support is that often the teeth being saved are problematic, or periodontally compromised, and might not last for support during implant integration, or the transitional prosthesis may fracture. A 2-stage procedure mandates an additional surgery with uncovering of the underlying implants, and that a patient must wear a removable denture during healing.[14]

Immediate loading is the authors' preferred option.[15] An immediate-load protocol can provide patients with a transitional restoration the same day, or within 48 hours of the time of surgery when adequate implant stability is achieved. An immediate-load protocol negates a second surgical procedure for implant uncovering. When immediate loading is performed, the authors recommend an acrylic, screw-retained provisional to be utilized while the implants heal for a period of 3 to 5 months (Figures 17 to 20).

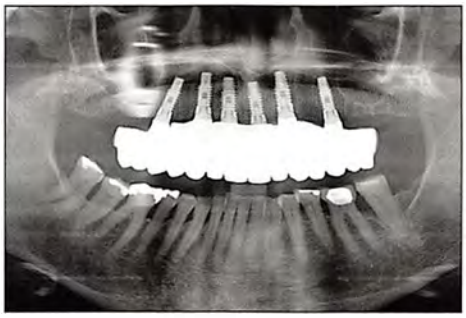

**Figure 19.** Panoramic radiograph of a final full-arch, zirconia, screw-retained bridge after immediate loading.

**Figure 20.** Example of a finished full-arch, maxillary Prettau zirconia, screw-retained bridge after immediate loading.

### IN SUMMARY

There are unique advantages of a screw-retained, CAD/CAM zirconia implant bridge as compared to other fixed options. The inherent strength of yttrium-stabilized zirconia allows for rigged implant fixation with a low susceptibility to chipping. This is especially true when the prosthesis is monolithic zirconia (no porcelain on the facial/occlusal areas).

Treatment planning for a screw-retained, CAD/CAM zirconia implant bridge requires an assessment of the prognosis of any remaining teeth. Many factors have to be considered before completely edentulating a patient versus saving certain teeth. These factors include an assessment of the prognosis of remaining teeth, quantity and quality of available bone, aesthetic advantages of each plan, the time factors involved related to a patient's lifestyle, and the financial ramifications of various plans.

A comprehensive patient assessment is needed before a final plan can be presented—this includes a CBCT scan, a photographic series, charting existing restorations, an assessment of TMJ status, and additional diagnostics, if required. Presenting the ideal determined options to a patient, including the financial aspects, is an important part of the treatment planning process. A presentation that is organized and simplified will improve doctor-patient communication, aiding the patient to make an educated and informed decision. Informed consent must be given to the patient that outlines the risks and benefits of each treatment option.

Lastly, a treatment plan for a full-arch, CAD/CAM zirconia implant restoration must include a plan for provisionalization during implant integration. Depending on many factors, implants can either be immediately loaded, done in a 2-stage protocol, or staged using residual natural teeth to support a transitional restoration.

This article reviewed concepts related to treatment planning for a CAD/CAM, screw-retained, implant-supported zirconia restoration as multifactorial, as is the presentation of the treatment plan to the patient.✦

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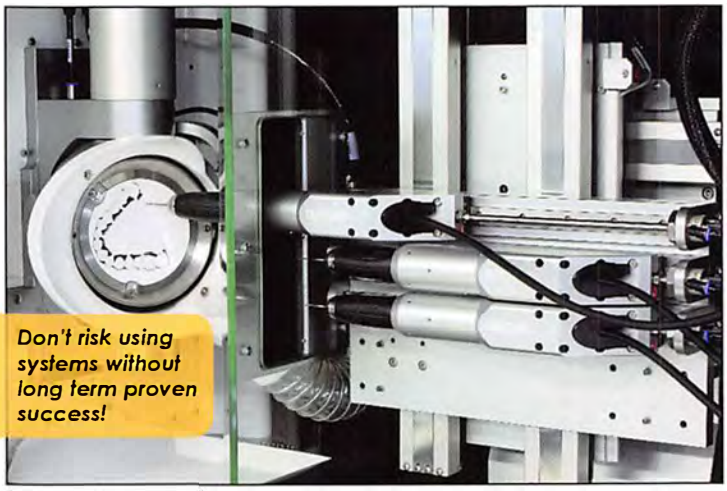

