Case Report

A New All-ceramic Zirconium Post and Core System

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Clinical significance

The results of this study suggest that good esthetic results and improvements in gingival color, degree of inflammation, pervasive bleeding, and skin responses caused by dental metal allergies can be achieved even on discolored or endodontically treated teeth using the newly developed all-ceramic post and core.

ABSTRACT

Purpose : A study was done to investigate the use of a newly developed esthetically and mechanically superior all-ceramic zirconium post and core system (CosmoPost®, Ivoclar, Liechtenstein). Fabrication techniques and clinical cases are discussed.

Materials and Methods : CosmoPost®s are cylindrical conical-shaped posts made of ZrO₂-TZP and are marketed with corresponding rotary drilling and trimming instruments. The ceramic cores can be fabricated by either direct or indirect methods.

Results : The authors have used zirconium all-ceramic posts and cores since 1997 to improve esthetics and to treat cases of dental metal allergy. Results at achieving natural tooth color and translucency have been evaluated as excellent. No failures of crowns, post and cores have been observed up to the present.

Conclusion : Good esthetic results and improvements in the oral soft tissue in cases of dental metal allergy can be achieved using the newly developed all-ceramic post and core.

Key words

zirconia post, all-ceramic post and core, Empress® post and core, CosmoPost®

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INTRODUCTION

All-ceramic post and core materials made of ZrO_2 -TZP (tetragonal zirconium polycrystals) stabilized with 3 mol% Y_2O_3 were recently introduced¹⁻⁷. These post and core systems are based on a hybrid-type composite^{1,2}) or castable ceramic attached to the zirconium post³⁻⁷). However, it is uncertain whether the core portion can achieve the strength and longevity required without the occurrence of internal cracks in the core itself or at the interface between the core and post²⁻⁴).

The purpose of this study was to examine an esthetically and mechanically superior zirconium post and ceramic core system called Empress CosmoPost[®] 6,7). The materials and fabrication techniques (chairside and laboratory procedures) are described in the first part of this paper ; in the second part, the results of clinical cases are discussed.

MATERIALS AND METHODS

Empress all-ceramic core materials (Ivoclar AG, Schaan, Liechtenstein) are viscous leucite-reinforced glasses that are fabricated using a lost-wax investment mold^{6,7}). A highly translucent ceramic ingot (Cosmo[®], Ivoclar AG) is

provided (Fig. 1). The all-ceramic posts in this system are made of tetragonal zirconium polycrystals (ZrO_2 -TZP) stabilized with 3 mol% Y_2O_3 (CosmoPost[®], Ivoclar AG) ; they are manufactured in two different diameters (1.4 and 1.7 mm) and are 20.5 mm long (Fig. 2). The different diameters minimize problems encountered when fitting the post in the root canal. Conventional rotary drilling and trimming instruments with corresponding diameters are included in the set⁸).

Post and Core Fabrication

1. Chairside procedures (Part 1)

This post and core system is recommended for non-vital anterior or premolar teeth. For premolar teeth with two root canals, the larger or longer canal is selected (Fig. 3).

After endodontic treatment, any softened dentin is removed and sharp corners are rounded. At least one half of the height of the prospective crown preparation should be conserved in the dentin so that the crown margins will encompass the remaining cervical dentin by at least 2 to 3 mm vertically (Fig. 1). The preparation must establish a root face, core margins, and all-ceramic crown margins that are not flush with the gingiva (Fig. 1).

After preparation, the correct zirconium post is selected according to the diameter of the root

Fig. 1 All-ceramic posts and cores and preparations for crowns

Fig. 2 Zirconium posts (CosmoPost[®]) and instruments for drilling and trimming

Fig. 3 All-ceramic posts and cores for anterior and premolar teeth

Fig. 4 Direct build-up technique using resin pattern materials

Fig. 5 Ceramic post and core after heat pressing

canal and is tested for fit. A dental X-ray radiograph is taken to check the length of the post in the canal. The post should be about 5 mm short of the root apex to minimize the risk of root fissures and subsequent vertical root fracture.

2. Laboratory procedures

An impression of the ceramic core can be obtained using either a direct or indirect method.

1) Direct method

This method involves a direct build-up technique using resin pattern materials such as GC Pattern Resin (GC, Tokyo, Japan) or DuraLay (Reliance Dental Mfg., Worth, IL, USA). The resin pattern is built up directly in the root canal.

Fig. 6 Impression of the post inserted into the root canal

Before the conventional build-up procedure takes place, the entire post surface must be sandblasted with $50\ \mu\text{m}\ \text{Al}_2\text{O}_3$ at 4 bars pressure, then cleaned with chloroform to improve the retention between the post and the ceramic core after the ceramic ingot is pressed. However, CosmoPost®s are pre-sandblasted by the manufacturer. After preparation of the tooth, including making the resin pattern, the pattern is carefully removed (Fig. 4), sprued with $\phi\ 2.5\text{--}3\ \text{mm}$ wax sprues and invested immediately using the IPS Empress® staining technique investment material.

