Use of Precision Milling to Achieve a Passive Fit on a Lost-Wax Framework

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Creating a passive fit with conventional casting techniques on long-span fixed partial dentures (FPDs) is not always possible. It is critical, however, that the restorations are passive when splinted together on root-formed implants, as a poor fit may lead to the application of excessive force to the junction between the cortical bone and the fixture.[1] Although lost-wax casting has in many ways been the "industry standard" for many years, modern technologies allow a more predictable solution. Although many CAD/CAM systems can produce frameworks with incredible accuracy, milling frameworks out of full-arch high-noble alloy may not be economical.

Consequently, technologies such as the Cresco Precision Method (Astra Tech Inc., Waltham, MA) that combine conventional lost-wax techniques with precision milling allow a practical solution to this dilemma. This system utilizes a unique approach to obtaining a passive fit without compromising the strength or homogeneity of the sectioned framework.[2] This article highlights a case presentation in which the fabrication of an aesthetic full-arch, implant-borne restoration was facilitated from a high-noble alloy framework and fused porcelain.

Case Presentation

Preoperative Evaluation and Treatment Planning

A 61-year-old male patient presented with a maxillary overdenture retained by four Locator abutments (Zest Anchors, La Mesa, CA) on implants positioned at tooth sites #5, #7, #10, and #13 (Figure 1). The patient was unsatisfied with his current prosthesis due to its overall thickness as well as the psychological effect of having to wear a removable prosthesis. Since the patient had just received this prosthesis, he was apprehensive about investing the additional time and energy into additional surgeries. The final goal, a fixed restoration that would compensate for the patient's resorbed ridge, necessitated pink porcelain. As separate fixed bridges would have left a visible line on the simulated tissues, a roundhouse design was chosen.

Figure 1. The patient presented with a maxillary overdenture retained by four Locator abutments on implants positioned at tooth sites #5, #7, #10, and #13.

Figure 2. The screw access channels of the selected abutment system were selected for their ability to be modified up to 17 degrees.

Figure 3. The passivity of the framework would be guaranteed through a proprietary milling and welding procedure near the implant interface.

Figure 4. Placement of bridge connectors on the model prior to milling.

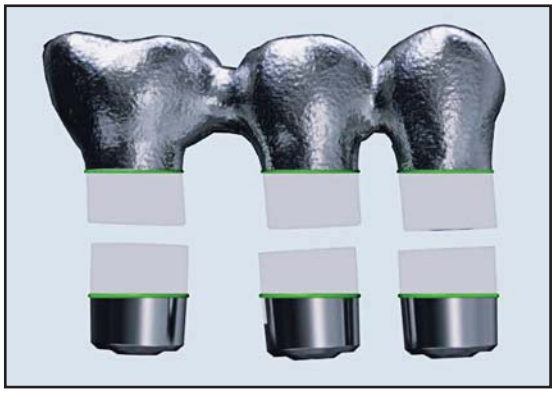

Figure 5. Bridge connectors were milled to match the abutment interface, and the implant-prosthesis connection interface was milled.

Figure 6. The framework was placed on the working model along with the pre-cast bridge connectors.

To properly support this restoration, additional implants would be necessary. A tooth-shaded temporary flangeless denture was fabricated to fit over the existing Locator abutments to provide the oral surgeon with a surgical template. This technique provided the patient with an opportunity to preview the fixed prosthesis (eg, its length, function, lip support).

Restorative Options

The initial treatment plan had been to fabricate custom CAD/CAM titanium abutments with short-span porcelain-fused-to-metal PFDs cemented on top of them. The patient's high lip line and the aesthetic demands of this case, however, dictated the use of a one-piece restoration. After researching the available restorative options, the decision was made to use the Cresco Precision Method (Astra Tech Inc., Waltham, MA) and to follow Treatment Plan IV as outlined by Spiekermann et al.[3] This screw-retained system was selected instead of a traditional bridge over implant abutments because it did not have the associated complications of a cement-retained bridge with respect to retrievability. Unlike cast screw-retained, long-span FPDs, this system offered a solution that was completely passive, ensuring no degenerative forces would be present. The Cresco system's screw access channels could be bent to tolerate up to 17 degrees in any direction (Figure 2), and its trans-gingival abutments could be placed prior to restoration fabrication. These considerations allowed lingualized screw access channels without angulated abutments. Furthermore, the passivity of the framework would be guaranteed through a proprietary milling

