

CAD/CAM POST-AND-CORE: DIFFERENT MATERIALS FOR ESTHETIC AND FRACTURE STRENGTH

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Abstract: A post-and-cores are dental restorations used to sufficiently build up tooth structure for future restoration with a crown, when there is not enough tooth structure for proper retaining, due to loss of tooth structure from decay or fracture. Posts are cemented into canals to enhance retention and to aid in creating a seal along the canal. There are many different post-and-core systems, prefabricated and custom made, but none can provide perfect restorative solution for every clinical case.

Digital dentistry (CAD-CAM) is widely present in the laboratory and dental offices. It is precise, fast and simple technology which can be used for fabricating of post and cores also. An optical scanner collects images of three-dimensional structures utilizing triangulation procedure. The traditional silicon impression is scanned to mill a personalized post or a scanner penetrate into the canal depth and read it down. Different methods have been presented during last years, and appropriate techniques for digitalizing should be determined.

Keywords: post-and-core, CAD-CAM, zirconia post, fiber post.

1. INTRODUCTION

A post-and-cores are dental restorations used to sufficiently build up tooth structure for future restoration with a crown, when there is not enough tooth structure for proper retaining, due to loss of tooth structure from decay or fracture.¹ Posts are cemented into root canals to enhance retention and to aid in creating a seal along the canal.² There are many different post-and-core systems, prefabricated and custom made, but none can provide perfect restorative solution for every clinical case. Prefabricated post-and-core systems are classified according to shape configuration, material and retention.³ The methods of post retention can be active or passive.



Figure 1. Cast metallic custom post-and-core.

Custom post-and-cores adapt better in the root canal and require minimal tooth removal. Cast metallic custom posts have higher moduli of elasticity than natural dentin and create stress and fracture of the less elastic root under occlusal forces (figure 1).⁵ Fibre-posts are flexible (with lower elastic moduli from 45.7 to 53.8 GPa) and under load distribute stresses between the post and the dentine. They are biocompatible, have a high tensile strength, desirable shade and modulus of elasticity similar to dentine. All ceramic post-and-cores are manufactured from glass-infiltrated alumina ceramic with 3 to 6 times higher flexural strength and fracture toughness than conventional feldspathic ceramics material. Zirconium dioxide ceramic is the most promising material for the fabrication of all-ceramic posts and cores today.

The establishment of reliable bonds at the root-postcore interfaces is critical for the clinical success of a post-retained restoration. Clinical studies however showed significant failure of post-retained crowns compared to restorations of vital teeth. Recurrent caries, endodontic or cement failure, post dislodgement, core, teeth or crown fracture are most common.⁶

Optimum prefabricated core material should be easily placed with rapid-setting, high-strength, dimensionally stable material with minimum marginal leakage and an effective bonding mechanism⁷. Cast metal post-and-core underlying all ceramic crowns is a poor esthetic solution due to the translucency of ceramics, while pre-fabricated glass fiber posts with variable shades, enhanced mechanical properties and biocompatibility were good solution for such cases.⁸ When post-and-core are made of the same material esthetic is better and separation of the core from post due to different materials modulus of elasticity is less likely to occur.⁹ High-strength ceramics, fiber, resin and zirconia allow milling of post-and-core with optimal esthetics and better fitting in the root canal using CAD/CAM technology (computer-aided design/computer-aided manufacturing).¹⁰ Less cement layer thickness, good retention and higher fracture resistance are some advantages of digital technology used for fabrication of post and core. The aim of the paper is to evaluate different materials and digital manufacturing method for post-and-cores.

2. MATERIAL AND METHODS

Digital dentistry is widely present in the laboratory and dental offices. It is precise, fast and simple technology which can be used for fabricating of fixed and mobile dental prosthesis and post-and-cores also. However, different methods have been presented during last years and appropriate techniques for digitalizing the post space should be determined.¹¹ Maximal root conservation with minimal or no preparation of a post-space result in thicker dentin walls and higher resistance of the root. Marginal and internal fit of the post and core is also very important for its longevity and clinical success.

