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New Options
for Implant-Borne Restorations

Using Precision Milled Materials to Restore an Edentulous Maxilla

Abstract

This article discusses the use of a precision milled titanium substructure and individually cemented zirconia crowns to successfully rehabilitate an edentulous maxilla. The patient had extreme resorbtion that necessitated both hard and soft tissue simulation. The use of ceramic intended for titanium, as well as high strength zirconia allowed for a successful rehabilitation.

Introduction

With the increasing rate of technological advances in dentistry, new opportunities are constantly presented to patients. One such example is the discovery of the capability of titanium to osseointegrate, a phenomenon that has revolutionized the restorative process for partially or fully edentulous patients. With CAD/CAM technology, numerous materials can be milled to tolerances that are seldom achieved with conventional methods. In addition to titanium implants, CAD/CAM software can compensate for materials that change dimension when sintered such as zirconia and alumina, allowing for extremely accurate fabrication of these custom restorations. One such example will be discussed in this article, which utilized a CAD/CAM milled titanium bar with individually cemented zirconia crowns.

Patient Selection

A male patient in his early 50's presented with a bleak periodontal outlook. His mandible had a number of teeth extracted and restored using conventional fixed partial dentures. His maxilla required greater involvement. The decision was made to extract all of his maxillary teeth and place Lifecore Restore implants (Lifecore Biomedical, Chaska, MN) in the sockets of #3, 5, 8, 11, 12, and 13. The transitional denture was modified with a soft liner designed to place minimal stress upon the mucosa.

Previous restorations on the mandible prevented the idealization of the occlusion on the maxilla. The patient was comfortable with the Class III "edge-to-edge" relationship, so the decision was made to maintain his occlusion. The patient was adamant about not having a removable appliance. The decision was made to proceed with a milled titanium bar fused with porcelain and individually cemented zirconia crowns. This method would provide the patient with a durable option that could be repaired at a minimal cost should the need arise. The distal extensions on the framework would be required to bear the occlusal forces, so the strongest biocompatible material[1] was preferred to prevent flexing of the porcelain support. Furthermore, the one piece design of the framework would distribute the load equally to the implants[2].

An open tray pick-up impression was taken and the preliminary cast was made. Using temporary cylinders and

cast methyl methacrylate, an implant verification index was designed as a "high-water" or "stilted" bar, far enough off the tissue to allow for the accurate impression of the gingival contour when the impression material was flowed between the index and tissue[3]. The implant verification jig was cut using an ultra-thin 2/10mm disk between each implant prior to being screwed into place. Each section was verified for proper seating with x-rays as well as checked for any contact between pieces using dental floss. Each piece of the verification index is luted together using GC Pattern Resin (GC America, Alsip, IL) and picked up in an impression and a new master model was generated using low expansion resin reinforced stone (ETI Empire Direct, Anaheim, CA). On this new master model, an occlusal rim was made using titanium temporary cylinders on four of the implants to secure the occlusal rim in place while a comfortable vertical dimension and centric was determined for this patient.

Temporization and Framework Fabrication

Denture teeth (Vitapan, Vident, Brea, CA) were set into the same occlusal rim and returned for a try-in. This step is crucial to determine the esthetics, phonetics and centric[4] for the new provisional denture as this setup would be used later to create the milled titanium bar. The denture setup was returned after an intra-oral try in and processed into acrylic (Figs. 17, 19, 20). A duplicate of this processed denture was made and the duplicated teeth prepared in the lab to the ideal preparation. This prepared


Fig. 1


Fig. 2


Fig. 3


Fig. 4


Fig. 5


Fig. 6


Fig. 7


Fig. 8


Fig. 9


Fig. 10


Fig. 11


Fig. 12


Fig. 13


Fig. 14

acrylic bar was subsequently "copy-milled" in Commercially Pure Grade4 titanium (CAM StrucSure, Biomet 3i, Palm Beach, FL) (Figs. 1, 2, 9, 10, 11, 12, 13, 14).

To account for the resorbtion of the maxilla, it was necessary to provide a gingival tissue simulation for this case. The creation of a reliable ceramic intended for use on titanium (Vita Titankeramic, Vident, Brea, CA) allowed for the development of a tissue simulation that was natural looking and applicable for this particular case (Fig. 24). Porcelain was used instead of composite or acrylic because of its inherent long term dimensional and color stability. Due to this treatment plan, it was necessary for the bar to be milled out of Commercially Pure Grade 4 (CP4) titanium. Titanium Grades CP3 and CP4 are both indicated for use with titanium porcelain; however, CP4 titanium has a higher tensile strength[5, 6, 7]. The bar was sent to be tried intra-orally and found to be clinically passive after passing the quarter turn screw test[8].

Final Production

The accurate fit of the bar allowed the immediate commencement of porcelain application. Applying porcelain to titanium is very similar to the application to cast ceramic alloy with the exception of a few key steps. When treating titanium for porcelain, it is necessary to create mechanical retention on the surface of the metal. This is achieved by media blasting with 100-150um Aluminum Oxide. Careful application of the opaque agent is necessary to create the ideal surface for the ceramic to adhere to while adequately masking the silver metallic color of the titanium. With several gingival shades currently available from the manufacturer, creating a natural appearance which simulates the gingiva is possible (Figs. 3, 4, 7, 8).

