REVIEW ARTICLE

Management of Endodontically Treated Teeth - An Overview

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ABSTRACT

The goal of dental treatment is to provide optimal oral health, esthetics, and function. Therapeutic efforts should produce predictable treatment results that are easily maintainable and reliable over the long term. After endodontic therapy, a tooth must be restored to functional and esthetic demands. Endodontically treated teeth which are to be used as abutments in prosthodontic reconstructions, must be judged carefully regarding their ability to withstand a higher load than a single tooth normally is exposed to.

Keywords: Core and ferrule, Endodontically treated teeth, Post.

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INTRODUCTION

The goal of endodontics and restorative dentistry is to retain the natural teeth with maximal function and pleasing esthetics.[1] It is generally agreed that the successful treatment of a badly broken tooth with pulpal disease depends not only on good endodontic therapy but also on good prosthetic reconstruction of the tooth after the endodontic therapy is complete.[2] Endodontically treated teeth generally have a good prognosis. It can resume full function and serve as an abutment to fixed partial denture also. However, special techniques are needed to restore such a tooth because a considerable amount of tooth structure has been lost due to caries or previous restoration or endodontic treatment itself.[3] This loss of tooth structure makes retention of a subsequent restoration problematic and increases the likelihood of fracture during function. Extensive research has gone into the subject of endodontically treated teeth, yet it remains controversial from many perspectives. This article focuses mainly on recent publications and changing trends in treatment planning, understanding of the subject, options available to us with regard to materials. Traditional belief was that endodontically treated teeth were weaker or more brittle than vital teeth.[4] Their moisture content was reduced and clinical fracture occurred. It was assumed that, for this reason, the tooth had to be strengthened by removing part of the root canal filling and replacing it with a metal post. A metal post was used to retain a core that replaced the lost tooth structure and resulted in the shape of a conventional preparation on which a crown could be fabricated. Recent studies have challenged this theory. These studies did not conclude that endodontically treated teeth were more brittle. Hence, it is the loss of the tooth structure associated with caries, subsequent access preparations that lead to a higher fracture rate in endodontically treated teeth compared with vital teeth, rather than changes in dentin. Furthermore, few studies indicate that the restorations that enhance structural integrity would be expected to increase the prognosis of endodontically treated teeth exposed to heavy masticatory loading forces.[5]

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POST AND CORE

The primary purpose of a post is to retain a core in a tooth with extensive loss of coronal tooth structure.[[6] Preparation of a post space adds a certain degree of risk to a restoration procedure. Procedural accidents in the form of perforation can occur. The placement of posts also may increase the chances of root fracture and treatment failure, especially if an oversized post channel is prepared. Hence, posts should only be used when other options are not available to retain a core. The need for a post varies greatly between anterior and posterior teeth.[7] Anterior teeth with minimal loss of tooth structure may be restored with a bonded restoration in the access opening. If an endodontically treated tooth is to receive a crown, a post is often indicated. In most cases, the remaining coronal tooth structure is thin after it has received root canal therapy and has been prepared for a crown. Anterior teeth must resist lateral and shearing types of forces, and hence, the amount of remaining tooth structure and the functional requirements of the tooth determine whether anterior tooth requires a post.[[8] Premolar is usually bulkier than anterior teeth but often is single-rooted teeth with relatively small

pulp chambers. For these reasons, they require posts more often than molars. Premolars are more likely than molars to be subjected to lateral forces during mastication.[9] Endodontically treated molar teeth should receive cuspal coverage, but in most cases, they do not require a post. Unless the destruction of coronal tooth structure is extensive, the pulp chamber and canals provide adequate retention for a core buildup. Molars must primarily resist vertical forces.[10] If a post is required, post should be placed in the largest canal, which is the palatal canal in the maxillary molars and a distal canal in the mandibular molars. Rarely more than one post is required in a molar.

FACTORS TO BE CONSIDERED WHILE PLANNING POSTS[[11]

1. Retention and resistance form.
2. Mode of failure.
3. Preservation of tooth structure.
4. Ferrule effect.
5. Retrievability.

