A review of the management of endodontically treated teeth

Post, core and the final restoration

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ABSTRACT

Background. The clinical decision as to whether an endodontically treated (ET) tooth requires a post and a crown poses a challenge to dental practitioners. The author conducted a review of the principles for the use of post and core and the newer materials such as ceramic and fiber-reinforced posts.

Types of Studies Reviewed. Using a MEDLINE search and resulting cross-references, the author selected original research articles and previous review articles on the topic of ET teeth, as well as that of post and core.

Results. The author reviewed the principles for the use of posts in terms of when it is necessary to use a post, different types of posts, various post materials and designs. He also reviewed the criteria and technique for post space preparation and post cementation. Finally, he discussed the principles of core buildup, as well as options for the final restorations.

Clinical Implications. The author provides a review of the principles for the use of post and core, crowns and the different materials available today to help clinicians make a clinical decision based on sound evidence.

Key Words: Post; core; endodontically treated teeth; fiber-reinforced post

In a separate article that describes the basic concepts in restoring endodontically treated (ET) teeth, I mentioned that endodontic treatment is performed often and that there is a high demand for the restoration of ET teeth.[1] Some of the basic, yet important, concepts in the management of ET teeth are microleakage, the ferrule effect and biological width. It generally is agreed that the successful treatment of a badly broken down tooth with pulpal disease depends not only on good endodontic therapy, but also on good prosthetic reconstruction of the tooth after endodontic therapy is completed.

Restoration of teeth after endodontic treatment is becoming an integral part of the restorative practice in dentistry.

In this article, I review the principles in the use of a post, including when to use a post, types of posts, post materials, post design, post space preparation in terms of length and width, and the cementation of a post. I also discuss the principles in core buildup and the options available in final restorations.

PRINCIPLES IN THE USE OF A POST

Do posts strengthen ET teeth? It has been suggested that ET teeth dry out over time[2] and that the dentin in ET teeth undergoes changes in collagen cross-linking.[3] Therefore, it has been suggested that ET teeth are more brittle and may fracture more easily than non-ET teeth.[4–6] It is believed that it is the loss of tooth structure from caries, trauma or both that makes ET teeth more susceptible to fracture.[7,8] Some clinicians believe that a post should be placed into the root after endodontic treatment to strengthen or reinforce it. Some studies, however, point out that posts do not strengthen teeth, but instead that the preparation of a post space and the placement of a post can weaken the root and may lead to root fracture.[9–12] These studies further suggest that a post should be used only when there is insufficient tooth substance remaining to support the final restoration. In other words, the main function of a post is the retention of a core to support the coronal restoration.

Perhaps using new adhesive materials and technology, clinicians can bond the post securely to the dentin in the root canal space, the core to the post and the final restoration to the core and tooth. With all components having similar physical properties successfully bonded together, dentistry may be able to claim that a post can strengthen and reinforce the root. However, dentistry can say only that a post is used primarily to retain a core in a tooth with extensive loss of structure; the post does not make the tooth stronger.

When to use a post. Since a post does not strengthen an ET tooth and the preparation of a post space may increase the risk of root fracture and treatment failure,[13] the decision whether to use a post in any clinical situation must be made judiciously. Most teeth require endodontic treatment as a result of trauma, extensive caries or restoration. The practice of endodontic therapy prefers an access cavity preparation that gives endodontic instruments "straight line" access into the canal space. This, along with the concept of "crown down" in endodontic therapy, means that more sound coronal and radicular dentin must be removed for efficient cleaning and shaping of the root canal system. Therefore, the evaluation of whether a post is needed is based on how much natural tooth substance remains to retain a core buildup and support the final restoration after caries removal and endodontic treatment are completed.

Many ET molars do not require a post because they have more tooth substance and a larger pulp chamber to retain a core buildup.[14] When a post is required as a result of extensive loss of natural tooth substance, it should be placed in the largest and straightest canal to avoid weakening the root too much during post space preparation and root perforation in curved canals. The distal canal of mandibular molars and the palatal canal of maxillary molars usually are the best canals for post placement. When core retention still is insufficient after a single post is inserted, placement of pins can be considered for additional retention.[14]

Premolars have less tooth substance and smaller pulp chambers to retain a core buildup after endodontic treatment than do molars, and posts are required more often in premolars. In addition to root taper and curvature, many pre-molar roots are thin mesiodistally, and some have proximal root invaginations. Furthermore, the clinical crown of the mandibular first premolar often is inclined lingually in relation to its root. These anatomical characteristics must be considered carefully during post space preparation to avoid perforating the root.