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# Success With Screw-Retained Zirconia Bridges, Part 2

## *Surgical and Prosthetic Steps*

### INTRODUCTION

A zirconia, implant-supported, screw-retained bridge offers many advantages for full-arch tooth replacement. The advantages over the alternative fixed options are less susceptibility to chipping, better implant stabilization, and ideal aesthetics. In part one of this 2-part series, the aspects of treatment planning for a full-arch, zirconia, screw-retained bridge were covered. Part one reviewed the necessary treatment planning steps in detail, and important techniques for presenting the plan to the patient. Part 2 of this series outlines the surgical and prosthetic steps for patients who present with the need for fabrication of a full-arch reconstruction, and specifically, a zirconia, implant-supported, screw-retained Prettau restoration.

The surgical steps necessary to deliver an ideal zirconia option include: presurgical prosthetic planning, extraction, soft-tissue reflection, alveoloplasty, osteotomy preparation, implant placement, grafting, and implant uncovering. Once the surgical phase has been completed, the prosthetic phase will then include initial presurgical and post-surgical impressions, delivery of the first interim prosthesis, final impressions, verification indexing, try-in of a screw-retained wax setup, the delivery of a second screw-retained interim prosthesis milled from a disk of polymethylmethacrylate (PMMA) (if required), delivery of the definitive Prettau restoration, and an occlusal nightguard.

Each of the surgical and prosthetic steps will now be outlined and explained through clinical illustration in an attempt to aid the clinician in providing full-arch, implant-supported, screw-retained, zirconia restorations.

### OVERVIEW OF THE SURGICAL STEPS

The surgical steps needed to create success for full-arch, zirconia, implant-supported, screw-retained restorations are based upon a proper diagnosis and treatment planning contingent utilizing CBCT imaging (Figures 1 and 2).[1,2] Once the plan has been accepted, the proper sequence begins with extractions (when teeth are present), careful soft-tissue reflection, alveoloplasty (as required), implant placement, bone grafting, management of healing, and surgical uncovering of the implants. Although each patient's clinical presentation may be unique and different, the surgical steps should occur in the recommended sequence to provide for successful treatment outcomes. Having a standard sequence to inform patients allows for improved efficiency and better treatment for the patient. The authors agree that expeditious surgical treatment through efficiency and planning is an important principle that minimizes blood loss, reduces the chance of infection, patient morbidity, and results in an improved treatment experience for the patient (Figure 3).

**Figure 1.** Occlusal surface of Prettau monolithic zirconia bridge (Tischler Dental) showing screw holes.

**Figure 2.** Facial surface of the full-contour Prettau monolithic zirconia bridge, showing good aesthetics.

#### Extractions

Patients who are dentate require tooth extractions. Good diagnostic and surgical skills set the tone for the entire case, starting with careful tooth removal. It is important that site preservation techniques be employed to maintain as much bone as possible. When residual bone is available post-extraction, it provides for increased implant stability, better containment for bone grafting, and improved visualization of implant positions and angulations during implant placement if a surgical guide is not utilized (Figure 4). Although alveoloplasty may be required to level bone around an extraction site, any available bone that can be maintained can be an advantage and should be visualized on the CBCT scan. Recommended techniques for atraumatic extraction are: utilizing rotation when possible, sectioning molars, utilizing leverage forceps, the careful use of elevators, and allowing enough time for the bone to expand to help elevate a root. To improve efficiency and expedite treatment, the authors recommend that clinicians organize a separate and dedicated surgical kit with all the instruments required.