Retention and Resistance Form

Post retention refers to the ability of a post to resist vertical dislodging forces. Retention is influenced by post length, diameter, taper, and luting cement used and whether a post is active or passive. Increasing the length and diameter of the post can increase retention of the post. Parallel posts are more retentive than tapered posts. Active posts are more retentive than passive posts. Diameter is the least important of all the factors. Resistance refers to the ability of the post and tooth to withstand lateral and rotational forces. Factors influencing resistance form are post length, rigidity, presence of anti-rotational features, and the presence of a ferrule. A restoration lacking in resistance form is not likely to be a long-term success regardless of the retentiveness of the post.[[12]

Mode of Failure

All post systems have some percentage of failure. Some posts have a higher percentage of failure that results in teeth that are non-restorable. Teeth restored with less rigid posts (fiber posts) tend to have failures that are more likely to be restorable. Teeth prepared with a ferrule also tend to fail in a more favorable mode. Composite resin cores tend to fail more favorably than amalgam or gold.[[13]

PRESERVATION OF TOOTH STRUCTURE

Coronal and radicular tooth structure should be conserved whenever possible. Preparation of post space should require minimal removal of additional radicular dentin beyond the requirements for endodontic therapy. Further, enlargement only weakens the root. It has been shown that cemented metal posts do not strengthen the root. Bonded posts are reported to strengthen the root initially, but this strengthening effect is lost overtime as the tooth is exposed to functional stresses and the resin bond to dentin weakens. Minimal enlargement of a post space means that the post must be made of a strong material that can withstand functional and parafunctional forces.[14]

The Ferrule Effect

Ferrule is defined as a vertical band of tooth structure at the gingival aspect of crown preparation. It primarily provides resistance form and enhances longevity. A ferrule with 1–2 mm of vertical tooth structure doubles the resistance to fracture versus teeth restored without a ferrule. It was reported that there was no difference in fracture resistance with or without 2 mm ferrule using prefabricated posts and resin cement. However, fracture patterns were more favorable when a ferrule was present. In some cases, especially in anteriors, it is necessary to perform crown lengthening/orthodontic eruption of a tooth to provide an adequate ferrule.[15]

Retrievability

Endodontic treatment can fail. Therefore, it is important that posts can be retrieved if retreatment becomes necessary. Metal and fiber posts are easy to retrieve. In contrast, ceramic and zirconium posts are considered to be very difficult and sometimes impossible to retrieve.[[16]

Longevity Studies

Studies have reported 82% success for anteriors teeth restored with metal posts for >10 years. Median survival rate of teeth with metal posts was found to be 17.4 years.[17] The clinical studies with fiber posts are recent publications with a short recall period. However, Ferrari *et al*. found that 3.2% was the failure rate of 1306 fiber posts placed in recalls of 1–6 years.[18] Carbon fiber posts showed a 7.7% failure rate in 52 teeth with average follow-up of 28 months.[19] Quartz fiber posts showed a 1.6% failure rate in 180 teeth with an average recall of 30 months. Initial results seem promising with this relatively newer technology.[20]

Different types of posts available can be grouped as follows:

1. Active or passive.
2. Parallel or tapered.
3. By material composition.

Active/Passive

Active posts are threaded and are intended to engage the walls of the canal, whereas passive posts are retained only by the luting agents. Active posts are more retentive than passive posts but introduce more stress into the root than passive posts. Active posts should be used in short roots where maximum retention is needed.[21]

Parallel/Tapered

Parallel posts are more retentive.[22] Parallel posts induce less stress into the root; there is less of a wedging effect and lesser chance of root fracture than tapered post. Tapered posts, on the other hand, require less dentin removal because most roots are tapered. They are indicated in teeth with thin roots and delicate morphology.[22]

PREFABRICATED POST AND CORE

Prefabricated posts are made of stainless steel, nickel chromium alloy, brass, or titanium alloy. They are all very rigid except titanium. They are round and offer little resistance to rotational forces. Hence, they should be used only when adequate tooth structure remains. When minimum tooth remains, anti-rotational features should be incorporated into post preparation with slots or pins. They have low fracture strength and removal is difficult. Brass can corrode. For these reasons, titanium and brass posts should be avoided.[23]

