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Case Report

The Customized Forming of the Applied Post-Core System: Case Reports

Abstract

The high success rate of endodontic treatments caused an increase in demand for the post-core systems in restoration of severely damaged teeth. Although metal posts are the most commonly used alternatives, the metallic color and the opaque appearance of these materials lead to discoloration of the gums and the roots. Thus, non-metal posts systems could be preferred over metal posts to be used with all-ceramic crowns. Due to their superior mechanical and biological properties, CAM/CAD fabricated zirconia post and cores can be applied inside the root canal and can be supported with ceramic crowns. Hence, the aesthetic concerns could be attended quickly and with ease. This article presents the prosthetic rehabilitation treatment of two patients with severe dentin loss, using CAD/CAM fabricated post-core and zirconia base crowns.

Introduction

In the restoration of endodontically treated teeth with extensive coronal damage, a post-core is recommended to enhance support and retention of the crown [1-3]. These post core models are produced using various materials such as titanium, carbon, polyethylene fiber and stainless steel. However, corrosion reaction of metal posts cause metallic taste, oral burning, oral pain, sensitization and other allergic reactions. Metal posts also have negative effects on the aesthetic results, which lead to the increased preference of all-ceramic restorations [4]. Non-metal posts are superior to metal posts, both due to health and esthetic concerns. With non-metal posts corrosion reaction doesn't occur and chance of toxicity is very low. The available color options are also closer to the tooth color. As a result of these advantages, a number of different all-ceramic posts, such as fiber reinforced composite resin posts (FRC) and yttrium-stabilized zirconia-based ceramic posts has been widely available for the restoration of teeth [4-7]. The use of zirconia as a post and core was introduced by Meyenberg et al. in 1993 [8].

The CAD/CAM technique provides high precision and quality in a shorter period of time. Especially in the restoration of teeth with all ceramic crowns, the CAD/CAM system produces superior results in satisfying the aesthetic demands of the patient. This technique is particularly advantageous with cases that require building custom posts. Custom made posts enhance adaptation to prepared canal wall. The current CAD/CAM system use alumina or partially sintered zirconia blocks to mill a post and core. It achieves notable precision in building posts. It is also relatively quicker, since a post and core can be completed in the same appointment, when using this technique [8-10].

This paper reports two cases of yttrium-stabilized zirconia-based ceramic post restorations, which are manufactured using the CAD/CAM (Dental Wings, Montreal, Kanada) technique, for two patients with severe coronal loss.

Case I

A 22 year-old female patient came to our hospital with a severe sensitivity complaint in the first right and left maxillary molar teeth. The radiographic and intraoral examination of the teeth 16 and 26 displayed the previous restoration of the caries in these teeth. However, the composite filling treatment seemed to have failed due to the passive eruption of mandibular teeth, which caused a decline in the occlusal distance (Figure 1). As a result of the increasing complaints of the patient, a conventional endodontic treatment was approved. After considering the aesthetic concerns of the patient, and the short supragingival crown height, CAD/CAM (Dental Wings, Montreal, Kanada) fabricated zirconia post and cores, and ceramic crowns were planned as the restoration treatment to enhance the retention of the crown.

Following the endodontic treatment of the teeth, a portion of the gutta percha was removed preserving $\frac{1}{3}$ of the apical seal using burs (Gates Glidden; Sendoline, Sweden). The coronal portion of the teeth was prepared to prevent acute angles between the post surfaces and the apical surface of the core-post junction because the laser scanner of the CAD/CAM system can read rounded internal line angles better.



Figure 1: Appearance of the teeth from occlusion before the restoration.

Water irrigation prior to acrylic resin placement in the root canals is performed also to prevent the posts from getting stuck in the canal. To record the anatomies of the canals, the plastic posts (Spee Dee Plastic Pins; Pulpdent Corp, Watertown, USA) were covered with autopolymerizing acrylic resin (GC Pattern Resin; GC Corp, Tokyo, Japan) and then inserted into the canals. The posts were kept in position for a few seconds and then quickly removed to check their accuracy. To prevent the posts from getting stuck in the canal, the posts were continuously moved in and out of the canal until they were completely polymerized. The post patterns were placed in the canals and the cores were completed using acrylic resin. The teeth and the polymerized post and cores were prepared using diamond rotary cutting instruments.