A few studies have concluded that a post is not necessary in an ET anterior tooth with minimal loss of tooth structure.[9,10,12] These teeth may be restored conservatively with a bonded restoration in the access cavity.[10,15] Should tooth discoloration become a concern, whitening and placement of veneers can be considered, since a study by Baratieri and colleagues[16] concluded that the use of posts did not improve the fracture resistance of ET maxillary incisors that received veneers with direct composite. If an anterior tooth must be prepared to receive a crown after endodontic treatment because a good amount of tooth structure was lost, a post may be necessary to retain the core so that these teeth can resist functional forces. Special care must be exercised when placing posts in mandibular incisors, as they have thin roots in the mesiodistal dimension, which makes post space preparation difficult.

Types of posts. There are two main categories of posts: custom-fabricated and prefabricated. Custom-fabricated cast gold post and core has been used for decades as a foundation restoration to support the final restoration in ET teeth.

One six-year retrospective study[17] reported a success rate of 90.6 percent using a cast post and core as a foundation restoration. Cast gold alloy (type III or IV) is an inert material with modulus of elasticity (stiffness of 14.5×10^6 psi) and coefficient of thermal expansion ($\approx 15\,[C^{-1}] \times 10^6$) similar to those of enamel, and yet it has good compressive strength that can withstand normal occlusal forces.

Other base metal alloys have been used, but their hardness might be a major disadvantage in adjustment and may predispose the tooth to root fracture. Many practitioners prefer to use a cast gold post and core for ET anterior teeth. Its major disadvantage, however, is esthetics, as the metal shows through the newer all-ceramic restorations. One way to overcome this is to make a porcelain-fused-to-metal post and core from a metal ceramic alloy to mask the shade of the metal.[18]

Another disadvantage of the cast post and core placement procedure is that it requires two visits and laboratory fabrication. An alternative is a prefabricated post that can be adjusted and inserted in a single visit. Many types of prefabricated posts (in terms of shape, design, material) are available, and I will discuss them later in the article.

A photoelastic stress analysis of post design led to the conclusion that cement-retained posts and parallel posts were the least stressful to the root, but they also were the least retentive.[19] Certain screw-type posts offer more retention, but they exert more stress on the root and should be considered only in short roots in which obtaining sufficient retention within the root is difficult. Pontius and Hutter[20] speculated that the successful bonding of fiber-reinforced posts may assist in the retention of posts in the root canal space so that shorter posts may be used.

In regard to conservation of tooth structure, the use of tapered posts requires removing less dentin because root canal spaces are cleaned and shaped in a tapered fashion. Although parallel posts and screw posts are more retentive in the root canal, more dentin removal is required in their post space preparation. This can be undesirable, especially in post space preparation for parallel posts, as more dentin is removed from the thinner apical and middle aspects of the root canal walls.

Materials. Stainless steel, titanium and titanium alloys, gold-plated brass, ceramic and fiber-reinforced polymers have been used as materials for prefabricated posts. The ideal post and core material should have physical properties—such as modulus of elasticity, compressive strength and coefficient of thermal expansion—that are similar to those of dentin. In addition, prefabricated posts should not be corrosive and should bond easily and strongly to dentin inside the root using suitable cement so that the entire assembly of a post and core resembles the original tooth. Unfortunately, no such material is available to date even though fiber-reinforced posts look promising; I discuss it in more detail later.

Titanium posts have low fracture strength and tend to break more easily compared with stainless steel posts during removal in retreatment cases.

Stainless steel has been used for a long time in prefabricated posts. However, it contains nickel, and nickel sensitivity is a concern, especially among female patients. Stainless steel and brass have problems with corrosion. Pure titanium has slightly lower physical properties such as in compressive and flexural strength than alloys, but it is the least corrosive and most biocompatible material.[21] Titanium posts, however, have low fracture strength and tend to break more easily compared with stainless steel posts during removal in retreatment cases. Furthermore, most titanium alloys used in posts have a density similar to that of gutta-percha when seen on radiographs, which makes them more difficult to detect. Ceramic has good biocompatibility, high flexural strength and fracture toughness,[22–24] and it is esthetically pleasing, especially under all-ceramic crowns. However, two in vitro studies reported poor resin-bonding capability of ceramic posts to dentin under fatigue testing.[25,26] This type of post is relatively new, and long-term clinical results are not yet available.

