ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2021; 7(4): 09-13

www.oraljournal.com
Received: 07-08-2021
Accepted: 09-09-2021

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A novel approach of restoring endodontically treated tooth by using cad-cam milled peek post and core system: A case report

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DOI: https://doi.org/10.22271/oral.2021.v7.i4a.1344

Abstract
The choice of appropriate definitive restoration of endodontically treated teeth should be guided by the amount of remaining hard tissues as well as functional and aesthetic considerations. Post and-core materials with biomechanical properties similar to the dentin could also be advantageous in reducing the risk of root fractures. The high performance polymer Poly-ether-ether-ketone (PEEK) is an example of one such type of material. This case report describes the restoration of endodontically treated mandibular premolar with the use of CAD-CAM milled post and core system followed by restoration with full coverage porcelain fused to metal crown.

Keywords: post and core, Polyetheretherketone (PEEK), CAD-CAM, PEEK post

Introduction
The choice of appropriate definitive restoration of endodontically treated teeth should be guided by the amount of remaining hard tissues as well as functional and aesthetic considerations. However, in cases of inadequate remaining coronal structure, complete crowns often require the additional support afforded by a post-retained core. For this purpose, a prefabricated root post or an indirect, custom-made post and core can be used. Custom-fabricated cast post-and-cores are still considered to be the gold standard for restoring extensively damaged endodontically treated teeth. Recent reports suggest that the rigidity of the post should be equal or almost equal to that of dentin, so as to distribute the functional forces evenly along the length of the root [1].

The characteristics of post include its material, elastic modulus, diameter and height that contribute greatly to the resistance to fracture of the restored tooth. Metallic cast posts such as gold, nickel-chromium, titanium, and stainless steel are already in use. But due to low biocompatibility, chances of corrosion of these metallic cast posts and the negative effects on esthetics, clinicians have found non-metallic posts as alternative to it. Non-metallic posts such as fiber-reinforced composite (FRC), glass fiber-reinforced post and ceramic posts are commonly used now [2]. According to Lanza *et al*., an ideal material for a post-and-core system should be sufficiently elastic to accompany the natural flexural movements of the tooth. Post and-core materials with biomechanical properties similar to the dentin could also be advantageous in reducing the risk of root fractures. Examples of these materials are the high-performance polymers, such as poletheretherketone (PEEK) and polyetherketoneketone (PEKK), and nano-ceramic composites etc [3].

Polyetheretherketone (PEEK) material is a polycyclic, aromatic, thermoplastic polymer that is semi-crystalline and has a linear structure, which can be produced by casting under heat and pressure with CAD-Cam technology and the wax waste management method. It is biologically inert material and has several remarkable properties like resistance to hydrolysis, high temperatures & chemical wear with superior mechanical performance. The most important property of this material is that it has a low elasticity modulus [3-4Gpa] closer to that of bone. It is very light material with a low density [1.23g/cm^3] and can be modified with various materials.

To meet aesthetic requirements, this material with low half lucency can be coated with composite resins for which it requires surface treatments. The use of PEEK has become extremely widespread in the medical field with excellent results. In dentistry, it can be used to fabricate implant and implant abutments, orthodontic wires, crowns, FDPs, RPD frameworks and posts etc [4].

Although previous studies evaluated CAD/CAM post-and-core systems, none of them analyzed the use of PEEK as a CAD/CAM post-and-core material. Literature regarding the mechanical behavior of PEEK post-and-cores milled in a CAD/CAM system is scarce, making it difficult to compare results [3]. This case report describes the restoration of an endodontically treated mandibular premolar by using CAD-CAM milled PEEK post and core followed by restoration with full coverage porcelain fused to metal crown.

Case report

A 21 year old male patient reported to the department of Prosthodontics, Government dental college and hospital, Aurangabad, Maharashtra, with a history of endodntic treatment with lower left second premolar tooth. He was referred to the department for crown prosthesis with the same tooth. The intra oral examination revealed anterior open bite, presence of endodntically treated 35, which was left with significantly less coronal tooth structure, indicating the need for a post and core restoration prior to crown prosthesis [figure-1, 2 and 3]. In primary investigations, the intra oral periapical radiograph [IOPA] revealed missing distal coronal wall and radiopaque restoration indicating root canal treatment with 35 [figure 4a]. Based on the patient's esthetic requirements, considerations of remaining coronal tooth structure and occlusion, various treatment options were explained to patient, and the decision of restoring the tooth with CAD-CAM fabricated PEEK post and core followed by full coverage PFM crown was made. Informed consent of the patient was obtained regarding the nature of the procedure, number of visits, total cost of treatment and possible consequences and risks had been explained to the patient. Informed consent was obtained from patient regarding photographs and documentation.