To guarantee the correct alignment of the junctions, the post and core patterns were placed in the scanning ring of the CAD system horizontally. The scanned post and core patterns were milled from a zirconia block (Zirkonzahn, Switzerland). Exact copies of the patterns were produced by the CAM system. Later, these copies were put in the sintering furnace (Figure 2). The sintering process was completed at 1430°C in approximately 6 hours. Following the sintering, the fit of the zirconia post and cores with the teeth were controlled (Figure 3) and they were cemented using dual cure resin cement (Variolink II, Ivoclar Vivadent, Schaan/Leichtenstein). For the cementing process, 37% orthophosphoric acid (Total etch) was applied inside the canals and cleaned after 30 seconds. Enamel and dentin bonding (Syntac Primer - Syntac Adhesive) system was applied as prescribed by the manufacturer. The transparent adhesive resin cement base and catalyst pastes (Variolink II, Ivoclar Vivadent, Schaan/Leichtenstein), mixed in a 1:1 ratio in accordance with the manufacturer's instructions, were applied and the excess was overflowed. The excess cement was removed with the help of a probe and irradiated for a period of 40 seconds in each direction. To fabricate zirconia-based crowns, impressions were taken using silicone-based materials. Crowns were manufactured with the same CAD/CAM procedure used for the zirconia-based post and cores. After both the marginal fit, and the internal fit, occlusal and proximal contacts were examined during the try in (Figure 4). The crowns were cemented with the adhesive procedure explained in the preceding paragraph (Figure 5).

Case II

The sixteen year old patient had enamel hypoplasia on all her teeth. A screwed post core system with composite filling was applied to her mandibular right central tooth in our faculty's pediatric dentistry clinic, however the filling had come off (Figure 6). Esthetic concerns of the patient were evaluated and CAD/CAM fabricated zirconia post and core and ceramic crown were decided to be used to enhance the retention of the crown on the short-rooted tooth.

The tooth, which had post preparation due to a previous endodontic treatment, was prepared to avoid any angles and, consequently, to improve the readings of the CAD/CAM laser scanner. The canal was cleaned with water. The plastic post was inserted into the canal and covered with auto polymerizing acrylic resin (GC Pattern Resin; GC Corp, Tokyo, Japan). Polymerized post and core was prepared using



Figure 2: zirconia post-cores after sintering.



Figure 3: Fitting of zirconia post-cores.



Figure 4: Zirconia based crowns after sintering.



Figure 5: Fitting of zirconia based Crowns.

diamond burs on the surface of the tooth. A one-to-one copy of the scanned post and core model was milled from a zirconium bloc. The milled zirconium post and core was put into the oven for sintering. Following the sintering (Figure 7), the compatibility of the zirconia post and core with the tooth was checked (Figure 8). Cementing process was performed as explained above using the dual cure resin cement (Variolink II, Ivoclar Vivadent, Schaan/Leichtenstein). An impression was taken using silicone-based materials to fabricate zirconia-based crown. Crown was manufactured with the CAD/CAM. After the marginal fits were examined (Figure 9), the crowns were cemented with the same adhesive procedure.

Discussion

The high success rate of the current endodontic treatments increased the demand for the use of post and core systems in the restoration of the damaged teeth. Prefabricated post and core systems



Figure 6: Appearance of mandibular right central tooth.



Figure 7: Zirconia post-cores after sintering.



Figure 8: Fitting of zirconia post-core.



Figure 9: Fitting of zirconia based Crown.

are widely used due to the speed and the relatively lower cost of their application; however they lack in strength and aesthetics. Currently the strongest and the most durable ceramics in dental use are the yttrium-stabilized tetragonal zirconia polycrystals (Y-TZP). During mastication, the tetragonal crystal phase of Y-TZP transforms to a monoclinic phase [11,12]. The associated expansion in volume creates internal stress, which opposes the external pressure. This stress-induced phase transformation prevents fractures, that are frequently observed in traditional ceramics [11,12]. The high elastic modulus of zirconia however, is not considered an attractive characteristics for post-core restorations, given that great differences in the elastic modulus between the zirconia post and dentin could lead to root fractures. Zirconia based ceramic is also superior in the color match, specifically of anterior teeth and biological compatibility [13,14]. Therefore it yields more natural results in applications.

With the CAD/CAM systems technology, fabrication process is significantly shorter and achieves high precision [15,16]. Even though the currently available CAD/CAM systems are not programmed for fabrication of post-core restorations, our case reports illustrate that zirconia ceramics are remarkably convenient for this technology. In their soft pre-sintered condition, the machinable zirconia ceramics can be designed and milled.

Both cases presented in this report have been followed up over a period of three years with no evidence of fracture, debonding, or change in aesthetic qualities.

Conclusion

The all-ceramic post-core-crown restoration can an encouraging treatment modality for the aesthetic restoration of damaged teeth. The use of CAD/CAM technique for the construction of occlusal contact entirely in high-strength zirconia ceramic significantly can reduce the possibility of failure of the restoration due to fracture. It can also provide an anterior tooth restoration with exemplary esthetic properties.

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