Addressing bone loss and implant angulation with custom abutments and monolithic zirconia

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Introduction

According to the Misch prosthetic classifications for completely edentulous patients, the FP3 (fixed-prosthesis-3) is an implant restoration that addresses cases with significant tissue loss by including pink gingival areas that replace the lost bone and soft-tissue contours. The FP3 prosthesis allows for the reestablishment of proper function, esthetics, lip support and phonetics while avoiding over-elongated teeth. The fixed nature of this prosthesis type affords the highest levels of stability, chewing capability and patient satisfaction, making it the premium restorative option for fully edentulous cases.

For clinicians who favor the maximum durability and high esthetics of monolithic zirconia, the versatility of dental CAD/CAM technology allows for a screw- or cement-retained restoration. While both of these prosthetic options offer a predictable, highly effective means of restoring the edentulous arch, this article will focus on the indications, treatment protocol and benefits of the cementable full-arch BruxZir restoration (Glidewell Europe GmbH; Frankfurt/Main, Germany) over custom abutments.

Because of bone loss and anatomical factors, some implants must be tilted buccal-lingually in a manner that would situate the access holes on the incisal edge or facial aspect of a screw-retained restoration. The use of custom abutments and a cementable prosthesis corrects the angulation of the implants and eliminates the need for screw access holes. This approach also allows for a prosthesis with less buccal-lingual width in these challenging situations. Using CAD software, custom abutments can be designed in the precise manner needed to support an esthetic restoration. And because the entire body of the restoration is milled from high-strength monolithic zirconia, the problems of wear, chipping and fracture that can occur with layered porcelain, which has traditionally been used in cementable full-arch bridges, are prevented.

Determining whether a cementable FP3 prosthesis is indicated largely depends on the bone characteristics of the patient and the preferences of the practitioner. The clinical workflow for the full-arch BruxZir bridge over custom abutments is relatively simple to follow and includes many techniques used in traditional crown & bridge work. The protocol includes a poly(methyl methacrylate) try-in bridge, which offers a three-dimensional preview of the proposed restoration and is a precise communication tool between the practitioner and dental lab. Any necessary alterations are made to the PMMA try-in bridge, digitally scanned by...
In the following case report, a fully edentulous patient with limited vertical bone volume is provided with a cementable FP3 prosthesis, helping reestablish the hard- and soft-tissue architecture needed for a functional, esthetic restoration. A treatment plan is executed in which the latest advancements in dental implant design, CAD/CAM technology and prosthetic materials are utilized to overcome difficult anatomical circumstances and meet the immediate and long-term needs of the patient.

Case report

A male patient in his early sixties presented for treatment with an edentulous maxilla and grossly decayed, hyper-erupted mandibular dentition (Fig. 1). The patient was a heavy smoker, had not seen a dentist in nine years, and was not taking proper care of his remaining teeth due to pain and discomfort (Fig. 2). The patient’s upper denture had become increasingly loose-fitting since losing his teeth nearly a decade prior. His desire for a restoration that felt and functioned more like natural teeth led him to my practice, where he could undergo the surgical and prosthetic phases of treatment under one roof. Intraoral and radiographic evaluation indicated sufficient bone volume for full-arch implant therapy (Fig. 3).

Treatment options were presented to the patient for his edentulous upper arch and non-restorable mandibular dentition, including various combinations of fixed and removable implant prostheses. This involved a discussion of complete edentulism and its problems, consequences and solutions (PCS), the effect of tooth loss on oral health, and the differences in stability and function afforded by each treatment option. Dental financing programs were explained, which is an important part of treatment presentation, as it can help make implant therapy feasible for patients who cannot cover the entire cost upfront.

Figs. 5a & b: The implant osteotomies were created following a straightforward, user-friendly surgical protocol. Figs. 6a & b: The Hahn Tapered Implants were initially threaded into position with a handpiece.

