Using zirconia-based prosthesis in a complete-mouth reconstruction treatment for worn dentition with the altered vertical dimension of occlusion

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Zirconia has been used clinically in restorative dentistry for more than a decade.\textsuperscript{1-3} Because of the development of zirconia technology and methods,\textsuperscript{4,5} zirconia has been used to restore both the anterior and posterior dentition and for fixed dental prostheses and implant prostheses.\textsuperscript{1,6} Zirconia has become popular because of its high strength and toughness,\textsuperscript{4,5} high biocompatibility,\textsuperscript{7,8} low core thickness (0.3 mm anterior; 0.5 mm posterior),\textsuperscript{9,10} minimal framework or marginal distortion during firing,\textsuperscript{11} adequate marginal fit,\textsuperscript{12} small connector sizes for fixed dental prostheses,\textsuperscript{13} acceptable light transmission,\textsuperscript{14} ability to mask discolored teeth,\textsuperscript{15,16} availability of different framework shades, and ease of fabrication by means of computer-aided design and computer-aided manufacturing (CAD/CAM).\textsuperscript{17}

The most common problem in zirconia restorations has been veneer porcelain chipping.\textsuperscript{18-20} The problem has been reduced by designing anatomic frameworks so as to minimize unsupported veneer porcelain,\textsuperscript{21,22} choosing the appropriate veneering porcelain to match the thermal coefficient of the zirconia core,\textsuperscript{18,20} processing with slower cooling rate temperatures,\textsuperscript{18,22} and treating the zirconia core with a silica coating.\textsuperscript{23}

In restoring structurally compromised teeth with complete coverage restorations, achieving optimal retention and resistance form can be challenging.\textsuperscript{24,25} Resin-based cements will enhance restoration retention\textsuperscript{26-28}; however, the bond between the resin and zirconia is unpredictable.\textsuperscript{29} Because zirconia is silica free, bonding cannot be enhanced by applying the traditional ceramic surface treatment of hydrofluoric acid and silane primer.\textsuperscript{30} However, tribochemical treatments\textsuperscript{31,32} (airborne-particle abrasion with silica-coated aluminum oxide) and the subsequent application of primers containing phosphate and/or carboxylic monomers\textsuperscript{32-36} has led to improved zirconia-resin bonding.\textsuperscript{37}

Another challenge in restoring a worn dentition is increasing the vertical dimension of occlusion (VDO) to create restorative space. To determine the needed change in the VDO, clinicians should assess dentofacial esthetics, occlusion, choice of restorative material, and neuromuscular adaptation.\textsuperscript{38}

The complete mouth treatment presented used bonded zirconia on structurally compromised teeth at an altered VDO.

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revealed short teeth (maxillary central incisor heights were 7.5 mm and mandibular central incisor heights were 4 mm), wear of the anterior teeth, several missing teeth, and multiple defective restorations (Fig. 2). Both horizontal and vertical overlaps were 3 mm. A panoramic radiograph (Fig. 3) revealed existing implants on the sites of the maxillary right canine, right lateral incisor, left first premolar, and left first molar (Nobel Replace; Nobel Biocare).

An increase in the height of the maxillary central incisors to 10.5 mm and that of the mandibular central incisors to 7.5 mm was planned based on a dentofacial analysis. From a diagnostic waxing, it was determined that a 4 mm increase in VDO at the incisor area could accommodate 3 mm of vertical and 3.5 mm of horizontal overlap with the new length of teeth as well as a shallower angle of anterior guidance (Fig. 4).38

After the removal of the existing interim restorations, new complete mouth interim restorations based on the diagnostic waxing were made. Subsequent periodontal treatments, foundation restorations on multiple teeth, and endodontic treatments followed by prefabricated foundation restorations on the maxillary right first molar and maxillary right second premolar were provided.

To offset the compromised retention and resistance form (Fig. 2), the margins were redefined and parallel axial walls created on the prepared teeth (Fig. 5). The autopolymerized acrylic resin external forms (New Outline; Anaxdent) were relined clinically to fabricate interim restorations.39 The interim restorations were maintained for 3 months to allow the patient to adapt to a new VDO, clinical crown lengths, phonetics, esthetics, and masticatory function (Fig. 6).2 After the adaptation period, definitive impressions were made with polyvinyl siloxane (Aquasil Ultra; Dentsply Caulk) impression material. A face bow transfer record of the maxillary interim restorations and a centric relation record was made with the anterior interim restorations as an anterior reference point and a silicone interocclusal record (Jet Bite; Coltène/Whaledent).