After removal of post RC silver amalgam restoration by using high speed airotor and round diamond bur, the canal opening was enlarged using no. 1 and 2 Gates glidden drills. The post space preparation was carried out sequencially by using no. 1, 2 and 3 pesso reamers and a 5mm of gutta percha restoration was left apically. A confirmatory radiograph was taken after post space preparation [figure 4b]. After sufficient cleaning and drying, the canal was coated with petroleum jelly using the paper points. To record the anatomy of canal, a plastic post pinjet [Angelus] covered with a coating of pattern resin [GC America INC] over it was inserted inside the canal. To prevent the posts from getting stuck in the canal, the post was continuously moved in and out of the canal until the resin was completely polymerized. The post pattern was placed in the canal, and the core was built up using pattern resin [figure 5a & 5b]. The tooth and the polymerized post and cores were finished using diamond rotary cutting instruments and tooth preparation was carried out for full coverage PFM crown. The patient was given a temporary dressing over the premolar using cotton & Zinc oxide eugenol cement.

The post and core pattern was scanned digitally [figure 6] using extra oral scanner [Shining 3D autoscan-DS EX Pro] and the designing was carried out using exoCAD software [figure 7a &b]. The post was then milled from a PEEK blank [Juvora ™ PEEK]. Exact post and core pattern was reproduced by the CAM system [figure 8]. The surface treatment of sandblasting was carried out under light pressure on the milled PEEK post. Following this, the fit of the PEEK post and core within the premolar tooth was assessed. The milled post and core was cemented [figure 9] using dual-cure resin cement [Densply Sirona Calibra esthetic resin cement]. For the cementation process, 37% orthophosphoric acid (total-etch technique) was applied inside the canals and rinsed after 30s. The PEEK post and the tooth structure were treated with bonding agent and light cured before cementation. The transparent adhesive resin cement base and catalyst pastes were mixed in a 1:1 ratio according to manufacturer's instructions. The cement layer was applied to the canal and the post, post was pressed inside the canal, and the excess cement was overflowed which was removed with the help of a probe and irradiated for a period of 40 s in each direction.

To fabricate PFM crown, maxillary and mandibular impressions were taken [figure 10] using alginate impression material [Zhermack Tropicalgin]. In metal try-in procedure, the marginal fit, internal fit & occlusal and proximal contacts were evaluated. The PFM crown was cemented [figure 11] using resin modified glass ionomer cement [GC fuji]. Patient was given all the post cementation instructions and was recalled at the intervals of 1 week, 1 month and 3 months for follow up.

Fig 1: Profile view

Fig 2: Pre-operative view

Fig 3: Occlusal view

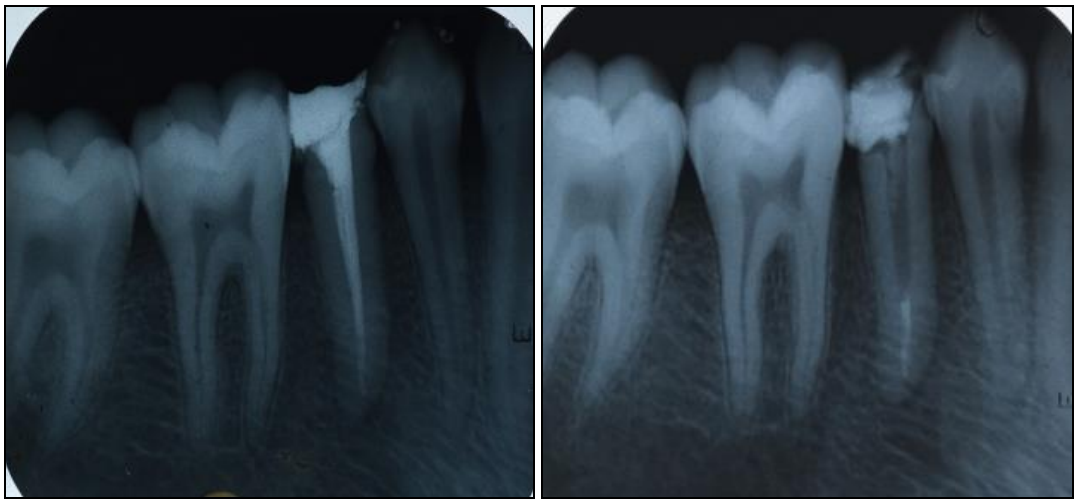

Fig 4: a) Intraoral preoperative radiograph, b] Radiograph showing post space preparation