Custom-Cast Post and Core

Cast post and core remain the standard for many years and are still used by clinicians. They do not perform as well as other types of posts during *in vitro* tests and clinical studies. They do offer some advantages. When multiple teeth require posts, it is more efficient to make an impression and fabricate them in the laboratory rather than placing a post and buildup in individual teeth as a chairside procedure. A cast post and core may be indicated when a tooth is misaligned and the core must be angled in relation to the post to achieve proper alignment with the adjacent teeth.[24]

Ceramic and Zirconium Post

Metal posts are visible through the more translucent all-ceramic crowns and even with less translucent restorations; they may cause the marginal gingival to appear dark. Hence, the esthetic posts such as zirconium and other ceramic materials have been developed. They are good esthetically, but the disadvantages are that they have to be thicker to be stronger. Zirconium posts cannot be etched; therefore, it is not possible to bond a composite core to post. Retrieval of zirconium and ceramic posts is very difficult. Some ceramic materials can be removed by grinding away the remaining post material with a bur, but this is a tedious and dangerous procedure. It is impossible to grind away a zirconium post.[25]

Fiber Post

They are more flexible than metal and are approximately of the same modulus of elasticity (stiffness) as dentin. When bonded with resin cement, they distribute forces evenly in the root resulting in fewer root fractures. They are available as carbon fiber, quartz fiber, glass fiber, and silicon fiber posts. Except carbon fiber, all the others are better esthetically. They are radiolucent. They are relatively easy to remove by boring through the middle of the post with ultrasonic or rotary instrument. The orientation of fibers helps keep the removal instrument in proper alignment. The length of the post should be three quarters the length of the root canal or at least same as the length of the final crown. About 4–5 mm of gutta-percha should remain apically to maintain an adequate seal and not 3 mm as thought traditionally.[26]

LUTING AGENTS

Most commonly luting agents are zinc phosphate, resin, glass ionomer, and resin-modified glass ionomer cement. Recent trend has been toward resin cement. Resin cements increase retention, tend to leak less than the other cement, and provide at least short-term strengthening of root. They are recommended, especially for roots with thin walls. Disadvantages of resins are that they are technique sensitive than most others. They need extra steps such as preparing the canal walls with acid or EDTA and placing a dentin-bonding agent. The fourth-generation adhesive systems (3-step systems) provide better adhesive seal to radicular dentin than the more recent fifth-generation 2-step systems. Self-cure or dual cure cement should be used due to limited light penetration into the root, even with translucent posts.[27]

CORE MATERIALS

The whole purpose of the post is to retain a core, which, in turn, helps retain the crown. With cast post and core, the core is formed on the post directly on the tooth or on the cast. Prefabricated posts are used with a restorative buildup material, which is formed after cementation of the post. At present, the best choices are amalgam and composite resin. Amalgam can cause esthetic problems and can make the gingiva look dark. Moreover, they have no natural adhesive property. Composite resin

is the most popular core material presently. It can be bonded to many of the current posts and to the remaining tooth structure. They possess high tensile strength and tooth can be prepared for crown immediately. It is tooth colored and can be used under translucent restoration.[28]

CONCLUSION

The restoration of endodontically treated teeth is a topic that is extensively studied and yet remains controversial from many perspectives. Most endodontically treated teeth require a post-and-core buildup for restoring the teeth to optimum health and function. Selection of an appropriate post-and-core system from the wide variety of those available may be a clinical dilemma. Selection of a post-and-core system should satisfy many interrelated biologic, mechanical, and esthetic factors to optimally restore the endodontically treated tooth to adequate form and function. The trend in clinical practice is toward fiber posts and literature is generally in favor of them. Their performance is similar to that of the metal posts and their failure mode is more favorable than with metal posts. If future long-term clinical research studies report similar levels of success as seen in the presently available short-term studies, fiber posts are here to stay. It is also important to remember that the prognosis of endodontically treated teeth depends not only on endodontic treatment success itself but also on the amount of remnant tooth tissue and the definitive restoration that will be placed onto the dental element.

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