Full Length Review Article

The Restoration of Endodontically treated teeth using Fibre Posts –A Review

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Received 20th December 2014; Published 31st January 2015

Endodontically treated teeth with inadequate tooth structure are highly susceptible to fracture and posts have been commonly used to restore such teeth. Custom cast posts and prefabricated posts have been commonly employed for a long time. It has been slowly replaced by the fibre posts which are more esthetic and also reduced the occurrence of root fracture which was common with the metallic posts.

Key words: Endodontics, Fibre posts and Esthetics.

INTRODUCTION

Loss of tooth structure due to fracture is a common occurrence in dentistry and is the third common cause of fracture other than 1,2 dental caries and periodontal diseases. Loss of such tooth structure would be either be a simple fracture involving enamel and dentin or could possibly involve the pulp. One-third of all dental emergencies are endodontic in origin and around 90% of emergencies with 3 pain are either pulpal or periodontal in origin. Endodontic therapy would be the treatment of choice if there is severe tooth structure loss involving the pulp. Teeth that are endodontically treated have little coronal tooth structure remaining due to either prior pathology and/or endodontic treatment. Several in vivo studies have cited endodontic treatment as the major etiological factor for tooth fracture. Other variables that could alter the strength of the tooth after endodontic treatment are dentin dehydration and the structure and variation of 6,7 arrangement of collagen fibers. These teeth with minimal tooth structure which is susceptible to fracture would ideally require a post to retain the core and the restoration. There is a belief that posts placed into the root canal teeth after endodontic therapy strengthens the teeth and reinforces the restored structure. But there are other studies which state that the preparation of post space and the placement of post in the weakened tooth structure would increase the 8-11 possibility of root fracture. They stated that posts should only be used when there is insufficient tooth structure remaining to support the final prosthesis. Hence, the main function of a post is the retention of the core to support the coronal restoration. Initially the posts used were metallic and were eventually replaced by the aesthetic fibre posts.

There are different fibre posts available in the market with different designs and techniques. This article reviews the various post designs used in root canals and the evolution of fibre posts in detail.

Desirable features of post-core materials

The properties of post-core reconstruction become all the more important as residual tooth structure decreases. Some desirable features of post-core materials include:

- Adequate compressive strength
- Flexural strength to prevent flexion of the core during functional and parafunctional movements.
- Bonding to the remaining tooth structure
- Thermal coefficient of expansion and contraction similar to tooth structures
- Minimal water absorption
- Inhibition of Dental Caries.

Evolution of fibre posts

Posts manufactured from different materials and of various designs are available which have been used to restore endodontically treated teeth. Historically, custom cast posts and prefabricated metal posts have been used in treatment of endodontically treated teeth when indicated. These posts can be fabricated from gold, platinum or stainless steel. Custom cast posts which has been traditionally used, has an advantage that the post and core was a single unit and hence the dislodgement of core was always prevented. But they had the disadvantage of requiring multiple visits, more expensive and a higher clinical ratio of 12 root fractures than the prefabricated posts. Prefabricated posts can be cemented into the intra radicular dentin in a single visit. These are available in different forms and shapes and can be manufactured from different materials. These prefabricated posts can be either active or passive posts.
Active posts are retentive in dentin by means of the threads in the post structure. They are threaded into the walls of root dentin and transfer more stresses to the root canal walls and the potential for vertical root fracture is higher during placement due to its wedging effect. Hence, the threaded posts due to its wedging effect and its high risks of causing vertical root fractures should be avoided. Passive posts and placed into the dentin and 14 cemented by means of a luting agent. Even though the passive posts do not engage dentin, they still transfer considerable stresses on to the root surfaces though lesser15 than the active posts. The shape of the posts can either be parallel or tapered and the 12 surface can be smooth, serrated or threaded. Parallel posts are most effective in terms of retention and less likely to cause vertical root fracture, but the removal of more amount of root dentin would be necessary than a tapered posts. Hence, they are less confirming to the original anatomy of the 16, 17 tooth. The fact that endodontic ally treated teeth may suffer from fracture and that the use of metal posts may result in increase of root fractures due to their lack of elasticity and corrosion has led to the search of posts with an elastic modulus similar to that of dentin.