Soft-tissue reflection for full-arch implant placement is the next surgical step in the sequence. A mid-crestal incision with full-thickness, muco-periosteal reflection is advocated when alveoloplasty is necessary (as defined by the CBCT based diagnosis and treatment plan). A periosteal elevator is used to reflect tissue, while keeping the instrument on the bone, whenever possible. For the maxillary arch, it is important to reflect far enough distally so that the sinus walls can be visualized to aid in determining the location of the most distal implant position. However, caution is advised since there are vital adjacent structures to avoid, including the infraorbital foramina and the palatal arteries located on the palate. The structures are usually superior enough from the reflection areas that they are not commonly a concern. A CBCT scan can aid in locating the position of the mandibular bilateral mental foramina.[2] The mandibular arch often requires enough reflection for visualization of the mental foramina to provide an adequate zone of safety from the mental nerves. A lingual bilateral tieback with sutures helps

to reposition the reflected soft-tissue flap from the surgical field of view (Figure 5).

### Alveoloplasty

When planning for a screw-retained, full-arch restoration fabricated from monolithic zirconia, it is extremely important to have an appropriate vertical height, measured from the implant platform to the occlusal table, for adequate material thickness. The recommended minimal "prosthetic space" is 12.0 mm; this can be determined by measuring the pre-existing vertical dimension of occlusion (VDO). If there is inadequate VDO, it can be re-established (or opened) by changing the occlusal height or the opposing arch to achieve the required prosthetic space, or through alveoloplasty. Alveoloplasty, or vertical reduction of the crestal bone, is the most predictable way to ensure adequate prosthetic space.[3]

In addition to the required vertical height necessary for the material thickness, the amount of alveoloplasty will be dictated by a patient's smile line in the maxillary arch. To achieve ideal aesthetics, it is necessary to keep the junction between the zirconia and the gingival crest hidden when a patient smiles (Figure 6). This is not an aesthetic concern on the mandible. A CBCT scan will indicate the adjacent anatomical markers to gauge the amount of bone to be removed. Often, an extraction site can be used to visually gauge the amount of bone to be reduced, using the implant receptor sites as a reference. A general rule is to place 10.0- to 12.0-mm length implants as apically as possible, and then to remove the vertical bone height (as needed) to obtain that position. For this type of restorative option, the surgical mindset is to reduce bone to achieve prosthetic success. While many clinicians are initially reluctant to remove bone, once the benefits are realized, that reluctance is negated. Alveoloplasty can be performed with either a round surgical bur on an electric handpiece, or an impact air handpiece. Both techniques require copious irrigation to avoid overheating of the bone, as well as good evacuation (Figure 7). Pre-prosthetic surgical planning with CBCT and interactive treatment planning can also provide clinicians with a "guided" method to achieve the desired amount of alveoloplasty through the fabrication and utilization of a bone reduction template.[4]

### Implant Placement

The desired position for implant placement as performed by the authors follows a standard sequence in both the maxilla and mandible. A CBCT scan is acquired after any extractions and prior to implant placement to assist in planning. In the maxilla, the goal is to place a minimum of 6 implants between the sinuses, unless there is adequate bone posteriorly to place implants of appropriate width and length. If there is inadequate posterior bone, the distal-most maxillary implants should be placed so that the angulation mimics the anterior wall of the sinus, or mesial to it (Figure 8). This precise placement can be achieved by taking an intraoperative radiograph, with a radiographic marker used