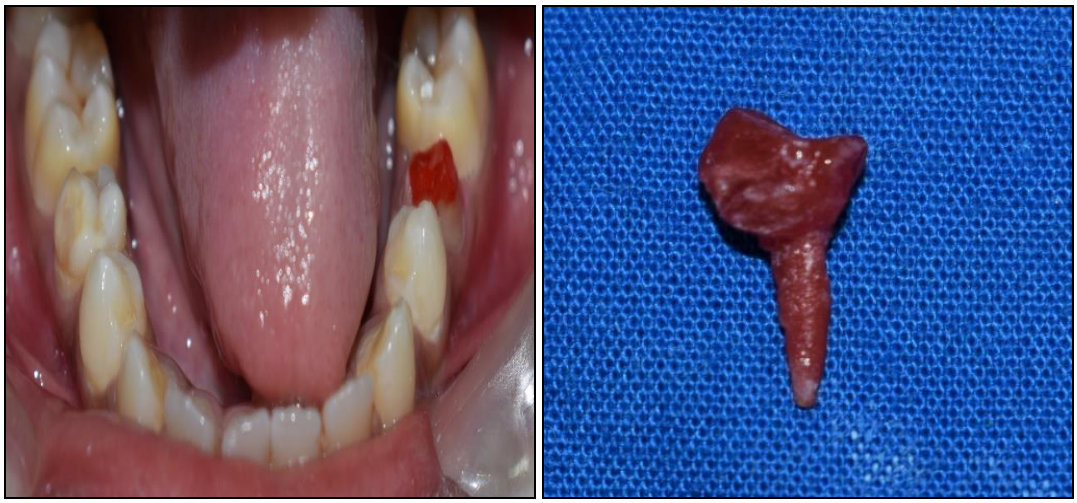

Fig 5: [a & b]: Endodontic post fabrication using pattern resin.