Fibre posts

Fibre posts were first introduced in 1990 18 and were rapidly accepted by clinicians 19. These non metallic posts were based on carbon fiber reinforcement principle. The major advantage of these fibre posts is their similar modulus of elasticity to that of dentin, producing a stress field similar to that of the natural teeth because of their high tensile strength, where as the metal posts exhibited higher stress distribution at the post dentin interface causing potential tooth cracking and fracture. The first fibre posts were made of carbon fibres, which were arranged longitudinally and embedded in an epoxy resin. The carbon fibres which were used were unaesthetic in appearance and hence were not indicated in the anterior teeth. Eventually, these black carbon fibres were rapidly replaced by more esthetic white and translucent quartz and glass fibres which are now the standard components of fibre posts. These fibre posts are available in different configurations. Other than the longitudinal fibres, they are also available as braided or woven and are around 7-10 micrometers in diameter.

Mechanical properties

Metal posts because of their rigidity usually had a higher strength than the fibre posts. But then the tendency to fracture was much higher wherein the fibre post, the failure mode normally is not root fracture. The flexural strength and modulus of elasticity of fibre posts were initially claimed to be closer to dentin. Infact the modulus of elasticity of fibre posts was lesser than that of dentin and hence they decreased the incidence of root fracture. When the fibre posts failed, they generally failed favourably and the teeth were restorable 20,21.

Adhesion to intra-radicular dentin

A basic prerequisite for adhesion of posts to the intra-radicular dentin is represented by the ability of the clinician to achieve a clean post-space preparation for post placement. During root canal treatment, sodium hypochlorite, EDTA, gutta percha 22 and sealers modify intra radicular dentin. As post space preparation extends deep into the root canal, the application of adhesive into the canal walls is not easier. Hence, for the dentin-post cement bond to be successful, several factors need to be considered which could possibly affect the intra-radicular dentin. These factors which need to be assessed include smear layer, post space preparation, irrigants and medicaments, eugenol and gutta-percha removal during retreatment.

The endodontic smear layer contains inorganic and organic substances and also includes microorganisms, necrotic material 123 and odontoblastic process. This smear layer which is seen over the root dentinal surface is also packed into the dentinal tubules which could have a detrimental effect on the bonding. Hence, while using a bonding system in the radicular dentin the mechanism by which different bonding systems affect the smear layer should be clearly understood. Adhesive systems interact with dentin by either removing the smear layer like using etch and rinse technique or by modifying the smear 24 layer when self-etch technique is followed. Although there is controversy as to retain or remove the smear layer in adhesive dentistry, it is considered to be advantageous to remove 25 the smear layer in intra-radicular dentin.

The endodontic smear layer could possibly be infected by microorganisms and allow intra-radicular medicaments into the dentinal 26 tubules. Apart from the smear layer that is produced during root canal procedures, post space preparation using drills could also produce smear layer which is rich in sealers and gutta-percha remnants and these could hinder the bonding of the resin cement if fibre posts are used. Various studies on pretreatment with chelating agents and 27 sodium hypochlorite and EDTA with 28 ultrasonics have also been suggested. Sodium hypochlorite is the common irrigant used in root canal treatment. Despite its positive effects on root canal walls during irrigation it leaves behind an oxygen rich later on the walls of the dentin which could adversely affect the bond strength of resin cements.

Hence, reducing agents like 10% ascorbic acid can be used to intra radicular dentin after sodium hypochlorite application. This converts the intraradicular dentin surface from an oxidizing to a reducing surface and facilitates 29 polymerization of resins. Use of Hydrogen peroxide and RC-prep during root canal treatment also has a detrimental effect on bonding and can be 30 altered by the use of 10% ascorbic acid. Eugenol present in the root canal sealers and temporary restorative materials can 30 permeate dentin and also inhibit the polymerization of resin based 31 materials. This can be reversed by mechanical cleaning of the root canal walls by using alcohol to remove all residual layer 32. In such instances etch and rinse system is preferred to self etch system, as the phosphoric acid pretreatment eliminates the contaminated smear layer and results in 33 demineralization of dentin.