Fig. 7: With high primary stability established, 3-mm-tall healing abutments were connected to the maxillary implants. Fig. 8: After extracting the patient’s mandibular teeth, a bone-leveling guide was placed over the arch to assist with the alveoplasty procedure. Fig. 9: Bone-level surgical guide seated over the mandible.
The patient strongly desired fixed restorations, as he had grown quite frustrated with his removable maxillary denture over the years. In addition, the patient had a pronounced gag reflex, making the fixed option optimal as it would free up the palate. An FP3 prosthesis was required for the patient’s upper restoration, which had undergone substantial bone resorption and gingival recession. The tissue contours would also need to be recreated in the mandible, where bone leveling was required to remove undercuts, create an ideal occlusal table, properly seat a bone-supported surgical guide, and establish adequate bone width in which to place the implants.

The anatomy of the patient’s ridges called for a cementable solution, as the labial-lingual bone volume required that several of the implants be tilted in a manner that would have required access holes too far to the facial if a screw-retained prosthesis were to be prescribed. This would have been especially problematic for this patient, as cigarette smoking tends to darken the composite used to seal the screw access holes. The patient also desired prostheses that occupied as little facial-palatal space as possible, further indicating a cementable solution. Thus, custom abutments would be utilized to correct the angulation of the implants and support a full-arch BruxZir restoration. The monolithic construction of the FP3 prosthesis, in which both the gingival areas and teeth are milled from the same block of solid zirconia, would ensure the longest-lasting restoration possible.

The patient returned for the records appointment, and upper and lower impressions were made so immediate temporary dentures could be fabricated for delivery at the surgical appointment. CBCT scanning was performed to provide the information needed for virtual treatment planning. The three-dimensional data obtained from the CBCT scans was used to determine the ideal length, width and placement of the implants in the key positions of the patient’s edentulous arches, including the first molar, first premolar, canine and central incisor regions. A total of eight implants would be placed in each arch, facilitating a prosthetic design that minimizes cantilevers and pontic spans.

From the digital treatment plan, a tissue-supported surgical guide was produced for the maxilla while a bone-level guide was created for the mandible, where a flap was required in order to evaluate the extraction sites and perform the alveoplasty.

The Hahn Tapered Implant was selected for the procedure because the pronounced thread design would help achieve optimal positioning and primary stability. The tapered shape and wide range of sizes also simplified the task of situating the implants in the key positions around the arch. Its conical internal hex connection results in a very stable seal between the implant and prosthesis, which is beneficial for crestal bone preservation and soft-tissue health.

At the surgical appointment, IV sedation was administered to the patient. The tissue-level surgical
guide was seated over the patient’s maxilla, and the fixation pins were tightened (Fig. 4). Tissue punches were used to provide access to the preplanned implant sites. The implant osteotomies were created following the simplified surgical protocol of the Hahn Tapered Implant System (Figs. 5a & b). Eight implants were placed from first molar to first molar in the maxillary arch (Figs. 6a & b). Healing abutments were connected to the implants to help prepare the soft tissue for the restorative phase (Fig. 7).

Next, the patient’s untreatable mandibular teeth were extracted, a flap was reflected, and alveoplasty was performed (Fig. 8). A bone-supported guide was seated in order to control the location and angulation of the implant osteotomies (Fig. 9). As the Hahn Tapered Implants were threaded into place, their deep, sharp threads engaged the walls of the socket sites and helped maintain proper position toward the lingual aspect (Figs. 10a & b). Because of anticipated tissue swelling as a result of the bone-leveling procedure, 5-mm-tall healing abutments were connected to the implants in the lower arch (Fig. 11). The immediate dentures were soft-relined to seat over the Hahn Tapered Implant Healing Abutments, the hourglass shape and undercuts of which provided a degree of retention that enhanced dental function for the patient during healing.

Four months later, the healing abutments were removed and the stability of the implants was confirmed (Fig. 12). Hahn Tapered Implant Impression Copings were seated with ease due to their contoured cervical area, which matches that of the healing abutment (Figs. 13a & b). Closed-tray impressions were taken, as well as a bite registration with the patient’s immediate dentures in place. Because the immediate dentures were well-fitting and satisfactory to the patient, duplicates were provided to the lab to aid the restoration design process.

