Restoration of endodontically treated teeth: The seven keys to success

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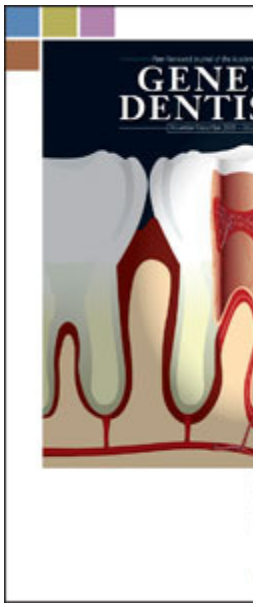

Preservation of tooth integrity and strength is important for the long-term survival of endodontically treated teeth. post space preparation requires reduction of the remaining supportive tooth structure. Restorative modalities follo must provide sufficient strength for the prosthetic material and tooth structures. This article presents seven key fa into consideration to ensure clinical success when restoring an endodontically treated tooth.

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Several factors play a role in the long-term survival of endodontically treated teeth and associated restorations. T key factors that affect tooth and restoration survival.

Fiber-reinforced resin posts should be used with caution until more long-term data are available

For many years, the standard method for restoring endodontically treated teeth has involved either a custom cas prefabricated metal post with a restorative material core.[1-3] A nationwide survey of dentists in 1994 reported that used prefabricated posts, the most popular being the parallel-sided serrated metal post.[4] It is likely that prefabric increased substantially since that 1994 survey.

The high demand for esthetic restorations and all-ceramic crowns has led to the development of a variety of nonr systems as alternatives to metal posts.[5-8] In addition to the esthetic advantages of nonmetallic posts, laboratory s these posts offer favorable physical and mechanical properties and less root fracture compared to metal posts.[9-1 fiber-reinforced posts have produced a wide range of reported failure percentages, ranging from 0% (after a mea 11.4% (after two years).[14-23] The most commonly reported complications are post loosening and root fracture (Fi core and the final restoration both depend on the retentive capacity of the post.[27]

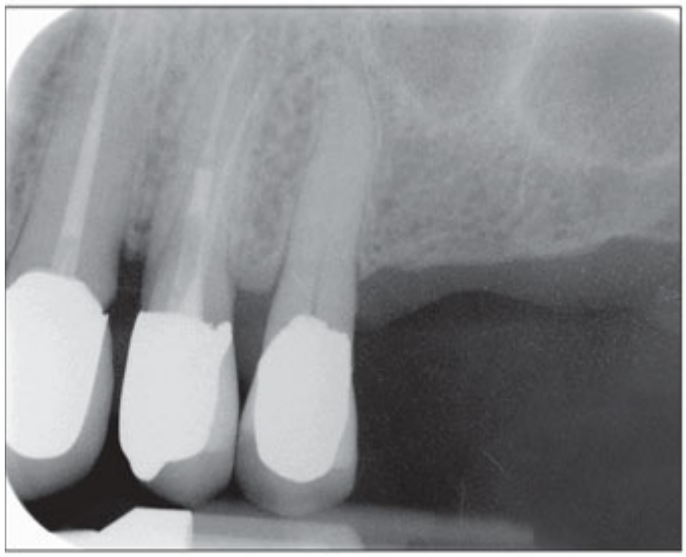

Fig. 1. A radiograph of a fractured maxillary first premolar with a prefabricated non-metallic post.

Fig. 2. A maxillary left central incisor with a broken core retained by a non-metallic prefabricated post.

Given the wide range of reported failure percentages, it appears that more long-term clinical data are needed to c fiber-reinforced posts.

Crowns should be placed on most endodontically treated posterior teeth to enhance their longevity
Clinicians have observed a difference between endodontically treated teeth and vital teeth. Endodontically treate than vital teeth. They tend to break during extraction; in addition, pulpless molars without crowns can fracture.[28,2

Multiple studies have shown that endodontically treated teeth benefit from the placement of crowns. Aquilino and endodontically treated teeth with crowns had a survival rate six times greater than that of teeth without crowns (F evaluated 116 teeth that had failed and were extracted; the authors reported that endodontically treated teeth wit an average of 50 months, while endodontically treated teeth with crowns were lost after an average of 87 months

Fig. 3. *Left*: An occlusal view of a fractured endodontically treated mandibular right first molar. *Right*: The extracted tooth revea

According to several clinical studies, fixed partial dentures have increased clinical failure when they are supporte abutment teeth rather than vital abutment teeth.[28,32-35] One study determined that crowns significantly improved treated posterior teeth but did not improve the success of anterior teeth, indicating that intact endodontically treat complete crown coverage unless they are weakened by large and/or multiple coronal restorations or they require color or form.[36]

