Seating zirconia-based posterior fixed partial dentures with a phosphate primer and an acrylic adhesive resin: A clinical report

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This article reports bonding technique and clinical performance of ceramic fixed partial dentures (FPDs) applied to a metal allergic patient. Frameworks of mandibular four- and three-unit FPDs were fabricated with a tetragonal zirconia polycrystal (TZP) material (Cercon) and veneered with feldspathic porcelain (Cerabien ZR). After try-in, the surface to be bonded was air-abraded with alumina (0.2 MPa), and treated with a single liquid primer (Alloy Primer) that contained a hydrophobic phosphate monomer (MDP). Abutment dentin surfaces were etched with 10% citric acid-3% ferric chloride (10-3) aqueous solution, and the FPDs were bonded with a tri-*n*-butylborane (TBB) initiated adhesive resin (Super-Bond C&B). After an observation period of two years, both FPDs were functioning satisfactorily. The materials and procedure reported here are applicable as an option for a prosthodontic treatment for the patients incompatible to specific metallic elements.
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Key Words: adhesive, ceramics, fixed partial denture, primer, zirconia

Introduction

Replacement of missing teeth in both the anterior and posterior regions is important for recovering tooth anatomic form, natural appearance, mastication, and other oral functions. Prosthodontic treatment for medically compromised patients is more difficult than that for physically healthy patients. Removable, fixed, and implant-supported dentures are used according to the location and number of teeth to be recovered, as well as condition of the abutments. Among the prosthodontic appliances, single restorations and fixed partial dentures (FPDs) with zirconia coping or framework are currently applicable and acceptable as an option for the replacement of missing teeth.[1-7]

Zirconia ceramics are being used in fabrication of denture frameworks and copings for single restorations. Varying materials and techniques are currently available for bonding zirconia; 1) silica sintering,[8] 2) tribocheminal coating,[9,10] and 3) application of a hydrophobic phosphate monomer.[8,10-13] Although a number of adhesive systems for seating zirconia restorations have been reported, only limited information is available concerning the clinical performance of zirconia restorations seated with a specific bonding system. This clinical report describes a technique for seating zirconia-based FPDs with a phosphate-based primer and a tri-*n*-butylborane initiated adhesive resin.

Clinical Report

A 74-year-old male patient, who had been diagnosed as pustulosis of palms and soles (Pustulosis palmaris et plantaris), presented with functional disturbances as a result of a missing mandibular right second premolar, first molar, and left molars. The patient was allergic to specific metal-protein complexes, and had undergone extraction of premolar and molars due to periodontitis. Several treatment options were therefore proposed: 1) ceramic implant; 2) a titanium-based removable partial denture (RPD); and 3) cermic FPD with considerable tooth reduction. The patient chose the third of the proposed options. The prosthodontic procedure was then explained in detail and consent was obtained from the patient.

Fig. 1. Abutment preparation for the right FPD

Fig. 2. A four-unit zirconia-based FPD

Figs. 3 and 4. The surfaces to be bonded were air-abraded with alumina under 0.2 MPa air pressure.