Another newer type of post is the fiber-reinforced polymer post. It is made of carbon or silica fibers surrounded by a matrix of polymer resin, which usually is an epoxy resin. The fibers are 7 to 10 micrometers in diameter and are available in a number of different configurations, including braided, woven and longitudinal. According to two in vitro studies,[27,28] the physical strength of fiber-reinforced post is significantly weaker than that of cast metal posts and cores. The highly rigid metal would transfer lateral forces without distortion to the less rigid dentin and lead to a higher chance of root fracture. The lower flexural modulus of fiber-reinforced posts (between 1 and 4×10^6 psi), on the other hand, measures closer to that of dentin ($\approx 2 \times 10^6$ psi) and can decrease the incidence of root fracture.[27,29] In the event of failure when restored with fiber-reinforced posts, teeth are more likely to be restorable.[28,30,31]

Fiber-reinforced posts are fabricated to bond with most resin cements and resin-based composite core materials. In vivo bonding of fiber-reinforced posts to the dentinal wall of the root canal space using resin cement has been demonstrated.[32–34] Scanning electron microscopic (SEM) evaluation has shown clearly the formation of a hybrid layer, resin tags and an adhesive lateral branch. Successful bonding minimizes the wedging effect of the post within the root canal, requires less dentin removal to accommodate a shorter and thinner post and leads to lower susceptibility to tooth fracture.[20] Successful bonding also means that the shape (parallel versus tapered) of the fiber-reinforced post may be less significant in relation to its retention than for a metal post.[35]

Since fiber-reinforced posts are metal-free, they do not cause metal allergies or corrode. They offer good esthetics in easily visible areas of the mouth, especially under the all-ceramic crowns and bridges. Finally, fiber-reinforced posts can be removed easily in case of an endodontic failure requiring re-treatment.[30] One study that evaluated three types of fiber-reinforced posts over one to six years reported a failure rate of only 3.2 percent, and the authors concluded that these posts can be used routinely in combination with bonding materials.[36] Two other retrospective studies up to four years long also reported a success rate of approximately 95 percent using fiber-reinforced posts to restore ET teeth.[37,38] Like the ceramic posts, fiber-reinforced posts are relatively new, and data on their long-term clinical performance are not available yet.

Post designs. In addition to the custom cast post and core, many commercially available prefabricated posts exist. For example, the axial form is either tapered or parallel, and the surface can be smooth, serrated with or without vents, or threaded using taps or self-threading. Caputo and Standlee[39] categorize these different design features into three basic combinations:

– tapered, serrated or smooth-sided, cemented into a post space prepared with a matched-size post drill;
– parallel-sided, serrated or smooth-sided, cemented into matched cylindrical channels prepared by a post drill;
– parallel-sided, threaded and inserted into pre-tapped channels.

Knowing the root anatomy of different teeth is important before attempting to prepare any canal space for post installation.

In general, parallel-sided posts are more retentive than tapered posts, and threaded posts are more retentive than cemented posts. With respect to their installation mode, all posts are referred to as either active or passive. Active posts engage dentin within the root canal space and transfer more stress to the remaining root structure. Passive posts, even though they do not engage dentin in the root canal space, still transfer stress to the remaining root structure, but to a lesser extent.[39]

Post space preparation. Knowing the root anatomy of different teeth is important before attempting to prepare any canal space for post installation. For instance, clinicians must be aware that root diameter may differ in the facial-lingual and mesiodistal dimensions. To determine the appropriate post length and width to avoid root perforation, clinicians must consider conditions such as root taper, proximal root invaginations, root curvatures and angle of the crown to the root during the mechanical preparation of a post space. Gutmann[40] gave a good review of anatomical and biological considerations in restoring ET teeth.

Dentists often use mechanical preparation techniques for post spaces because it is faster. Mechanical preparation is associated with a higher risk of root perforation and may disturb the apical seal. The thermal method of removing gutta-percha using heat pluggers is safer but more time-consuming. When mechanical preparation is preferred, it has been established that Gates-Glidden drills and P-type reamers used on low speed are the safest instruments.[41] Use of one of these instruments should precede the use of any post drill that comes with the prefabricated post kit. A combination of removing gutta-percha by heat pluggers followed by the post drill should be considered by inexperienced operators to minimize the risk of perforation.

