

Advances in post and core materials- A case study

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Abstract

Conventional approach over the years has supported that endodontically treated teeth fracture more readily and frequently than vital teeth. Cumulative loss of tooth structure from caries, trauma, restorative and endodontic procedures cause the fracture of tooth. It was propagated that a post served to strengthen the endodontically treated tooth.

Biocompatible High Performance Polymer, Poly Ether Ketone is being used in the world of dentistry very frequently and efficiently because of its low elastic modulus, great shock absorption, better stress distribution and better aesthetics as well. This article discuss about application of PEEK as a material of choice for restoring endodontically treated central incisor using customised PEEK post.

Keywords: PEEK, Customised Post, Exocad Software, Elastic Modulus, Etc.

Introduction

Advances in dentistry and development of technologies can be reached by improving materials. Biocompatibility, low plaque affinity, good aesthetics and characteristics close to dental structure are essential to modern materials used in advanced dentistry. Dental crown stability depends on the amount of tooth structure that extends into its interior. If the tooth structure left is too less which occupies this space, the crown will be easily dislodged, especially by oblique forces. Basically, the core is rebuilding the tooth so it is closer to its original dimensions. Hence, the crown's stability will greatly increase, and therefore its long-term chances for success

are maximized. Post and core allows indirect restoration of endodontically treated tooth.

There are few subjects in dentistry that have been studied more than the restoration of endodontically treated teeth. Yet, many practical questions and controversies remain in this clinically important element of the treatment plan. Fortunately, there are a number of areas in which the preponderance of research supports specific clinical procedures.

The classification of endodontic posts has been as varied and controversial as their historical development. They have been classified based on the numerous criteria which have categorized them as preformed and custom made post, metallic and non-metallic, stiff and flexible, esthetic and unaesthetic. Posts have also been popularly classified based on the material of construction as precious alloys, semiprecious alloys, base metal alloys, carbon fiber, glass fiber and all-ceramic posts.¹

PEEK is quite a new material in prosthodontics. Compared to the metals used in dentistry, PEEK is more aesthetic, stable, biocompatible, and lighter and has reduced degree of discoloration. This along with the reinforcing capabilities, functional harmony, biocompatibility, radiopacity, post design, fracture resistance, cementation, retention and ease of retrieval has been the factors which have spearheaded the quest for the ideal post.² This article discusses a case study in which an endodontically treated central incisor of a patient is restored by using a customised PEEK (Polyether ether ketone) post.

Case Report

A male patient 21 years old reported to the department with endodontically treated discolored front tooth as shown in Fig 1 and wanted to get a healthy looking tooth back. The endodontic treatment was done almost 2 years

back but the patient was getting his orthodontic treatment completed so the restoration was delayed.

Fig 1 shows extra-oral view of the patient showing discolored 11. As there were caries found in the coronal portion of 11, the excavation was done, the ferrule was created, and a subgingival margin was given. Then the post space preparation was done using peeso reamers upto no. 3 leaving 4 mm GP in the canal as shown in Fig 3.

Then an impression for the cast post was made of the prepared canal using auto polymerizing pattern resin and picked with addition silicon impression material as shown in Fig 4. Shade selection was done for the final restoration. The tooth was temporized using the index of patient's own tooth before preparation by direct technique (Fig 5). The impression was scanned using extraoral laboratory scanner for designing the customised PEEK post on Exocad software for milling as shown in Fig 6.

After milling, As the density of PEEK material is very less (1.28–1.32 g/cm³), the post milled was light in weight. The vacuum under pressure ensured a homogeneous and porosity-free post. Minor adjustments were done before cementing the post using dual cure resin cement (Variolink II) (fig 7). The preparation was finished and polished around the post and the ferrule as shown in Fig 7. Final impression was made after that gingival retraction using addition silicone impression material. An all ceramic crown was made over the to get the best aesthetics results and it was cemented with resin modified glass ionomer cement after verifying all the aesthetic requirements. (Fig 9, 10, 11, 12)