Following the application of the gingival ceramic, the prosthesis was screwed onto the master cast and all undercuts were blocked out for duplication. To obtain an

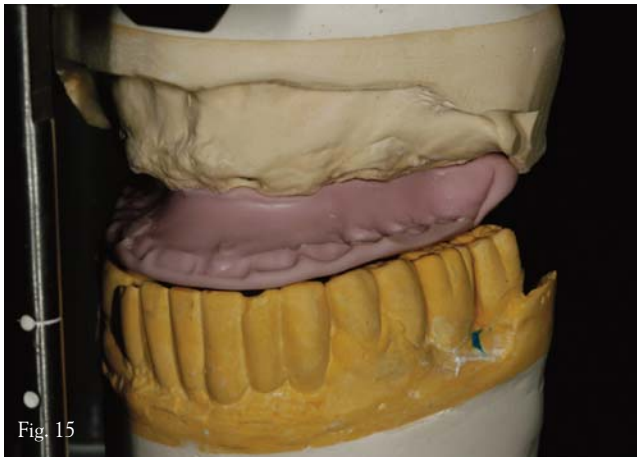
Fig. 15

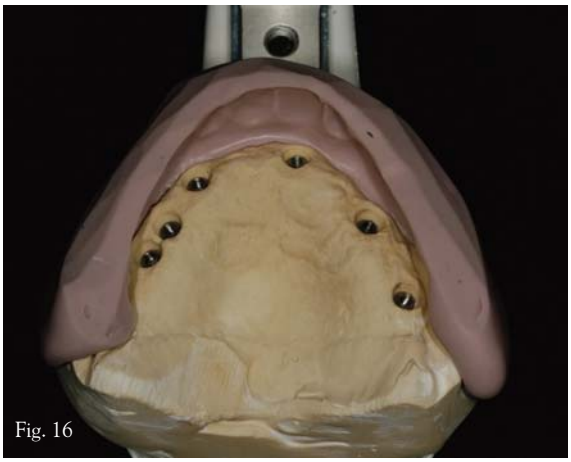
Fig. 16


Fig. 17


Fig. 18


Fig. 19

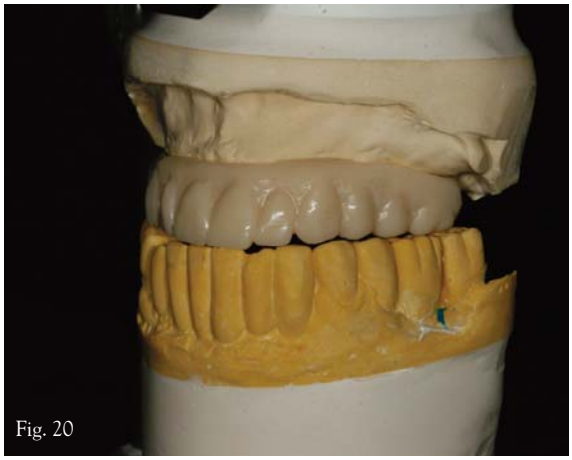
Fig. 20


Fig. 21


Fig. 22

accurate replication of the substructure, ultra-low viscosity polyvinyl siloxane was used (CAPSIL, Captek, Altamonte Springs, FL) (Fig. 23). This model was then poured in low expansion die stone, the dies isolated and the margins ditched (Fig. 5). These dies were scanned using a CAD/CAM optical scanner (LavaScan ST, 3M Espe, St. Paul, MN), and the copings were designed to the appropriate thicknesses providing ideal support for the layering ceramic (Figs. 6, 22).

Delivery of the Restoration

The bar was delivered and the crowns were cemented on top of the preps using resin reinforced luting cement (RelyX Luting Plus, 3M Espe, St. Paul, MN). The patient had no complaints of the porcelain impinging on the tissue and was instructed how to maintain appropriate hygiene and care. A visual inspection of the seated bar showed perfect tissue adaptation. X –rays and a visual inspection verified the passivity of the appliance, which was confirmed with the quarter turn screw test. The appliance had remained accurate despite multiple ceramic firings.

Discussion and Conclusion

Due to the implants having been placed in less than ideal sites (Figs. 16, 18), this type of restoration allowed for a fixed appliance while still maintaining "limited retrievability." In the event that porcelain should fracture from any of the restorations, a replacement could be made individually without re-firing the entire bridge. The combination of precision milled bars and ceramics intended for use with titanium allowed the delivery of just such a restoration. The resistance of the titanium to fatigue when fired in the ceramic furnace eliminated the all too common warping of a one-piece full arch prosthesis.

The bar's adaptation to the tissue allowed for the blocking out of any spaces that may cause trouble with phonetics, but was still hygienic and may be cleaned with ease using an interproximal brush (TePe Interdental Brush, TePe Oral

Fig. 23


Fig. 24

Health Care, Signal Hill, CA)(Fig. 4). The patient is exceedingly compliant and will take steps to guard against any future complications with the implant fixtures[9], ensuring the prosthesis will serve the patient for a long time.

Acknowledgement

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