Conversely, Mannocci et al evaluated endodontically treated premolars that had been restored (both with and wit either a post or direct composite resin restorations and reported similar success rates for both.[37] A similar retrosp Nagasiri and Chitmongkolsuk indicated that endodontically treated molars that are intact (except for the access c successfully using composite resin restorations.[38]

After considering the available data, the authors recognize the potential benefits of using composite resin to resto intact except for the access opening. However, since wear is an indicator of the forces that will be brought to bea data are needed to determine the long-term success of these teeth when varying degrees of occlusal wear are p authors recommend using crowns that encompass the cusps because they will help cusps that have been weake structure removal to withstand the occlusal forces of everyday mastication.

Conversely, it may be possible to avoid placing crowns on some previously restored posterior teeth, such as mar small, poorly developed lingual cusps that would not be subjected to the wedging effect from opposing cusps. Wi there is little chance that occlusal forces will separate the cusps, so the access opening can be restored without t coverage crown.[39]

Posts weaken endodontically treated teeth rather than enhance their clinical longevity

Historically, the use of posts has been based on the concept that they reinforce teeth; however, nearly every labo that posts either fail to increase the fracture resistance of extracted endodontically treated teeth or that they decr of the tooth when force is applied via a mechanical testing machine.[40-50] Pontius and Hutter reported that maxilla resisted higher failure loads than those with posts and crowns.[42] Gluskin et al found that mandibular incisors with exhibited greater resistance to transverse loads than teeth with posts and cores.[43] These studies showed no evic or reinforce teeth (Fig. 4).

Fig. 4. A radiograph of a fractured maxillary second premolar with a prefabricated metallic post.

Clinical studies also have failed to provide definitive support for the concept that posts strengthen endodontically longitudinal radiographic study, Eckerbom et al evaluated the radiographs of 200 consecutively treated patients s endodontic treatment and reported that teeth with posts had significantly more apical periodontitis.[29] In a 2003 ar clinical studies, Goodacre et al noted fractures in 3% of teeth with posts, with no evidence that posts enhanced th have had little effect on the clinical success of fixed partial denture abutments but they have been reported to imp removable partial denture abutments compared to endodontically treated abutments that did not use posts.[36]

Clinical and laboratory data indicate that teeth are not strengthened by posts; rather, their purpose is to retain a c adequate support for the definitive crown or prosthesis. Unfortunately, this primary purpose has not been comple survey showed that 24% of general dentists felt that posts strengthen teeth.53 A year earlier, Morgano et al repo age 50 believed that a post reinforces the tooth, compared to only 41% of dentists under age 41.[4] Thirty-nine per of full-time faculty, and 56% of non-faculty practitioners felt that posts reinforce teeth.[4] In a survey conducted in S found that 29% of general dental practitioners felt that a post reinforced the tooth, compared to 17% of board-cer

Since posts do not appear to reinforce teeth, they should be used only when the core cannot be retained by any

To ensure an adequate apical seal, 5 mm of gutta-percha should be retained

After an endodontically treated tooth is prepared for a post, the remaining gutta-percha at the apex is the only ba into the periapical area. Several studies showed that leakage increased when only 2–3 mm of gutta-percha was 4–5 mm of gutta-percha ensures an adequate seal.[54-60] Although multiple studies indicate that 4 mm produces a precisely 4 mm is difficult and radiographic variations in angulation could lead to retention of less than 4 mm. Wit to be a safer minimal radiographic length.

The best method for preserving the apical seal during preparation of a post space is to use the working length de treatment; the same reference point used on the tooth during endodontic therapy should be used during post pre preparation instrument with an appropriate diameter should be used with a rubber stopper placed around the inst to help ensure that an adequate amount of gutta-percha is retained apically.

Three methods have been advocated for removing gutta-percha when preparing a post space without disturbing thermal, and mechanical.[54,57,61-64] According to the literature, both hot hand instruments and rotary instruments adequately condensed gutta-percha, provided 5 mm is retained apically.[54,57,62-64] Several studies have determin percha immediately after root canal treatment has no detrimental effect on the apical seal.[55,56,58,61,65]

Short posts should be avoided

The appropriate length for a post should minimize the potential for damage to the tooth, optimize post retention, a apical seal for the root canal restoration. Several guidelines for determining the length have been proposed.[2,66-6

While short posts have never been advocated, they have been observed frequently on radiographs (Fig. 5). A 19 McAndrew examined 327 posts and found that only 111 (34%) were as long as the incisocervical length of the cr

endodontically treated teeth, Ross determined that only 28 posts (14%) were equal to or greater than 66% of the radiographic study of 217 posts determined that 11 (5%) were 66–75% of the root length.[72] Root fractures cause more frequently when short posts are used.[49,73-76] According to Trabert et al, increasing the length of a post incre fracture.[77]

Fig. 5. A very short post in the root of a maxillary right lateral incisor that will result in loosening and failure of the prosthesis.

