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ENDODONTICS

COLLEAGUES FOR EXCELLENCE

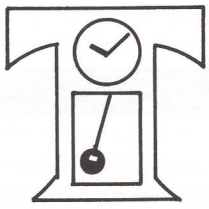
RESTORING ENDODONTICALLY TREATED TEETH

FACT—

Unrestored endodontically treated teeth are structurally compromised! Caries, previous restorations, fractures, wear, erosion, and endodontic procedures combine to necessitate careful and timely tooth reconstruction to ensure a favorable prognosis.

For years, little scientific rationale existed for the reconstructive techniques chosen for endodontically treated teeth. Many textbooks directed practitioners to restore every endodontically treated tooth with a post-core and crown. This empirical dictate was based on years of successful clinical practice. Practitioners believed that all endodontically treated teeth were brittle and required extensive restoration. Furthermore, when a tooth had a periradicular lesion, practitioners commonly waited months for radiographic evidence of healing prior to restoration. Recent scientific insights and technological advances have provided new perspectives on these and other restorative issues.

This issue of *ENDODONTICS: Colleagues for Excellence* addresses structural considerations and new materials and techniques that, when combined with sound clinical judgment and practical experience, can aid the practitioner in providing predictably successful restorative treatment for endodontically treated teeth.



Timing of tooth restoration

Until an endodontically treated tooth is restored to full function, treatment is incomplete. Recent studies have confirmed that coronal leakage is a significant etiology in endodontic failure. If an obturated canal is exposed to saliva, leakage will compromise the gutta-percha seal, and the tooth may require retreatment. In addition, the unrestored endodontically treated tooth is susceptible to fracture, which could lead to loss of the tooth. Because modern endodontic therapy achieves a predictably high success rate, postponing restoration for extended periods of time to be certain of endodontic success is unnecessary and could place the tooth at risk.

If a final restoration cannot be placed within a few weeks of endodontic treatment, a strong, leak-resistant, protective, provisional restoration is indicated. A well-processed temporary crown or bridge, glass ionomer, or acid etched composite build-up may be considered, as can a properly fitted and cemented orthodontic band.

How to choose a restoration

Multiple factors must be considered in choosing a final restoration. Crucial considerations include the amount of remaining sound tooth structure, occlusal function, opposing dentition, and position of the tooth in the arch, as well as length, width and curvature of the root(s).

It is also important to understand that changes occur in the dentin of endodontically treated teeth—changes that affect its function under stress. Despite popular opinion, these teeth are not brittle from loss of moisture content. While the collagen bonds in the dentin of endodontically treated teeth are weakened and may be more likely to break, weakness is primarily caused by loss of tooth structure due to caries, previous restorations, fractures, or preparation of the root canal and access cavity. Therefore, the strongest tooth is the one in which the most sound dentin and enamel can be retained and used to rebuild the tooth.

How to choose a restoration

Anterior teeth

In anterior teeth with intact marginal ridges, cingulum, and incisal edges, the placement of a lingual or palatal dentin-bonded composite resin is the treatment of choice. Extensive restorations requiring removal of sound, intact tooth structure are rarely warranted. Nevertheless, the presence of large or multiple restorations or unacceptable aesthetic conditions may preclude the use of the more conservative restorative options.

Discolored endodontically treated teeth may be bleached to an aesthetically acceptable color to prevent the need for removing sound tooth structure to place a veneer or porcelain fused to metal crown. However, when bleaching is indicated, caution may be advised if the tooth has been traumatized, as case histories for these teeth reveal a predisposition to cervical resorption.

Some anterior teeth may require complete coronal coverage along with posts and cores. This is common when large proximal restorations are present, caries has undermined the remaining marginal ridges, or the majority of the incisal edge has been lost due to trauma.

Posterior teeth

Posterior teeth present a different set of restorative needs due to their structure and the occlusal forces placed on them during function. Contemporary thought, in both research and clinical practice, supports the placement of a protective restoration with full cuspal coverage on these teeth. This is easily accomplished with a crown or onlay when sufficient tooth structure remains. Full coverage restorations prevent the fractures that can result from occlusal forces separating cusp tips during function.

However, complete coronal coverage may not always be necessary in cases of posterior teeth opposing partial or complete dentures. In these cases, the forces of mastication and cuspal interdigitation may be significantly reduced, thus minimizing chance of fracture.

Core restorative materials

The purpose of a core is to provide the compromised crown of the tooth with resistance, retention, and geometric form for the final restoration. The core material fills the pulp chamber and replaces lost tooth structure prior to crown preparation. A variety of accepted materials may be used for the core superstructure. Dentin-bonded reinforced composite resins and amalgams are the materials of choice. These may or may not be used in conjunction with a post. If a post is necessary, a cast metal post and core is a popular option.

When core material must be placed at the gingival tooth margins, several objectives should be met. Core materials should be distinguishable from tooth structure. Many reinforced composite materials are available in a variety of colors for this purpose. At least one to two millimeters of sound tooth structure gingival to the core is essential for a well designed crown preparation and marginal adaptation. No matter how well the core materials are bonded to the tooth structure, the potential for leakage exists if the materials are left exposed to the oral environment. In addition to improved sealing, crown cementation on tooth margins gingival to the core significantly enhances stability and increases retention. Resistance to root fracture and core fracture are also improved.