The IPS Empress® EP 500 furnace (Ivoclar AG) is used to press the ceramic ingot. After devesting and sandblasting, the sprues must be cut and carefully removed because of their brittle characteristics. Then the ceramic post and core are ultrasonically etched in 2% HF (hydrofluoric acid) solution for 7 minutes (for lower incisors or premolars) or 10 minutes (for canines or upper central incisors) for better fit of the ceramic core. Ultrasonic etching is performed because the IPS Empress® ceramic core size after pressing is slightly bigger than the original wax pattern. After etching, the etched layer is sandblasted with glass beads at 2 bars pressure (Fig. 5).

2) Indirect method

In this method, the zirconium post is inserted into the root canal and an impression is taken (Fig. 6). After the working master model and die are fabricated, the post must be removed

carefully to preserve a clear finishing line on the margin. Stone die hardening resin is applied on the margin, but a die-spacer should not be used on the prepared root surface because of the possible decrease of retention or fit of the internal core surface. If necessary, an occlusal registration bite record and an impression of the opposing dentition are taken at chairside.

Wax patterns are made on the working model, which are then sprued, invested and pressed in the same way as described for the direct build-up resin pattern. Several teeth can be prepared at the same time using this method.

After pressing, the internal surface of the Empress® ceramic core is examined under the microscope. Bubbles, flaws, and surface roughness are removed, and then the core is ultrasonically etched in 2% HF solution for only 5 minutes. After etching, the etched layer is sandblasted with glass beads at 2 bars pressure.

3. Chairside procedures (Part 2)

At the chairside, the all-ceramic post and core are placed, and the post length is checked by X-ray. If the fit is acceptable, the internal surface only of the ceramic core is etched with an etching gel, such as IPS Ceramic Etching gel® (Ivoclar), Vita Ceramics Etch® (Vita, Bad Sackingen, Germany) or HF Acid gel® (GC), to improve the retention of the core following cementation. The core is cleaned with steam, and then silane is applied over the etched layer.

The ceramic post and core are cemented with a dual cure resin luting cement (PANAVIA Fluoro Cement®, Kuraray, Kurashiki, Japan; IPS-Empress Cem Kit®, Ivoclar) applied with a dentin bonding system. After final preparation of the all-ceramic crown, a definitive impression is taken. The final restoration is also cemented with dual cure resin cement and a dentin bonding system.

Fig. 7 Case 1 : Final preparations for all-ceramic crown (teeth 7, 10)

Fig. 8 Case 1 : Final clinical result of Empress® crowns

Fig. 9 Case 2 : Preoperative situation

Fig. 10 Case 2 : Abutments for all-ceramic crowns and PFM bridge (tooth 10)

Fig. 11 Case 2 : Result of final restorations

RESULTS OF CLINICAL CASES

The authors have used Empress® zirconium all-ceramic posts and cores in Japanese patients since 1997 for esthetic improvement and in cases of dental metal allergy with patient consent. The results were evaluated in terms of damage to the crown, changes in the surface texture, fit, improvement in gingival color, degree of inflammation and pervasive bleeding. No failures from damage to crowns and all-ceramic posts and cores have been observed up to the present. The esthetic results were evaluated as excellent, based on the natural tooth color and translucency. The conditions of the oral soft tissue gradually improved after the cementation of IPS

Empress® crowns. Four typical cases are shown after the cementation of the zirconium all-ceramic post (CosmoPost®) and Empress® core (Cosmo®) (Figs. 7-17). Figs. 8, 11, 15 and 17 show the cases 6 to 12 months after cementation of the final Empress® crowns.

DISCUSSION

For non-vital, endodontically pretreated teeth, the use of a natural tooth-colored post and core build-up is desirable. The Empress® ceramic core material is a leucite-reinforced ceramic formed using the lost-wax investment mold technique. For this heat-pressing technique, there is no need to purchase new equipment, provided that the IPS Empress® furnace

Fig. 12 Case 3 : Preoperative situation (dental metal allergy)

Fig. 13 Case 3 : Skin response from dental metal allergy before treatment

Fig. 14 Case 3 : All-ceramic posts and cores for Empress® crowns (teeth 6, 7, 8, 9, and 10)

Fig. 15 Case 3 : Result of final Empress® restorations

Fig. 16 Case 4 : Preoperative situation (dental metal allergy)

Fig. 17 Case 4 : Gingival color, degree of inflammation, and pervasive bleeding gradually improved after the cementation of Empress® crowns

(EP 500, Ivoclar) is already available⁹⁾. An *in vitro* study showed that from the point of view of the retention of the post and core, this pressing technique was at least as good as the cementation technique using a resin core⁷⁾. The pressing system allows the use of the direct core build-up technique for a single unit, and the use of the indirect method when more than one post and core has to be fabricated at the same time. However, the problem with the direct build-up method is that the fit of the core cannot be controlled, resulting in long chair-side time during the cementation of the core. In the indirect method, a working model or die must be made. The zirconium post is inserted in advance, and then a final impression is taken. The finish line is clearly marked on the model, and wax patterns are reconstructed. The advantage of this method for the practitioner is the ability to control the forms, fit and thickness of the all-ceramic core materials on the working model.

The final crown is made from the newly developed translucent IPS Empress[®] ingot material using a layering technique. This material was specially developed for anterior teeth¹⁰⁾.

Good esthetic results and improvement of gingival color, degree of inflammation, pervasive bleeding, and skin response for dental metal allergy (Figs. 13, 16, and 17) can be achieved even on discolored or endodontically treated teeth using the newly developed all-ceramic post and core.

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