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.

**Background: Full-Arch Prosthetic Alternatives**

When treatment planning a screw-retained implant restoration, the material options are acrylic, ceram-o-metal, 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).

Acrylic hybrid bridges have a substantial record of chipping and prosthetic failure throughout time (Figure 3). This is due to the weak mechanical bond to a metal core, and the weak nature of acrylic as a material. By definition, a hybrid bridge is a metal bar with acrylic denture teeth. 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. 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. 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...
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 Zirkonzahn'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). 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. 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.

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 found that a minimum of 12.0 mm of prosthetic thickness measured from the occlusal table to the implant platform is adequate. 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. 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). 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. 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 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. 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). 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. 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. 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).

**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 rigid 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.

**REFERENCES**


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1. The longevity of success for screw-retained zirconia bridges, for the prosthesis and implant survival has proven success, as reported in the literature.
   a. True   b. False

2. Acrylic hybrid bridges have a substantial record of chipping and prosthetic failure throughout time.
   a. True   b. False

3. When a CAD/CAM titanium metal core is used, there are no issues with the acrylic attaching to the titanium because of an increased chemical bond.
   a. True   b. False

4. The success of adjacent dental implants has been shown to be improved through rigid splinting.
   a. True   b. False

5. The authors have found that a minimum of 10.0 mm of prosthetic thickness measured from the occlusal table to the implant platform is adequate.
   a. True   b. False

6. Patients who present with xerostomia represent a multifactorial etiology, with causative factors related to pharmaceutical, aging, autoimmune, or radiation based causes.
   a. True   b. False

7. The advantages and disadvantages of the alternative implant-supported options need to also be presented and documented as part of the patient chart.
   a. True   b. False

8. Using teeth to support a provisional, while implants integrate in a 2-stage manner, offers advantages and disadvantages. The advantage to utilizing teeth for support is that the implants can integrate without pressure from masticatory load—especially in softer bone.
   a. True   b. False
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Please check the correct box for each question below.

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