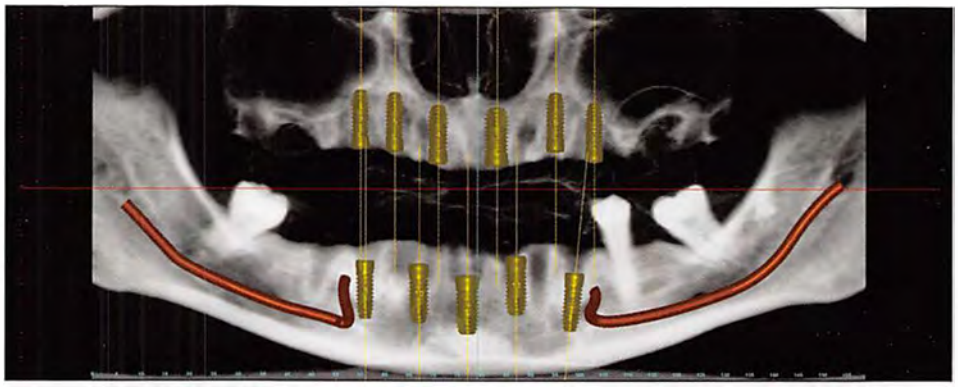

**Figure 3.** CT scan, panoramic view, showing implant positions for maxillary and mandibular zirconia, implant-supported, screw-retained bridges.