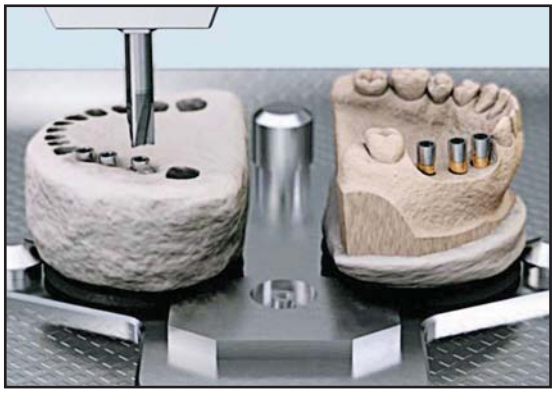

Figure 7. The framework and the bridge connectors were milled simultaneously to achieve a precision mating surface that was then laser welded.

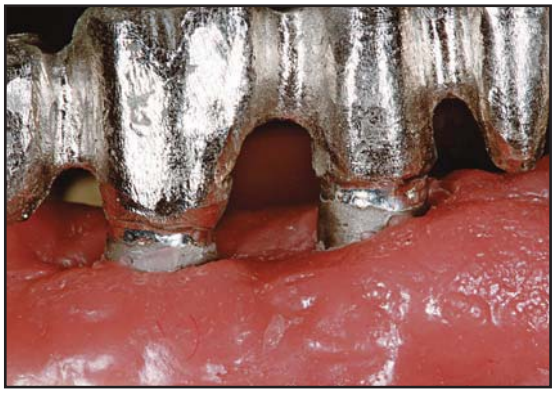

Figure 8. Detail of the passive fit of the framework. The horizontal weld allowed the joints to bear the compressive load.

Figure 9. The anatomic design of the frame helped to guard against porcelain fractures; the passive fit ensured the restoration would provide long-term function.

Figure 10. The frame was seated passively on the model.

and welding procedure near the implant interface (Figure 3). Separate bridge connection burnouts would be cast in the same alloy as the frame and forwarded to an authorized Cresco milling facility for precision finishing (Figure 4).

Framework Design

The working soft tissue cast, which had been generated from a luted verification acrylic jig to ensure accuracy, was sent with the framework and the bridge connection pieces for final milling at the selected Cresco milling facility. The bridge connectors were milled to match the Cresco abutment interface, and the implant-prosthesis connection interface was milled accordingly (Figure 5). The framework was placed on the working model, and the pre-cast bridge connectors were placed on a duplicate model made by the precision-finishing laboratory (Figure 6). Both the framework and the bridge connectors were milled simultaneously to achieve a precision mating surface that was then laser welded (Figure 7). This technique provided the ideal connection for laser welding between the two pieces and compensated for any warping that may have occurred in the casting process. This, in conjunction with the use of horizontal welding, accommodated any irregularities in the solder joints by loading the joint with compressive force in occlusion rather than torsion force (Figures 8 through 10).[4]

The finished framework was sent to be tried in the patient's mouth. It was visually inspected as well as confirmed with radiographs to be completely seated. Passivity was verified at final delivery using the quarter-turn screw test as outlined by Jemt.[5]

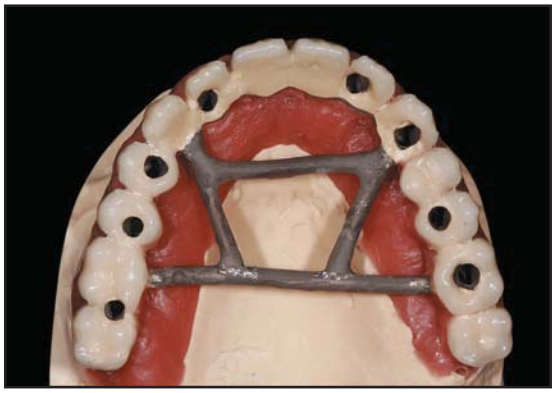

Figure 11. To reduce the risk of warping during ceramic firing, bracing bars were cast and welded to the palatal area of the framework.