Leary et al determined that posts that are equal to 75% of the root length offered the greatest rigidity and produc However, it can be difficult to utilize this apparently optimal post length. When a tooth has an average or below a post occupies two-thirds or more of the root length, it is not possible to retain 5 mm of gutta-percha at the apex.[78] length is determined by retaining 5 mm of apical gutta-percha and extending the post to that depth.

This post length guideline is appropriate for all teeth except for molars. Abou-Rass et al examined 150 extracted molars and determined that molar post spaces should not be prepared more than 7 mm apical to the orifice of the roots (the distal root of mandibular molars and the palatal root of maxillary molars) because of the increased pote Secondary roots (that is, the facial roots of maxillary molars and mesial roots of mandibular molars) cannot accor excess root thinning and potential perforation.

The potential for root thinning, perforation, and root fracture increases with large-diameter posts

Increasing the diameter of a post weakens the remaining root. It has been determined that stresses in a root incr increases.[80] Larger post diameters decrease the resistance to tooth fracture.[77] Deutsch et al determined that usi mm or more) increased the potential for root fracture sixfold for every millimeter of decreased root diameter.[81]

According to the literature, root fracture is the second most common cause of post and core failure.[14,16-18,25] Mul been associated with the potential for root fracture: large-diameter posts, short posts, and threaded posts (Fig. 6) recommended that post diameter should not exceed one-third of the root diameter and that post diameters be pr average root dimensions.[79]

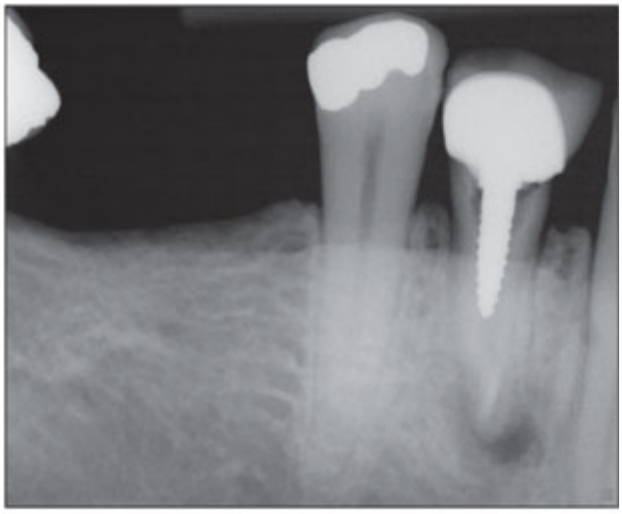

Fig. 6. A threaded post in a mandibular first premolar that has caused root fracture.

The post should be between 0.6–1.2 mm in diameter, depending on the tooth being restored.[84-86] Only post prep match the desired diameter of the post space should be used. When using a particular brand of post, make sure are made by the same manufacturer.

Understanding dental anatomy, the configuration of the roots and their variations, and appropriate instrument ang avoid root thinning and perforation. Instruments should be angled so that they follow the canal. Figure 7 is an exa was perforated because the instruments were at an improper angle when preparing the post space.