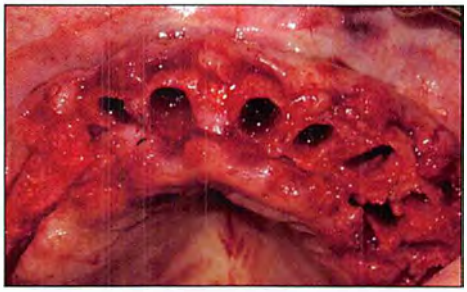

**Figure 4.** Example of maxillary arch post-extraction, with all walls of bone present—an ideal starting point.

**Figure 5.** Lingual tieback on mandible for better visibility during surgery.

**Figure 6.** Adequate alveoloplasty allows the zirconia/tissue junction to be hidden with a high smile.

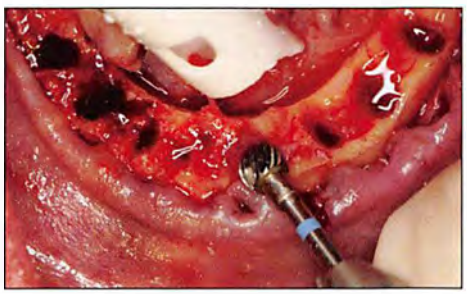

**Figure 7.** Performing alveoloplasty with a large round bur on an electric handpiece with sterile saline.

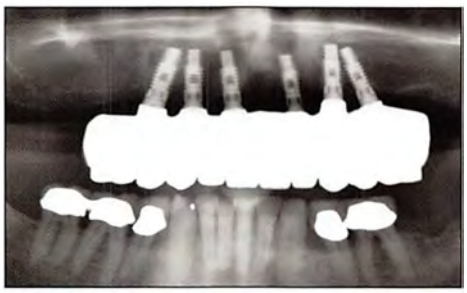

**Figure 8.** Maxillary Prettau zirconia bridge, showing distal implants angled to mimic the anterior sinus walls.

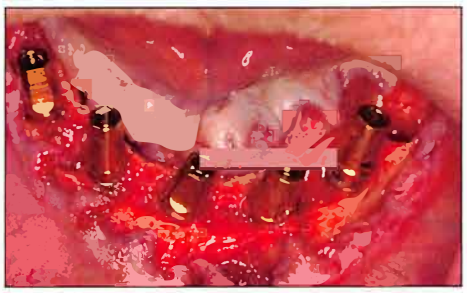

**Figure 9.** Five tapered implants (BioHorizons) placed between the foramen in the A to E positions.

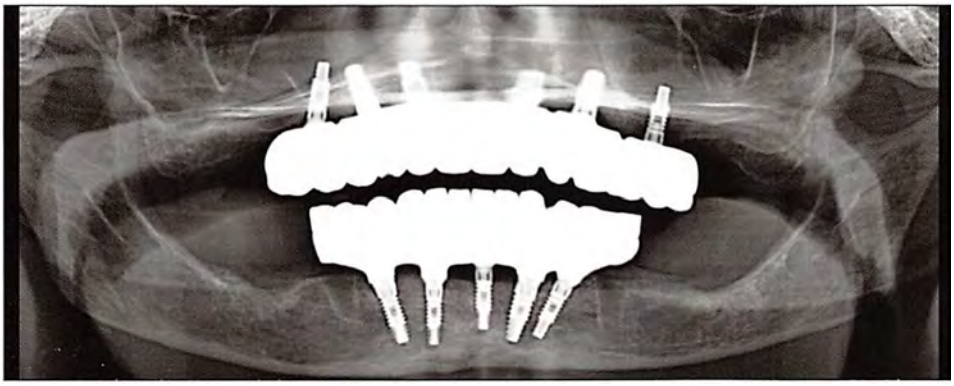

**Figure 10.** A panoramic example of a mandibular Prettau zirconia bridge, supported by 5 dental implants.

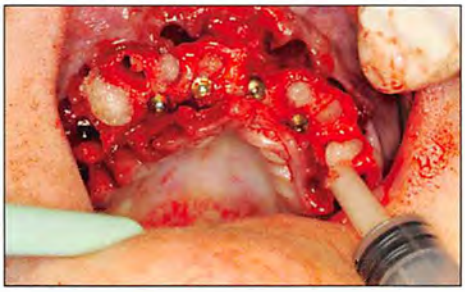

**Figure 11.** Demineralized freeze-dried bone allograft putty being delivered to extraction sites to obtain hygienic contours under the Prettau zirconia bridge.

**Figure 12.** Uncovery of 2-stage implants showing keratinized tissue on facial.

**Figure 13.** Retracted view, showing how alveolar reduction allows for hiding the zirconia-to-tissue interface during smiling.

**Figure 14.** MiraTray (Hager Worldwide) stock impression tray advocated by authors.

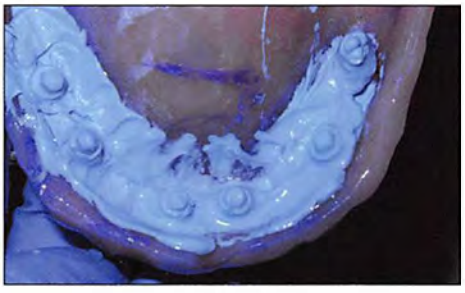

**Figure 15.** Example of detailed index impression with Blu-Mousse (Parkell), inside a denture base.

**Figure 16.** Verification jig used to verify positions of implants intraorally.

as a guide. These distally inclined implants allow for an increased anterior-posterior spread with the prosthetic goal to have a one-tooth cantilever. The next implants can be placed sequentially in the maxilla anteriorly on either side of the incisal foramen, as close to the foramen as possible. Ideally, the implants should be angled according to the prosthetic plan trying to direct the screw-access holes toward the cingulum areas of the proposed restoration. The next sequence involves the placement of the middle implants between the distal implants, and the implants adjacent to the incisal foramen, positioned with the screw-access holes directed toward the lingual or palatal.

For the mandibular arch, it is recommended to place 5 implants between the mental foramina, with the prosthetic goal to have a one-tooth distal cantilever (Figures 9 and 10).[5] The distal implants should be placed 3.0 mm anterior to the foramen with a 30° distal angulation. In order to avoid the anterior loop of the mental nerve as identified on the CBCT scan, the mental foramen needs to be visualized with adequate reflection during the surgical intervention. Following the recommended sequence, the next implant is placed anteriorly in the middle of the mandible with a lingual inclination for correct emergence of the screw-access hole. The next implants should bisect the distal and middle implant (angulated toward the cingulum) to avoid facial emergence of the screw-access hole. If an immediate loading protocol was planned, the implant insertion torque should be at least 35 Ncm or have an ISQ value exceeding 67 to provide adequate stability of the implants to support a screw-retained provisional prosthesis.