There are two possible root canal types: round and oval, and the commercial post are made with circular shape only. An indirect impression of a resin pattern or polyvinylsiloxane impression of the post space is made, but digital custom-made posts can be fabricated without impression and other laboratory procedures. Scanning of the intra-canal space is made with intraoral scanner which ensures the accurate anatomy of the root, its depth and position.¹² An optical scanner collects images of three-dimensional structures utilizing triangulation procedure. CAD-CAM technology (computer-aided design/computer-aided manufacturing) can be divided into two classifications based on digital data sharing capacity (figure 2).¹³ The scanner is able to read down to 9 mm in the root canal which is enough depth to most clinical cases.¹⁴

After the design has been finalized (CAM) a machining device (CAD) is used to mill the planned restoration. The final restoration is cut from a preformed block of restorative material in a milling chamber. Milling devices are classified according to the number of milling axes. Two milling processes are available: dry and wet milling. In wet milling the cutting bur is cooled by a spray of cold liquid to prevent overheating of the milled material. Wet milling is needed for all metals, glass fiber, glassceramic or presintered zirconia to prevent damage from heat.

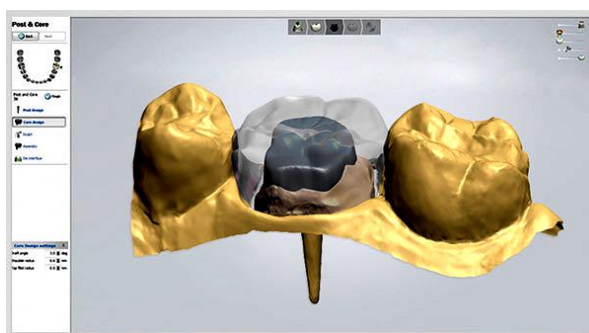


Figure 2. CAD-CAM post-and-core.

A new biocompatible material polymer - polyetheretherketone (PEEK) possess better stress distribution and can be considered as alternative dental materials for metal and glass ceramics. PEEK (figure 3) is organic thermoplastic polymers with good biocompatibility and similar compressive strength (246 MPa) to dentin (297 MPa), but lower elastic modulus (5.1 GPa) appropriate mechanical strength, shock-absorbing ability and a wide capability of fabrication processing.¹⁵



Figure 3. Post milling post from PEEK blocks.

3. DISCUSSION

The digital technique allows the concave surface of the root canal to be transferred into the convex surface of the post which improves the biomechanics of the endodontically treated tooth reducing the possibility of root fractures.¹⁶ Digital procedures can be direct or semi-direct. The traditional silicon impression is scanned to mill a personalized CAD-CAM post and core or an intraoral scan of post-space is performed. The use of custom prepared posts with very thin layer of cementing resin reduce polymerization stresses and gaps or voids formation in the adhesive interface.^{17, 18}

According to a 10-year retrospective study the fit of a cast post-core directly influences the ultimate survival of the restoration.¹⁹ Another study reported that endodontically treated teeth restored with post-and-core produce stresses concentrated at the coronal third of the root and at the interface between the core and the post. If the modulus of elasticity differs between materials, there is potential for separation of the core from the post. Such separation is less likely to occur when the post and the core are composed of the same material.²⁰

The use of digital impressions was more efficient than the traditional time involved in making impressions and pouring casts. Recent study reported that scanning was 10 minutes faster than conventional impressions for single abutments. Multiple studies have shown increased restoration quality and marginal fit with CAD-CAM systems.^{21, 22} In the field of post-core dentistry, PEEK has been recently introduced to be an alternative treatment option for many conventional methods. However, the literature is limited, and further randomized controlled trial studies have to be conducted for PEEK to be the material of choice for custom made post and core systems.²³

4. CONCLUSION

All-ceramic posts and cores by zirconia dioxide ceramic material fabricated with CAD-CAM technique and cemented with adhesive technology can be used in combination with all-ceramic crowns because they contribute to better light transmission, provide natural translucency to the all-ceramic restoration, and offer excellent biocompatibility. It can be concluded that the new materials and digital fabrication technology are viable alternative to the conventional post-and-cores.

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