Post length. Many authors have offered guidelines for determining the desired post length. It is not difficult to understand that the longer the post in the canal, the more retentive it is. However, increased post length also increases risk of fracture and perforation of the remaining root.[42] It generally is accepted that the apical 3 to 6 mm of gutta-percha must be preserved to maintain the apical seal.[43–45] Acceptable guidelines for determining the post length include the following:

– the post length should be equal to the clinical crown length[46,47];
– the post length should be equal to one-half to two-thirds of the length of the remaining root[4,48];
– the post should extend to one-half the length of the root that is supported by bone.[49]

As I stated previously, root anatomy varies from tooth to tooth and even within the same tooth in different patients. Clinicians must consider these variations along with the guidelines. Each clinical situation is unique, so the preparation of the post space must be evaluated carefully and planned for accordingly.

Post width. It is accepted widely that the post diameter makes little difference in the retention of the post. An increase in the post's width, on the other hand, will increase the risk of root fracture.[39,50] In general, the post width should not exceed one-third of the root width at its narrowest dimension, and clinicians should bear in mind that most roots are not perfectly rounded.[11] A minimum of 1 mm of sound dentin should be maintained circumferentially, especially in the apical area where the root surface usually becomes narrower and functional stresses are concentrated.[51] The cleaning and shaping procedures used in modern endodontic treatment are aggressive in the removal of dentin within the root canal space; therefore, removal of more dentin from the canal wall in the preparation of the post space should be kept to a minimum to preserve tooth substance and minimize root fracture.

Post cementation. Among the most commonly used dental cements—zinc phosphate, polycarboxylate, glass ionomer cement, resin-based composite and the hybrid of resin and ionomer cements—zinc phosphate has had the longest history of success. In addition to having an extended working time, it is compatible with zinc oxide eugenol (ZOE), which is contained in most root canal sealers. In the case of an endodontic failure, a metal post that is cemented in the canal space with zinc phosphate is easier to remove and has a lower risk of root fracture compared with a metal post that is bonded strongly with a resin-based composite cement in the root canal space.

Microleakage is the major concern when using polycarboxylate and glass ionomer cements. These cements also have a much lower modulus of elasticity than zinc phosphate and dentin. Resin-based composite, on the other hand, is becoming increasingly popular because of its potential to bond to dentin. Some authors have expressed concerns regarding microleakage and thermocycling of resin cements.[52,53] Others, however, have demonstrated improved retention of posts[54–57] and decreased microleakage[58–60] and higher fracture resistance of teeth[61] when posts are cemented with a resin cement than with other cements. Furthermore, thermocycling of resin cement used in thin film thickness probably is not as significant a problem compared with other restorative procedures, and the modulus of elasticity of resin-based composite is similar to that of dentin.

Bonding resin cement to the dentinal wall of the root canal space must be done carefully to improve bonding and minimize microleakage. First, any residual gutta-percha and root canal sealer must be removed from the dentinal walls to ensure proper bonding of resin to dentin. This can be accomplished by removing gutta-percha using thermal methods, mechanical methods or both, followed by cleansing the walls using a long Peeso brush with pumice slurry. Thorough rinsing of the canal space can be achieved by using a three-in-one syringe and an irrigation syringe. While it generally is believed that eugenol-containing root canal sealers can inhibit the polymerization of resin cements, studies have shown that there is no adverse effect on marginal seal[60] and post retention[62] when canals are obturated using an eugenol-containing sealer and a post is placed with a resin cement, as long as the canal walls are cleaned thoroughly.[63] Second, removal of the demineralized collagen layer using a specific proteolytic agent such as sodium hypochlorite has been shown in an SEM study to improve the bonding of resin to the root canal wall owing to the penetration of resin tags into dentinal tubules along the wall.[56] Finally, removal of the smear layer through acid treatment and the wet bonding of dentin without contamination must be done carefully as with other restorative procedures using resin-based composite to achieve success. A lentulo spiral can be used to carry acid etchant into the post space, while a fine-tipped microapplicator can be used to coat the canal walls with bonding agent. Other methods of preparing the canal walls for bonding also have been suggested.[55,57,63–65]

Another concern of using resin to cement a metal post is the difficulty in removing the post in case of endodontic failure. It is difficult and time-consuming to remove a well-bonded resin-cemented metal post, and the risk of a root fracture remains a concern. This problem, however, is not encountered if fiber-reinforced posts are used in combination with resin cement, since fiber-reinforced posts can be removed easily.

The use of various types of fiber-reinforced posts and resin cement is becoming more popular. However, dental practitioners must keep in mind that though preliminary studies on the use of these materials are promising, long-term clinical results still are not available.