## Grafting

When tooth extractions are required, the residual tooth sockets will leave voids in the alveolus. The authors have found that bone grafting is often required to fill these voids, and to help to provide support for the soft tissues. The authors use demineralized freeze-dried bone allograft (DFDBA) bone putties exclusively for this purpose. The crestal contour of the soft tissue plays an important role in long-term hygienic maintenance. Therefore, it is desirable for the ridge to heal with a flat profile, resulting in a more hygienic prosthesis. The DFDBA putties do not migrate when placed, and are hemostatic and osteoinductive, making them ideal for this purpose (Figure 11).[6] Careful soft-tissue management, proper closure, and suturing techniques all aid in the healing process when the implants are buried in a conventional 2-stage protocol.

## Surgical Uncovering of the Implants

After an adequate healing phase, a 2-stage protocol requires the exposure of the implants, and careful management of the soft tissue cannot be underestimated.

The surgical procedure to uncover the implants represents an opportunity to repo-

sition the right amount of keratinized tissue toward the facial of the implants. To facilitate the prosthetic phase, it is also important to ensure that the coronal aspect of the implants is not buried too deep under the tissue (Figure 12). Keratinized tissue surrounding the implant allows for reduced peri-implant issues and improved implant health.[7] Though adequate keratinized tissue is critical, too much tissue is problematic. The implant platform should not be more than 3.0 mm below the free gingival tissue to avoid path of insertion issues and/or potential pain due to compression of the tissue during try-in stages. If the implants are too deep in the tissue intermediate, multiunit abutments might be required, adding to the components required for the restoration as well as the cost of the restorative phase. Through the manipulation and/or reduction of abundant tissue at the surgical uncovering appointment, the desired tissue height can be obtained. When an immediate load protocol is utilized, the soft-tissue cuff height can be manipulated when repositioning and suturing the tissue at the time of surgical implant placement.

## PROSTHETIC STEPS

### Pre-Prosthetic Planning and Initial Impressions

The treatment plan must consider how a patient is to be provisionalized, during implant healing and after implants have been uncovered. Once the method for provisionalization has been established, a complete evaluation of aesthetic parameters (with an emphasis on the patient's VDO, incisal edge position, gingival display, and lip mobility) is performed. In a team approach, it is critical that the prosthetic doctor work closely with the surgeon to ensure that a sufficient alveoloplasty is done to create the minimal prosthetic space of 12 mm. In the maxillary arch, the alveoloplasty will also serve to hide the juncture of the pink prosthetic gingival area underneath the patient's lip when the patient is smiling maximally (Figure 13).

If only one arch is being treated, evaluation and adjustment of the opposing arch may be required to straighten or manage the occlusal plane. Initial full-face photographs of the patient at rest and at full smile, as well as close-up photos of the patient in occlusion, are taken for reference. Upper and lower alginate impressions that fully capture the vestibule areas, a centric bite relation, and face-bow records are taken. The shade and tooth mould is selected with patient input. If a patient is edentulous at first presentation, a conventional denture technique using a wax rim followed by a wax try-in is used to determine tooth position prior to surgery. A denture and duplicate wax-up are requested from the dental laboratory team.

**Figure 17.** Maxillary and mandibular polymethylmethacrylate screw-retained provisional used to guide the final zirconia bridge.