Based on the impressions, the lab poured and scanned stone models, creating a digital representation of the patient’s arches on which the designs for custom abutments and the cementable Figs. 14a & b: Advanced dental CAD software was used to design the custom abutments and the cementable FP3 prostheses, which included gingival areas in order to recreate the bone and soft-tissue contours. Figs. 15a & b: The PMMA try-in bridge and temporary restoration were milled based on the initial digital prosthetic design. Gingival stain was applied to the temporary appliance so it could function as an esthetic provisional.

Figs. 14a & b: Advanced dental CAD software was used to design the custom abutments and the cementable FP3 prostheses, which included gingival areas in order to recreate the bone and soft-tissue contours. Figs. 15a & b: The PMMA try-in bridge and temporary restoration were milled based on the initial digital prosthetic design. Gingival stain was applied to the temporary appliance so it could function as an esthetic provisional.

Fig. 16: Acrylic delivery jigs were used to seat and confirm proper orientation of the Inclusive Custom Titanium Abutments.

Fig. 17: The custom abutments adhered closely to the tissue anatomy of the implant sites, establishing margins at or near the gingival surface.

Fig. 18: The digitally fabricated PMMA try-in appliances were seated over the custom abutments, evaluated and modified to ensure proper fit, function, occlusion and esthetics.
restoration were created (Figs. 14a & b). Note that although the impressions, bite registration and immediate dentures were sufficient for establishing the initial prosthetic design for this patient, the dental lab requires a wax rim and setup try-in in most cases in order to establish the correct centric relation, vertical dimension, interocclusal relationship and other details. Inclusive Titanium Custom Abutments (Glidewell Europe GmbH) were fabricated, and a try-in bridge and a BioTemp's restoration (Glidewell Europe GmbH) were milled from solid blocks of PMMA (Figs. 15a & b).

The patient returned for clinical evaluation of the prosthetic design. The custom abutments were delivered using lab-provided acrylic delivery jigs, which helped ensure proper orientation during seating (Fig. 16). Due to the precision of the digital design process, the fit of the custom abutments was ideal, establishing margins that were at or a slight distance from the gingival surface (Fig. 17). This simplified the removal of excess cement from the margins and illustrates the advantages of CAD/CAM-produced abutments.

The PMMA try-in bridges were seated over the custom abutments, and slight alterations were made to fine-tune the gingival margins, length of teeth, and bite (Fig. 18). The same adjustments were then made to the BioTemp's restorations. A bite registration was taken with the try-in bridges in place. The provisional prostheses were affixed to the custom abutments with temporary cement, functioned well for the patient for the duration of healing, and helped the patient confirm that the prostheses did not present any functional or esthetic issues (Fig. 19).

The PMMA try-in bridges were returned to the lab along with photos, the bite registration and instructions for minor modifications, including lowering the gingival margins of the lower prosthesis and raising the gingival margins of the upper. The lab scanned the adjusted PMMA try-in bridges, made the requested alterations to the prosthetic design, and milled the final prostheses from BruxZir Solid Zirconia.

The final restoration was delivered at the next appointment and established accurate fit, function and interocclusal relationship (Fig. 20). No adjustments were needed for the monolithic zirconia prostheses because of the PMMA try-in process, which captured the precise modifications needed for proper form and esthetics. Final radiography confirmed complete seating of the BruxZir restoration on the Inclusive Custom Abutments (Fig. 21). The patient was extremely happy with the reconstruction of his edentulous arches, which restored esthetics, dental function, comfort and confidence (Fig. 22).

**Conclusion**

The accuracy of dental CAD/CAM technology and the versatility of prosthetic materials allow practitioners considerable flexibility in restoring the edentulous arch. For clinicians who prefer a cementable solution or cases in which bone anatomy precludes a screw-retained prosthesis, the monolithic zirconia restoration over custom abutments excels in restoring the teeth as well as the hard and soft tissue of the fully edentulous patient.

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**Editorial note:** A complete list of references are available from the publisher.