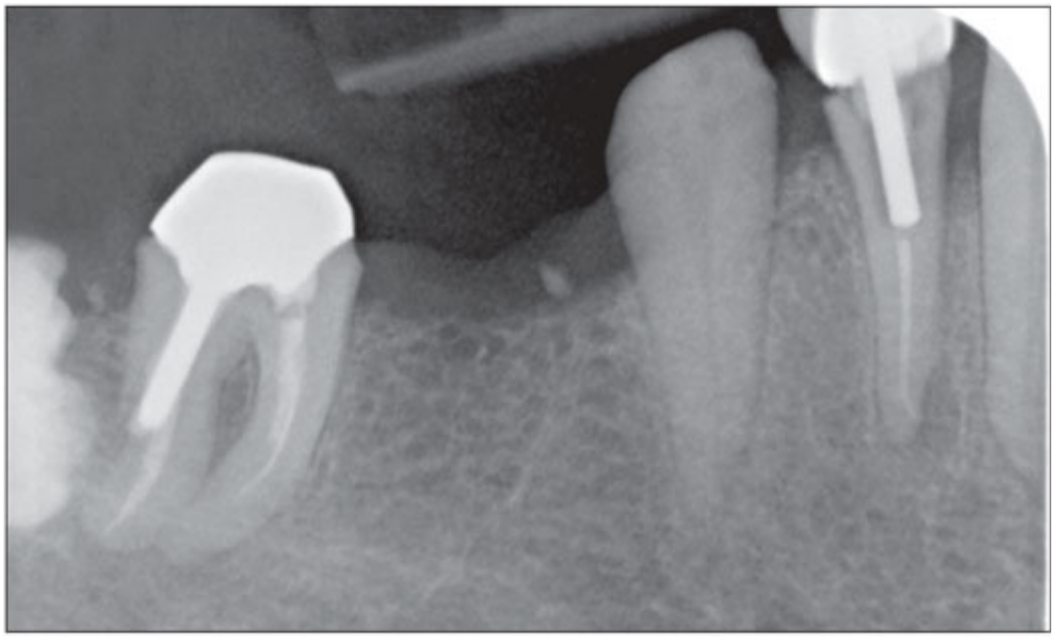

Fig. 7. A perforation in the distal root of the mandibular right second molar, the result of a post space prepared with instruments that were not held parallel to the root canal.

When posts are needed in premolars, it is best to place them in the palatal root of the maxillary premolar and in t mandibular premolar with multiple roots. Root taper, curvature, and depressions should be reviewed prior to post

When posts are needed in molars, they should be placed in roots with the greatest dentin thickness. These roots

maxillary molars and the distal roots of mandibular molars) are known as the primary roots. However, it is importa extending a post more than 7 mm apical to the root canal orifice in primary canals increases the risk of perforatio mandibular molars and the facial roots of maxillary molars should be avoided, if possible. Dentists also should av pressure on the root surface toward the furcation, as this surface is thinner than the outer surface due to root cur

For all teeth, the apical 5 mm of the roots should be avoided because most root curvatures occur within 5 mm of into this area increases the risk of excessive root thinning or perforation.

A cervical ferrule should engage tooth structure to prevent root fracture

Ferrules can be established by the core engaging tooth structure (known as the core ferrule) or by the overlying e structure (known as the crown ferrule).[88-97] The data indicate that crown ferrules are more effective than core fer the tooth's resistance to fracture.[89,91-93,98] Although the data indicate the benefit of a crown ferrule, not all practiti according to a survey by Morgano et al, 56% of general dentists, 67% of prosthodontists, and 73% of board-certi that core ferrules increased a tooth's fracture resistance.[4]

Different lengths and forms of the ferrule have been studied in the literature.[92,94,95,99] The length and form are es ferrule effect. When possible, encompassing 2.0 mm of intact tooth structure around the entire circumference of a effective crown ferrule. Ferrule effectiveness is enhanced by grasping larger amounts of tooth structure. The amo engaged by the overlying crown appears to be more important than the length of the post in increasing a tooth's 8 presents a case in which the length of the post was appropriate; however, the lack of a ferrule caused the resto

Fig. 8. *Left*: A clinical photo of a patient with very little cervical tooth structure for crown retention. *Right*: A crown with a fractu several months after placement.

If cervical tooth structure is insufficient for developing a ferrule, surgical crown lengthening or orthodontic extrusio expose more tooth structure. It may be prudent to extract a tooth and replace it with an implant and crown when developed, when crown lengthening would create an unacceptable esthetic environment or produce a furcation c present that would not allow for the development of appropriate post length.

Summary

Due to the wide range of reported failure rates in available clinical studies, fiber-reinforced resin posts should be long-term clinical data become available. Crowns are not needed for intact or minimally restored anterior teeth ur changes cannot be accomplished by more conservative means. Crowns should be placed on most endodonticall enhance their long-term survival. Some data indicate that posterior teeth that are intact except for the access ope satisfactorily with composite resin rather than a crown; however, the long-term success of this more conservative heavy occlusal forces is unknown.

Posts weaken teeth and should be used only when the core cannot be adequately retained by any other means. retained by preserving 5 mm of gutta-percha. Short posts should be avoided, as they increase the potential for rc except molars, optimal post length is determined by retaining 5 mm of apical gutta-percha and extending the pos

posts should be placed only in the primary roots (palatal roots of maxillary molars and distal roots of mandibular r
extend more than 7 mm apical to the orifice of the root canal due to the potential for root thinning or perforation.

To minimize root thinning and the potential for root fracture, the diameter of posts should not exceed one-third of
preparation instrument diameter should be matched to root diameter. Since crown ferrules increase the resistanc
placed on endodontically treated teeth should encompass 2.0 mm of tooth structure apical to the core whenever

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