**Figure 18.** Retracted view of maxillary and mandibular Prettau zirconia monolithic bridges.

**Figure 19.** Portrait image of maxillary and mandibular Prettau zirconia monolithic bridges.

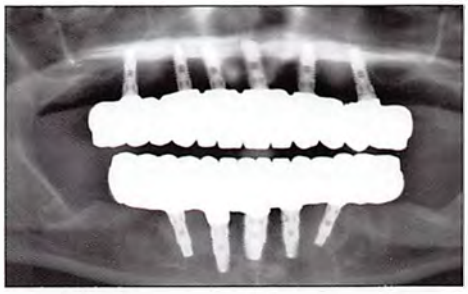

**Figure 20.** Panoramic image of maxillary and mandibular Prettau monolithic bridges.

### Delivery of the First Interim Prosthesis

Immediately following extraction and implant placement, the first provisional restoration is delivered. Options for provisionalization include temporization with a denture, or an immediately loaded, screw-retained provisional. Transitioning a patient by retaining teeth to support a cement-retained provisional is contraindicated, as it will interfere with an effective alveoloplasty procedure. If a complete denture is to be utilized for the provisional restoration, the authors recommend relining the denture with COE-SOFT (GC America). This material is ideal because more material can be easily added as bone remodeling and tissue changes occur during the initial healing phase. When a conventional 2-stage procedure is utilized, the reline process can capture the healing collars following the uncovering of the implants.

### Final Impression and Indexing

The authors advocate a splinted, open-tray impression technique due to increased accuracy than alternative techniques.[8,9] A polyether impression material (Impregum [3M ESPE]), used with MiraTray (Hager Worldwide) impression trays, is highly recommended (Figure 14).[10] The authors recommend using nonrotating, implant-engaging impression copings in the anterior region, and nonengaging impression copings for the distal-most areas. Nonengaging impression components in the posterior areas (where implants are divergent) will prevent the splinted, open-tray impression from getting locked on at the time of the open-tray splinted impression. Engaging, or "indexed" impression copings are used to ensure that multiunit abutments can be properly positioned, should they be deemed necessary in the anterior region; or when the implants will obviously require re-angulation. The authors recommend that the laboratory team determine the need for multiunit abutments after the soft-tissue models are fabricated and the diagnostic wax-up can be evaluated. When the relationship between the desired tooth position and implant position has been reviewed, the need for multiunit abutments can be determined by the laboratory technician. The lab team can then order the most appropriate abutments, negating the need for clinicians to stock components. In the posterior areas, where access hole placement is less aesthetically important, the authors will usually attach the prosthesis directly to the implant without the use of an intermediate abutment.

Ideally, indexing of the dental implant position is performed by relating the implant position to an approved wax setup (Figure 15). When the provisional is a denture, the duplicate wax setup, initially requested from the lab team, can be tried in and modified during healing time until patient and provider approval is achieved. If the provisional is an immediately loaded, screw-retained prosthesis, the duplicate wax-up can often provide a better starting point than would be achieved by indexing to a wax rim. Indexing can be performed either on healing caps or directly to the implant screw-access hole. Accurate indexing requires the use of a very rigid material such as classic set Blu-Mousse (Parkell). A centric bite registration is also required for proper mounting of the final impression. A verification jig and screw-retained wax setup should then be requested from the laboratory team.

### Verification Jig and Screw-Retained Wax-Up Try-In

Confirmation that the final impression is accurate is particularly critical for screw-retained prosthetics, or biological and prosthetic complications can result.[11] Therefore, proper use of a verification jig to confirm the accuracy of the final impression is required (Figure 16). The verification jig should be placed in the mouth, secured to the implants, and the clinical passivity of fit confirmed by completing Sheffield testing, and then reconfirmed of complete seating of the jig radiographically. The screw-retained wax setup is then tried in and evaluated with respect to aesthetics, phonetics, VDO, and occlusion. If significant modifications to the setup are required, try-in of a new screw-retained wax setup will be necessary. Photographs should be taken to facilitate communication with the laboratory team. If the wax setup is approved, the lab team should be asked to return a screw-retained, CAD/CAM-milled, PMMA, provisional restoration.

### PMMA Delivery

If multiunit abutments are required, they can be placed when the screw-retained PMMA is delivered (if they were not placed previously). If the final impression was not an abutment level impression, a new tissue impression will be required following delivery of the multiunit abutments so the laboratory can properly orient the multiunit analogs on the master working cast. The authors advocate using a soft body vinyl polysiloxane (VPS) impression material expressed around the existing verification jig that has been broadened to act concurrently as a custom tray.