Cementation of posts to intraradicular dentin

Fibre posts are cemented to intraradicular dentin by using resin cement. For the bonding to be successful, the
substrate should be clean of debris and the selection of resin cement should be assessed. As mentioned earlier, etch and rinse adhesives help in the removal of smear layer and hence when bonded with the dual cured resin cement, does increase the bond strength. Most clinicians prefer using dual cured resin adhesives for bonding to root canal dentin because of their ability to self polymerize in the absence of light in the deeper regions of post cavity. Light curing still remains mandatory to obtain complete adhesive polymerization. During polymerization process, shrinkage stresses are common and could decrease retention and increase leakage. Apart from polymerization shrinkage, other factors that could influence shrinkage stress and gap formation is the cavity configuration factor (C-factor), which is the ratio of the bonded to the 34 unbonded surface areas of the restorations. When the C-factor is higher, the shrinkage stress would exceed the bond strength of the 35 bonding agents. The C-factor is highly unfavorable in root canals where it can range from 20-20028.

Considering the debonding failures seen due the higher C-factors, another important issue to be assessed is the shape of the posts. The circular shape of the posts does not correspond to the shape of the canals. In addition the post diameter should also be taken into account, as the posts could fit perfectly at the apical end while in the remainder of the canal the post is too thin compared to the canal wall and hence a thicker luting cement is required, which becomes the weakest part of the system under occlusal loading. Hence, for minimizing resin cement 36 thickness, the use of anatomic posts, oval 37 posts indirect luting procedures may be useful in clinical practice.

In the absence of clinical symptoms or a sinus tract, the post-endodontic restoration can be performed at the same visit as the root canal. In single rooted teeth, the fibre post with the core could strengthen the thin remaining root structure and prevent fracture of the remaining restoration. In multi rooted teeth, the posts are usually placed in the larger canals. Normally, the palatal and distal canals are preferred for the maxillary and mandibular molars respectively.

**Light transmitting posts**

Many posts available are claimed to be translucent, or in other words, permit light to pass through the post. As light cured resin cements are not indicated for luting fibre posts, the role of light can be important when dual cured resin cements are used. For any dual cured setting cement, the light should activate the setting reaction after which the reaction continues in self-cure mode. There are several post systems which claims that the light is transmitted through the translucent post which could cure both the resin cement and the bonding adhesives.

**Superficial treatment of fibre posts**

Since the introduction of fibre posts, there has been several efforts to improve bonding inside the root canals. Despite the development of new adhesive systems, bonding inside the root canal still is unfavorable compared to coronal 38, 39 dentin. The most common adhesive failure is debonding at the resin cement-dentin interface 40. Immediately after fibre post cementation and core buildup, the restoration has to resist the stresses transmitted during the reduction of the core structure. At the coronal level, the amount of residual tooth structure remaining favors a strong adhesion and retention. At the post-core interfacial level, only the chemical interaction between the surface of post and the core material would ensure the bonding of the material around the post.

In an attempt to achieve good bonding of fibre posts to resin cements, several surface treatment of fibre posts have been recommended. Treating the posts with silane coupling agent may be advisable but then opinions differ on the efficiency of post silanazation. Hydrofluoric acid has recently been recommended for etching fibre posts. Etching with hydrofluoric acid creates a roughened surface that allows for micromechanical interlocking with the resinous restoration. Another method of superficial treatment of posts is by means of sandblasting with alumina particles which results in increased roughness of the surface.

**Removal of posts**

Orthograde root canal retreatment requires the removal of the existing coronal restoration in order to obtain access to the root canal system and this may include the 41 removal of the post. Several techniques can be used to remove posts and these include the use of ultrasonic vibration which is the most commonly preferred. A general consensus among clinicians is that it is far easier to remove the fibre posts than the metal posts. Unlike cast posts or prefabricated posts, fibre posts are not retrieved in a single piece. Special drills are supplied by the manufacturers which help in removing the posts without the risk of perforation or removal of excess dentin.

**Conclusion**

Based on the clinical reviews available on the use of fibre posts for endodontically treated teeth, it can be concluded that Posts do not strengthen endodontically treated teeth and are used for buildup and to retain the coronal restorations. Fibre posts are a better option than the metallic posts and have a less likelihood of root fractures. A thorough understanding of the different post systems and with the choice of the adhesive systems and the core materials are important in achieving long term clinical success.

**REFERENCES**


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