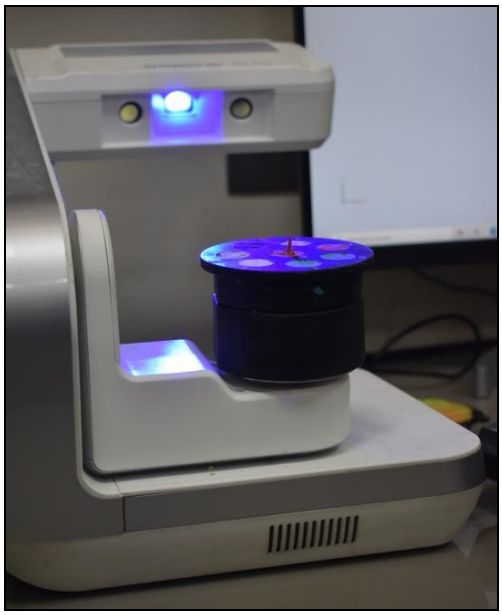

Fig 6: Scanning of post pattern

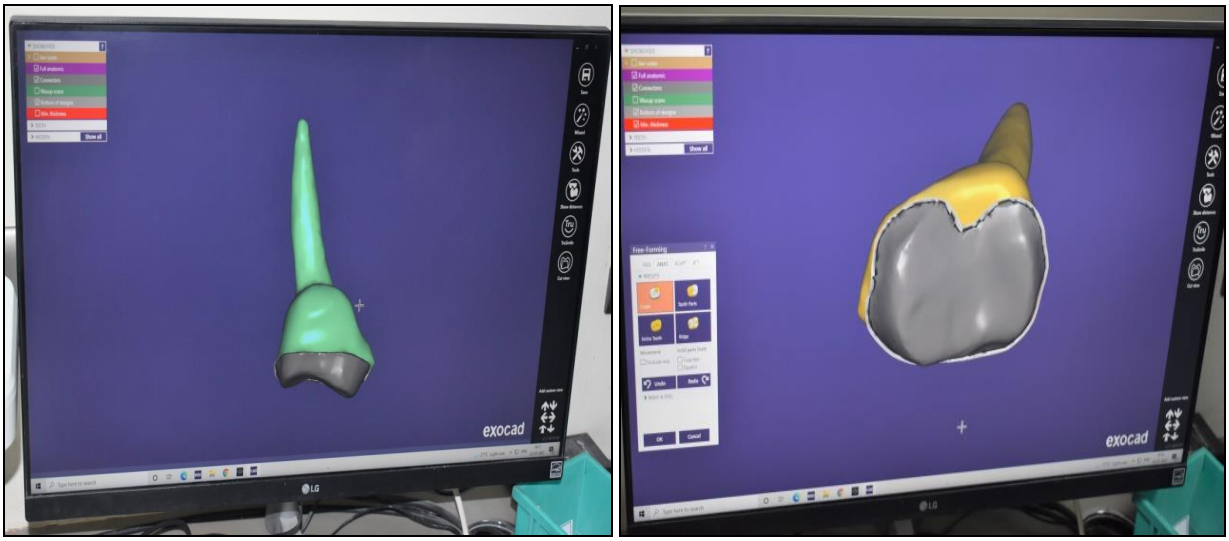

Fig 7: a & b: CAD-CAM aided designing of post

Fig 8: Milled PEEK post

Fig 9: Cementation of PEEK post

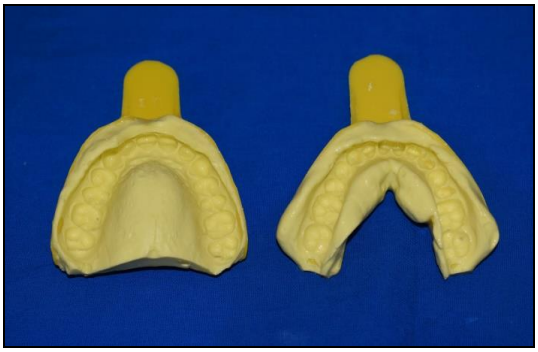

Fig 10: Final impressions

Fig 11: Cementation of porcelain fused to metal crown

Discussion

This case report describes use of PEEK as a post and core material for restoring grossly destructed endodontically treated tooth. With the advent of new technology, CAD-CAM dentistry is evolving day by day. The post pattern was scanned by using extraoral lab scanner and designed and milled by CAD-CAM system. The milled PEEK post resembled exactly to the scanned pattern and required negligible chairside adjustment to fit in patient's mouth. This high performance polymer PEEK having modulus of elasticity lower than dentin, when used as a post material offers special advantage of less stress concentration and lower incidences of root fracture [5].

Post and core is considered as the foundation restoration for mutilated dentition. The main purpose of this procedure is to provide retention for the core restoration, which replaces lost tooth structure. Post and core can be prefabricated post with composite core build up or one piece custom made post. The custom made post and core is indicated in various situations wherein gross tooth structure is lost, anterior deep bite, teeth with wider canals and where a change in angulation is required for enhancing aesthetics [6]. Cast posts and cores have its own advantages, they include preservation of the maximum tooth structure as the post is fabricated to fit the radicular space with a superior adaptation to the root canal. As core is an inherent part of the post, it does not need to be retained by the post. The anti-rotational property is also an additional advantage. However it has a disadvantage of involving multiple-visit procedures [7].

For a post and core restored endodontically treated tooth, a root fracture is an undesirable incident. According to previous

studies, one of the causes of root fracture of such teeth is stress concentration around the post-apex. Clinically, when a high elastic modulus metal post and core is used as an intra-radicular post and core in endodontically treated teeth, vertical root fractures often occur, which then lead to extraction of the teeth. To prevent catastrophic vertical root fracture, a prefabricated fiberglass post and resin core is currently being used as a post and core system. Since fiberglass has a lower elastic modulus than metal but similar strength, fiberglass post systems induce favorable stress distributions within the root and generally exhibit a repairable horizontal fracture mode when root fracture occurs. However, while fiberglass has a lower elastic modulus than metal, its elastic modulus is still several times higher than that of dentine. Recently, the high-performance polymer PEEK with an elastic modulus lower than that of fiberglass and similar to that of dentin has been introduced as an alternative intra-radicular post-core material. However, there have been rarely any experimental and clinical studies on the use of this material as a post-core system [8].

The bond between PEEK post core and resin cement is one of the factors affecting the retention of the post and core system. This bond can be enhanced by two factors: surface treatment with airborne particle abrasion [110um Aluminium oxide powder under 200-300 KPa pressure at minimum distance of 3 mm] and the use of surface bonding agents [5]. In this case, the PEEK post was treated with airborne particle abrasion under light pressure and was luted with dual cure resin cement to form a homogenous system inside the canal. The PFM crown was cemented using resin modified glass ionomer cement which easily bonds with resin and offers better retention along with strength.

Conclusion

PEEK with its excellent mechanical, biological and esthetic properties, can be used as post and core restorative material as it combines the advantages of cast post core with the advantages of more flexible esthetic posts. However further studies are needed for PEEK to be established as material of choice for custom made post and core restorations.

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