Numerous in vitro and in vivo studies have been conducted to compare failure mode, retention and fracture strength of various post systems using continuous or intermittent loading with mixed results. Schwartz and Robbins[66] offered a good summary of these studies in their review of post placement and restoration of ET teeth.

PRINCIPLES OF CORE BUILDUP

The construction of a core buildup is necessary as the amount of residual tooth substance decreases,[67] and the buildup augments the development of retention and resistance provided by the remaining tooth structure.[68] Morgano and Brackett[68] described some of the desirable features of a core material. They include adequate compressive strength to resist intraoral forces,[69] sufficient flexural strength,[69] biocompatibility,[70] resistance to leakage of oral fluids at the core-to-tooth interface,[71,72] ease of manipulation,[73] ability to bond to remaining tooth structure,[74–76] thermal coefficient of expansion and contraction similar to tooth structure,[71] dimensional stability,[77] minimal potential for water absorption[78–80] and inhibition of dental caries.[81] Unfortunately, as the commonly used materials all exhibit certain strengths and weaknesses, such an ideal core material does not exist.

The most commonly used core materials are cast gold, amalgam, resin-based composite and glass ionomer cement. Both cast gold and amalgam have been used successfully for many years, as they exhibit high strength and low solubility, and their coefficient of thermal expansion is similar to that of tooth substance. Placing cast gold post and core, however, is an indirect procedure requiring two visits. Placing an amalgam core requires a prolonged setting time, making it difficult to prepare immediately after placement if a crown is the final restoration.

Placing amalgam can be challenging in badly broken-down teeth, and many patients are concerned about the presence of mercury in amalgam, regardless of whether there is scientific evidence to support the claim of toxicity. Both gold and amalgam are not esthetically pleasing, especially under the newer all-porcelain restorations.

Resin-based composite offers an esthetically pleasing material especially in the anterior section under an all-porcelain restoration. It has good strength characteristics and low solubility. Some of the negative features of resin-based composite are polymerization shrinkage, hydroscopic expansion as a result of water adsorption and incorporation of voids in the buildup because it cannot be condensed like amalgam. Furthermore, resin-based composite is incompatible with ZOE in many root canal sealers, which can result in resin that is not cured completely. These negative features may lead to microleakage if they are not addressed properly during placement of the material. Proper removal of the residual root canal sealer coupled with a small incremental buildup using a condensable resin-based composite material may help alleviate the potential of microleakage.

One in vitro study comparing resin-based composite, amalgam and cast gold as core material under a crown in ET teeth found no significant difference in fracture and failure characteristics among these materials, provided a 2-mm ferrule existed on the margin of healthy tooth substance.[82] Glass ionomer cement, on the other hand, was shown to be weak in tensile and compressive strengths, and it had low fracture resistance as a core material in another study.[83] Glass ionomer cement also exhibits a low modulus of elasticity, poor bonding characteristics to dentin and enamel, poor condensability and high solubility. Therefore, the use of glass ionomer cement as a core material should be avoided.

THE FINAL RESTORATION

As I stated earlier, ET anterior teeth with minimal loss of tooth structure may be restored conservatively with a bonded restoration in the access cavity.[10,12,15] Neither a post nor a crown is required unless a great deal of natural tooth substance is lost as a result of caries or fracture.

Castings such as gold onlay, gold crowns, metal-ceramic crowns, and all-porcelain restorations with cuspal coverage are used routinely as standard and acceptable methods to restore posterior ET teeth. These restorations can provide ET teeth with the desired protection; however, they require extensive tooth preparation and can be expensive. In my review of the literature, I found mixed opinions as to whether full cuspal coverage should be carried out routinely on ET teeth.

Reeh and colleagues[84] compared the contributions of endodontic and restorative procedures to the loss of cuspal stiffness by using nondestructive occlusal loading on extracted intact human teeth. They concluded that endodontic procedures reduced the relative stiffness by only 5 percent. An occlusal cavity preparation, on the other hand, caused a 20 percent reduction of cuspal stiffness and mesial-occlusodistal cavity preparation caused a 63 percent reduction. They concluded that endodontic procedures do not weaken teeth with intact marginal ridges. These researchers confirmed in another study that it is the loss of marginal ridges that was primarily responsible for the change in stiffness.[7] Oliveira and colleagues[8] concluded that the greatest factor influencing the strength of ET teeth (specifically premolars) was the amount of remaining tooth structure. If a tooth is not fractured or severely damaged by caries before endodontic treatment, it may be sufficient to treat the endodontic access with a simple restoration.