Fig. 5. Application of Alloy Primer with MDP

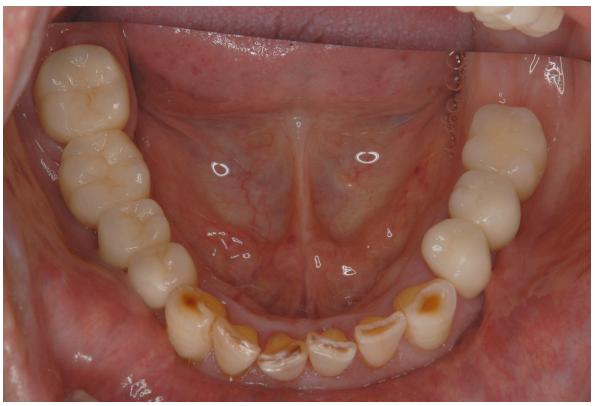

Fig. 6. Occlusal view after two years of posterior FPDs

For the prosthodontic procedure, fabrication of two fixed partial dentures was planned. The procedure started after improvement in the condition of the periodontal tissues of abutments. Intercuspal position and lateral mandibular movement were examined intraorally with articulating paper and wax materials, and were examined extraorally using a stone cast mounted on an articulator. After examination of the maxillo-mandubular relation, the areas and thickness to be reduced were determined. Considering the age of the patient as well as appearance of pulp chamber detected from the radiographs, possible amount of reduction for the occlusal plane and axial walls were estimated as approximately 1.5 and 1.2-1.5 mm, respectively. Reduction was then performed by means of a high-speed diamond rotary cutting instrument with marginal rounded shoulder preparation (Fig. 1). Frameworks of a right four-unit FPD (Fig. 2) and a left three-unit cantilevered FPD with a flat back pontic were fabricated with a tetragonal zirconia polycrystal (TZP) material (Cercon, Dentsply/Sankin, Tokyo, Japan).

Feldspathic ceramic material (Cerabien ZR, Noritake Dental Supply, Miyoshi, Japan) was layered entirely surrounding the frameworks, and sintered in an electric furnace for the reproduction of tooth color.

The completed FPDs were tried-in at the next appointment. The inner surfaces of the retainers were air-abraded with 50- to 70-μm grain sized alumina (Hi-Aluminas, Shofu Inc., Kyoto, Japan) using an airborne particle abrader (0.2 MPa pressure; Jet-Blast II, J. Morita Corp., Suita, Japan) (Figs. 3 and 4), and treated with a single liquid primer (Alloy Primer, Kuraray Medical Inc., Tokyo, Japan; Fig. 5) that contained 10-methacryloyl-oxydecyl dihydrogen phosphate (MDP). The abutment dentinal surfaces were conditioned with 10% citric acid-3% ferric chloride (10-3) aqueous solution (Green Activator, Sun Medical Co., Ltd., Moriyama, Japan), washed with water, and air-dried. The FPDs were then seated with a tri-*n*-butylborane (TBB) initiated adhesive resin (Super-Bond C&B, Sun Medical Co., Ltd.). The patient then entered a maintenance program. After an observation period of two years, the FPDs were still functioning satisfactorily (Fig. 6).

Discussion

One of the problems associated with prosthodontic treatment for metal allergic patients has been difficulty in fabrication of both fixed and removable dentures. Due to the pustulosis of palms and soles, application of metallic FPDs to this patient appeared to be contraindicated. The dentist in charge of the patient proposed options for prosthodontic treatments, and the patient accepted fabrication and seating of zirconia-based FPDs. Transitional acrylic FPDs were bilaterally seated for about three months. No side effects derived from the acrylic resin were detected. Considering the clinical courses of zirconia FPDs,[1-7] frameworks of the left four-unit FPD and the right three-unit cantilevered FPD were fabricated with the Cercon TZP material and veneered with feldspathic porcelain (Cerabien ZR). The reason for selecting the Cerabien ZR porcelain was excellent bonding between zirconia and the porcelain material.[14]

Alumina abrasion after try-in was performed with 0.2 MPa air pressure. The pressure was approximately 1/2 to 1/3 as compared with that for metallic substrates. Although both porcelain and zirconia are considerably hard and rigid materials, loss of marginal structure by alumina blasting appeared to be apparent for the ceramic materials, if air pressure for the alumina abrasion is excessive. Care must be taken therefore with the blasting alumina especially around the marginal areas.

A single liquid primer (Alloy Primer) that contained MDP was used for priming the zirconia. This is based on the literature reporting the effectiveness of the MDP for bonding zirconia[8,10-13] Durable bond to abutment dentin can be achieved by mild etching with 10-3 solution for 10-15 s. However, clinicians should be aware that the 10-3 etching is effective only for combined application with the TBB initiated Super-Bond C&B resin. It is reported that the light transmittance of zirconia is 42-72% as compared with that of feldspathic porcelain.[15] The authors therefore did not use dual-curable luting agent for seating the zirconia FPDs.

During the observation period, both FPDs were functioning satisfactorily. In particular, resistance to occlusal loading of both cantilevered FPD framework and zirconia-porcelain bonding was confirmed. The materials and procedure presented in this report are applicable as one of the options of a prosthodontic treatment for the patients incompatible to specific metallic elements.

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