Discussion

Previous studies states that cause of root fracture of post-restored teeth is stress concentration around the post-apex.³ clinically when elastic modulus of post and core is more than that of dentin, vertical fracture is prone to happen. To resolve the problem of root fracture after post

and core treatment, fiberglass posts are used which has low elastic modulus as compared to metal. However, fiberglass post has elastic modulus of 45.7 GPa^{4,5} which is less than elastic modulus of metal alloys which is 110.0 GPa but they are still more than elastic modulus of dentin (18.6 GPa).⁶ PEEK has elastic modulus of 5.1 GPa which is lower than dentin as well as all other materials. According to Drummond JL⁵ the decrease in the strength property due to thermal cycling and the cyclic loading of fibre-reinforced resin posts and the glass FiberKor posts indicates that their utilization in the oral environment enhances their degradation and potentially shortens their clinical life.⁷

Polyetheretherketone (PEEK) material is a polycyclic, aromatic, thermoplastic polymer that is semi-crystalline and has a linear structure. PEEK has good mechanical properties such as resistance to high temperature and resistance to hydrolysis. In addition, because of the property of high biocompatibility, use of PEEK has increased in orthopaedic and trauma cases.⁷

Lee KS⁴ conducted a finite element analysis to evaluate biomechanical evaluation of a tooth restored with high performance Polymer PEKK- Polyetherketoneketone (belongs to the same PolyArylEther family) Post-Core System. They concluded that it has a significantly lower elastic modulus and flexural strength than metal and fiberglass, the use of it as a dental post-core system showed potentially high fracture resistance compared to that of metal and fiberglass post-core systems. With the lower elastic modulus than dentine and enamel, it exhibited a favourable stress distribution profile at the intra-radicular surface, indicating a lower possibility of root fracture than for conventional post-core materials.⁸

Stress-based problems could be reduced with this material due to the low elasticity modulus. In the light of this information, PEEK material could be considered as an

alternative to conventional materials in the field of dentistry.⁷

Conclusion

In the field of restorative dentistry, PEEK is one of the recently introduced materials, to be an alternative treatment modality with superior material properties for many conventional methods. It is being used as a material of choice in field of dentistry for various treatment options like cast partial dentures, implant prosthesis, FPD framework, etc. However, the literature and research is limited, and further studies have to be conducted for PEEK to be the material of choice for custom made post and core systems.



Fig 1: Picture showing extraoral view of the patient.



Fig 2: Picture showing intraoral view of the patient with discoloured 11.



Fig 3: Picture showing a prepared tooth after caries excavation and with the pattern resin to make impression of the post space of 11.

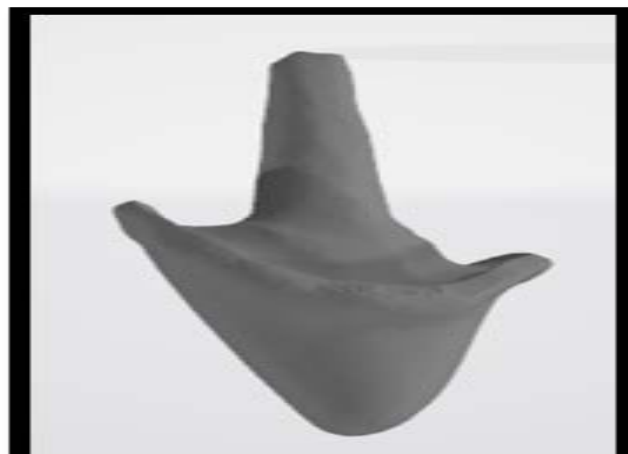


Fig 6: Picture showing a CAD model of the designed cast post for 11 on Exocad software.



Fig 4: Picture showing the pick-up final impression of the post space with addition silicone material.



Fig 7: Picture showing armamentarium for cementation of PEEK post



Fig 5: Picture showing temporisation of 11 before receiving the final restoration.



Fig 8: Picture showing the final adjusted PEEK cast post after final preparation with 11.



Fig 9: Picture showing all ceramic final restoration with 11.



Fig 10: Picture showing all ceramic final restoration with 11.



Fig 11: Picture showing extraoral picture of the patient after final restoration with 11



Fig. 12: Picture showing extraoral smiling picture of the patient after final restoration with 11.

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