The screw-retained, PMMA provisional should be inserted and evaluated in terms of occlusion, aesthetics, phonetics, and hygienic access. Achieving mutually protected occlusion or group function occlusion with shallow anterior guidance is ideal when opposing natural dentition or with another full-arch fixed-implant restoration.[12] Aesthetic modifications can be achieved with disks and burs to fully customize the final aesthetic result (Figure 17). When evaluating phonetics, it is imperative on the maxillary arch that there is intimate contact between the intaglio surface of the prosthesis and the tissue surface, or phonetic complications or "air bubbling" will result. If contact is inadequate, cold cure acrylic or tray adhesive and composite can be added to the intaglio surface to achieve enhanced tissue contact. If this is required, it should alert the restorative doctor that the soft tissue may have changed since the final impression was taken, and a new soft-tissue impression should be taken so that the final restoration will have the proper soft-tissue contours. This impression can also be taken by expressing soft-body VPS impression around the broadened verification jig. The ability to cleanse the restorations should be evaluated at the PMMA stage, and any modifications to improve hygiene access should be made at that time. Hygiene access will be affected by prosthetic design contingent upon proper surgical protocol, which results in a flat healed ridge with sufficient bone reduction to allow for a hidden prosthetic gingival to natural gingival margin without overflanging. The PMMA restoration is digitally scanned in the dental laboratory with a desktop optical scanner prior to being sent to the restorative clinician for delivery. If any modifications to the PMMA restoration are required, the restoration must be screwed onto the master cast, and a high-quality VPS impression should be taken to record the differences. The resultant cast will then be digitally superimposed or "married" to the pre-scanned digital PMMA to ensure that the final restoration will be a replica of the modified PMMA.

*The advantages over the alternative fixed options are less susceptibility to chipping, better implant stabilization, and ideal aesthetics.*

### Final Prettau Bridge and Occlusal Guard Delivery

Delivery of the final zirconia Prettau Bridge is similar to delivery of the screw-retained PMMA. Upon insertion, passivity of the final prosthesis should be evaluated and complete seat of the prosthesis confirmed radiographically. The occlusion should be checked and adjusted. Although the occlusion has been previously ascertained at the PMMA stage, small modifications to the occlusion will still be necessary at final delivery (Figures 18 to 20). Phonetics, aesthetics, and cleansability are confirmed. The final prosthesis is then torqued onto the implants according to the manufacturer's recommendations. The use of an occlusal guard may reduce overload from nocturnal parafunction.[13]

Regardless of documentation of bruxism, the authors advocate utilization of an occlusal guard whenever the Prettau Bridge (Tischler Dental) is opposing natural teeth or other fixed implant-supported restorations.

### IN SUMMARY

Part 2 of this 2-part series reviewed both the surgical and prosthetic steps required to achieve successful full-arch, screw-retained, zirconia restorations. The methodical sequencing demonstrated predictable surgical steps of extraction, tissue reflection, alveoloplasty, osteotomy preparation, implant placement, grafting, and implant uncovering. The importance of adequate bone reduction in order to provide sufficient prosthetic space cannot be underestimated. Proper prosthetic steps included: preliminary impressions, delivery of interim prosthesis, final impressions, indexing, verification jig try-in, screw-retained wax-up try-in, delivery of the transitional PMMA restoration, followed by delivery of the final zirconia bridge. If the recommended steps as outlined herein are properly followed, success with the final prosthesis can be predictably achieved.✦

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*Disclosure: Dr. Tischler is the owner of Tischler Dental Laboratory, which produces the Prettau Implant Bridge. He is also on the BioHorizons Implant System Educational panel.*

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*Disclosure: Dr. Ganz has been a past consultant/lecturer for Imaging Sciences, DENTSPLY, AstraTech, Materialize, Osstell, and BioHorizons.*

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*Disclosure: Dr. Patch reports no disclosures.*