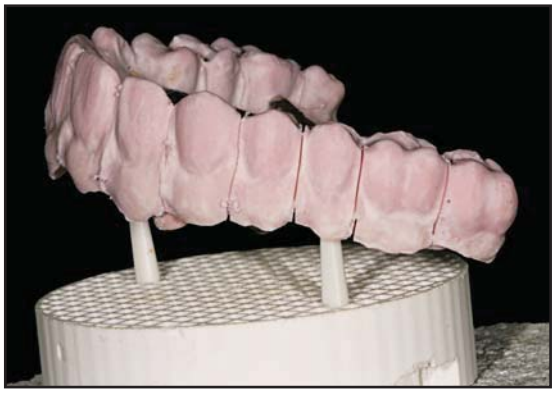

Figure 12. View of the porcelain buildup conducted to render the natural aesthetics of the prosthesis.

Figure 13. The aesthetic porcelain buildup involved the careful replication of tooth and gingival tissues.

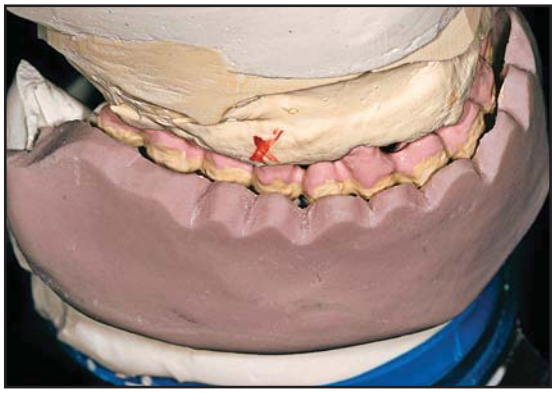

Figure 14. Following the porcelain buildup, occlusion was defined to achieve anterior guidance and balanced centric contacts.

Final Restoration

The patient presented to the laboratory for a custom-shade consultation to determine the appropriate tooth shade as well as gingival shade to successfully blend the restoration with the rest of his oral cavity. To reduce the risk of warping during the ceramic firings, bracing bars were cast and welded to the palatal area of the framework (Figure 11). Porcelain was built up, and the occlusion was defined to achieve anterior guidance and balanced centric contacts (Figures 12 through 14). The desired result—a true-to-life tooth-colored ceramic and a natural gingival simulation—was achieved through careful application of the ceramic (Figures 15 and 16). After the final try-in of the prosthesis, the palatally bracing bars were cut off and the connecting joints were polished (Figure 17).

Delivery

The provisional prosthesis, worn by the patient while pending the definitive implant restoration, was removed and the final was tried in. The framework was again visually inspected and confirmed with radiographs to be seated. Prior to seating the screws, passivity was tested again with the quarter-turn screw test.[5] The prosthesis satisfied the tests and was delivered using the slot-type screws associated with the system and a torque driver to the manufacturer's recommended force.

The restorative dentist supplied the patient with floss (ie, Super Floss, Oral B, Proctor & Gamble, Cincinnati, OH) and interdental brushes (ie, TePe Interdental Brushes, TePe Oral Health Care, Signal Hill, CA) to further facilitate proper oral health care for this compliant patient. This will allow the definitive restoration to serve him for many years (Figure 18).

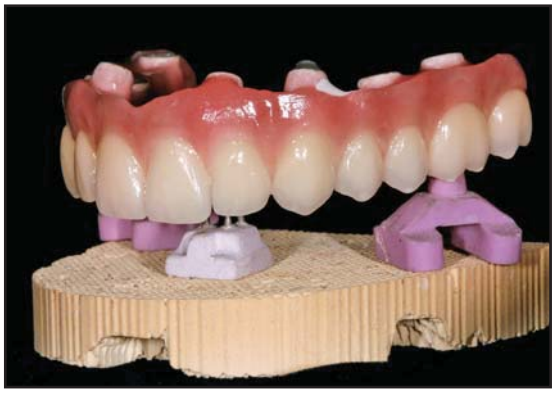

Figure 15. View of the maxillary implant prosthesis following completion of the aesthetic ceramic buildup.

Figure 16. Note the natural form and color of the prosthesis build using the Cresco Precision Method (Astra Tech Inc., Waltham, MA).

Figure 17. View of the final prosthesis try-in. Note the screw access for retrievability.

Figure 18. Postoperative view of the full-arch, screw-retained prosthesis upon seating.

Conclusion

This case presentation has demonstrated the use of a simple technology that combines conventional lost-wax techniques with precision milling for the fabrication of screw-retained implant bridges. This approach not only obtains the desired passive fit of the components but also satisfies the strength requirements of the framework itself. As shown through the high-noble alloy framework and fused porcelain depicted herein, this system presents convenience to dental professionals and continues to elevate the standard of care.

Acknowledgement

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