If only a routine restoration is necessary, resin-based composite with acid etching of enamel and dentin is the restoration of choice.[7,85] In a three-year clinical study, Mannocci and colleagues[86] concluded that the clinical success rates of ET premolars with limited loss of tooth structure restored with fiber-reinforced posts and direct composite were equivalent to full coverage with metal-ceramic crowns. Restoring teeth with resin-based composite coupled with acid etching of enamel and dentin can result in recovery of tooth stiffness of up to 88 percent of that of unaltered teeth.[7] It can be concluded from these studies that the routine use of crowns on ET teeth may not be necessary if the marginal ridges are intact and most of the natural tooth substance is preserved.

It is necessary for dental practitioners to evaluate each clinical situation carefully to determine if full cuspal coverage is required for long-term clinical success.

Panitvisai and Messer[87] studied the extent of cuspal flexure after endodontic and restorative procedures and found that cuspal deflection increased with increasing cavity size in mandibular molars, and it was greatest after endodontic access. The authors concluded that cuspal coverage is important so as to minimize the danger of marginal leakage and cuspal fracture in ET teeth. In a 10-year retrospective study of ET teeth, Aquilino and Caplan[88] found that ET teeth that did not receive crowns after obturation were lost six times more often than teeth that received crowns after obturation. The authors observed a strong association between crown placement and the survival of ET teeth.

In view of the conflicting results of these studies, it is necessary for dental practitioners to evaluate each clinical situation carefully to determine if full cuspal coverage is required for long-term clinical success. Unless the majority of natural tooth substance remains after endodontic treatment, it probably is safer to provide some kind of cuspal coverage in the final coronal restoration since most teeth that require endodontic treatment usually are damaged severely as a result of caries, fracture or both.

Other restorative options. When the marginal ridges are lost as a result of extensive loss of tooth structure from caries, fracture or both, cuspal protection may be necessary for long-term preservation of the remaining tooth structure. An onlay, which conserves more tooth structure, or a crown can accomplish this. Castings have been used for many years with good success. In the past decade, porcelain onlay and different types of all-ceramic crowns also have been fabricated with good results. Recently, dental material research has focused on the development of esthetic materials such as resin-based composite with improved bonding and the all-ceramic restorations. Porcelain crowns have been in service for a number of years, and all-ceramic bridges also are available.

When a tooth is needed to support a removable prosthesis but it is compromised periodontally or has an unfavorable crown-to-root ratio, endodontic treatment followed by a metal coping or magnet installation can support an overdenture with good success. This way, the patient can function with improved proprioception and better stability of the denture than with a complete denture.

CONCLUSIONS

The number of endodontic procedures has increased steadily in the past decade with highly predictable results. Therefore, restoration of teeth after endodontic treatment is becoming an integral part of the restorative practice in dentistry. Proper restoration of ET teeth begins with a good understanding of their physical and biomechanical properties, anatomy, and a sound knowledge of the endodontic, periodontal, restorative and occlusal principles.[1] Although many new restorative materials have become available over the past several years, some basic concepts in restoring ET teeth remain the same.

In this article, I reviewed the principles in the use of posts and the various types of posts that are available. A thorough understanding of posts is necessary to make the right selection, as there are so many choices available. Finally, the choice of core material and the final restoration are important in achieving long-term clinical success.

As a result of this review, I have concluded that posts do not strengthen ET teeth and should not be used in them routinely. The main function of a post is for the retention of a core if there is insufficient tooth substance left to support the coronal final restoration.

The reason that many different types of posts with different designs and materials are available is because they all have certain strengths and weaknesses. Selection criteria should include adequate strength, modulus of elasticity, retention, biocompatibility, esthetics and retrievability. The new fiber-reinforced posts offer impressive results, but clinical evaluation is necessary over a longer term.

Post space preparation requires good understanding and knowledge of tooth anatomy to avoid unnecessary mishaps. Cementation of posts with resin cement seems to offer better retention, less microleakage and higher resistance to tooth fracture. However, cementing a post with resin cement must be performed meticulously, as this procedure is technique-sensitive.

Gold, amalgam and resin-based composite are acceptable core materials, and each has its advantages and disadvantages. However, the use of glass ionomer cement as a core material should be avoided, owing to its low strength, low stiffness, poor bonding characteristics and high solubility.

Although many promising new materials are available and there are definite indications for their use, long-term clinical evaluations are needed. Clinicians must keep this fact in mind when selecting these materials.

FOOTNOTES

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