Definitive casts were poured and fabricated, and the casts of the interim restorations and the definitive casts were articulated with a cross-mounting technique.40 Zirconia copings (Katana; Noritake) were fabricated by CAD/CAM and evaluated clinically for marginal and internal adaptation. After veneer porcelain (CZR; Noritake) was applied, the esthetics, marginal and internal fit interproximal contacts, and occlusion were evaluated at the bisque bake stage. Minimal occlusal adjustments were required.

The internal surfaces of the zirconia restorations were airborne-particle abraded with tribochemical silica coated 30 μm Al₂O₃ (CoJet; 3M ESPE). A zirconia primer was then applied for 5 seconds (Z Prime Plus; Bisco) and air dried. The teeth were also treated with 30 μm Al₂O₃ (CoJet; 3M ESPE), followed by a 30-second application of desensitizer (Gluma; Heraeus Kulzer). Customized zirconia/titanium implant abutments (Procera; Nobel Biocare) were tightened to 35 Ncm, and their seating was verified with periapical radiographs.
The zirconia crowns were cemented with self-etching dual-polymerized adhesive (All-bond SE; Bisco), followed by dual-polymerized resin cements (Duo-Link; Bisco) that were light polymerized. The cemented implant-supported crowns and FDPs were cemented with interim resin cements (Premier Implant Cement; Premier Products Co) for future retrievability. The patient was instructed on oral hygiene, care of the new

Figure 4. Diagnostic waxing.

Figure 5. Frontal view of prepared teeth.

Figure 6. Smile with interim restorations.

Figure 7. Two-year postoperative frontal view.

Figure 8. Postoperative maxillary occlusal view.

Figure 9. Postoperative mandibular occlusal view.
prostheses, and the wearing of a heat-polymerized clear occlusal device.

SUMMARY

This treatment of a worn dentition was successful in gaining restorative space by an alteration of the VDO. The treatment demonstrated that the retention and resistance of zirconia-based restorations can be improved by using an appropriate primer and luting agent (Figs. 7–11).

REFERENCES

Noteworthy Abstracts of the Current Literature

Surface characteristics and corrosion properties of selective laser melted Co-Cr dental alloy after porcelain firing

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Objective. We examined the surface characteristics and corrosion properties of selective laser melted (SLM) cobalt-chromium (Co-Cr) dental alloys before and after porcelain-fused-to-metal (PFM) firing.

Methods. Samples were manufactured utilizing SLM techniques and control specimens were fabricated using traditional casting methods. The microstructure and surface composition were examined using metallographic microscopy, X-ray diffraction (XRD), and X-ray photoelectron spectroscopy (XPS). Corrosion properties were evaluated using electrochemical impedance spectroscopy. Student’s t-test was used to evaluate differences in numerical results of electrochemical corrosion tests between SLM and cast specimens before or after PFM firing. The results of electrochemical corrosion tests of the SLM and cast samples before and after firing were analyzed using one-way ANOVA.

Results. Although PFM firing altered the microstructure of the SLM specimens, they still exhibited a compact and homogeneous structure, and XPS analysis indicated that there were no significant differences in the surface composition of the specimens after firing. In artificial saliva at pH 5, the Rp value of the SLM specimens was 6.21MΩcm(-2) before firing and 2.84MΩcm(-2) after firing, suggesting there was no significant difference in electrochemical corrosion properties (P>0.05). In artificial saliva at pH 2.5, the Rp value of the SLM group was 4.80MΩcm(-2) before firing and 2.88MΩcm(-2) after firing, again indicating no significant difference in electrochemical corrosion properties (P>0.05). At pH 2.5, there was a significant difference in corrosion behavior between the cast and SLM groups, with the Rp value of the cast group being 0.78MΩcm(-2) vs. 2.88MΩcm(-2) for the SLM group.

Significance. The improved post-firing corrosion resistance of SLM specimens provides further support for their use in prosthodontic applications, as the oral environment may become temporarily acidic following meals.

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