When these objectives cannot be readily achieved due to deep caries or tooth fractures, periodontal crown lengthening is indicated. In the case of the severely compromised endodontically treated tooth, crown lengthening ensures not only a properly restored tooth, but also allows for a sound biologic attachment of periodontal tissues two to three millimeters apical to the crown.

The role of posts/dowels

In recent years, research on the restoration of endodontically treated teeth has addressed a number of commonly asked questions:

- When is a post necessary?
- Does a post strengthen the endodontically treated tooth?
- What role does the post play in relation to the core build-up or crown?
- How long should the post be?
- What shape/size/type of post is the best to use?
- What is the best way to create the space for the post?
- What material should be used to cement the post?

While experience can answer some of these questions, it must be combined with scientific assessment to ensure a complete understanding of the issues.

The primary purpose and main indication for a post is to retain a core that can be used to support the final restoration. Posts ***do not*** *reinforce endodontically treated teeth, and a post* ***is not*** *necessary when substantial tooth structure is present after a tooth has been prepared.* In actuality, placing a post can predispose a tooth to fracture. In response to the discovery that posts do not strengthen teeth—they only serve to retain the core—research into design, shape, diameter, and length of posts now focuses on issues of retention.

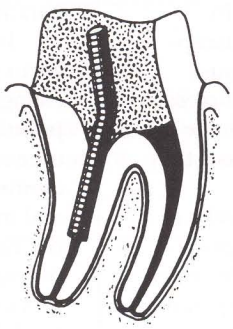


Figure 1: At times it is necessary to bend a prefabricated post prior to cementation to achieve a more ideal placement within the core material.

Regarding post design and shape, threaded posts are more retentive than serrated posts, which are more retentive than smooth-sided posts. Parallel-sided posts are generally preferable to tapered posts. Tapered posts can be successful in selected cases but are the least retentive and rely heavily on the integrity and strength of the cementing medium used. While highly retentive, threaded posts may predispose the root to fracture, as can tapered posts. Studies show that parallel-sided posts are less likely to contribute to root fracture. All

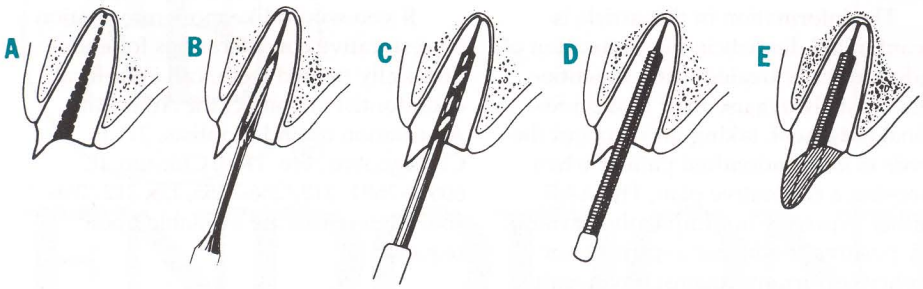


Figure 2:
A—Completed endodontic therapy
B—After gutta-percha has been removed with a heated instrument, the canal is enlarged using Peeso reamers.
C—Final post space preparation using the post manufacturer's bur
D—Post cemented in place
E—After post length adjustment, the core is fabricated and contoured around the post.

of these factors must be considered, along with the anatomy of the root in question, when selecting the ideal post design for a particular tooth.

Post size should not exceed one-third of root diameter. Increased post diameter ***does not*** *significantly improve post retention.* On the contrary, the increased removal of tooth structure to accommodate a larger post can lead to perforation or predispose the root to fracture. In choosing a post size, the practitioner must consider that root diameter decreases apically and that concavities in the root can be invisible radiographically. These anatomical factors can contribute to thin dentinal walls that are subject to fracture during the initial post cementation or during occlusion if the post is too wide.

Post length has been clinically and scientifically controversial for decades, and many formulae for recommended lengths have been proposed. While longer posts demonstrate increased retention, their position in the root may lead to clinical problems. In thin or curved roots, long posts can cause perforations or fractures. In short roots, they may disrupt the apical seal.

Clinical success rates support post length equal to or greater than the crown length of the tooth. Because retention tends to increase with length, posts between one half and three quarters of the length of the root are recommended. However, root width and curvature as well as the amount of filling material present in the canal space must also be considered when determining post design.

One of the goals of root canal treatment is to seal the root canal system in three dimensions. To achieve this, a minimum of four to five millimeters of root canal filling material must be retained as the apical seal. Because of the complex anatomy of root apices, any less than four to five millimeters may lead to leakage.

Preparation of the post space to this level can be accomplished immediately after obturation with gutta-percha and sealer using either a heated instrument or slow speed rotary instruments, such as Peeso reamers, Gates Glidden drills, or the post space preparation burs specifically designed for prefabricated posts.

Once the coronal filling is removed and the space prepared, the remaining material in the canal should be gently but firmly vertically condensed. After the post has been cemented in place, there should be no space remaining between the filling material and the end of the post.

With previously filled root canals, the practitioner must determine the acceptability of the treated case prior to creating post space. A definitive final restoration should never be placed over an endodontic failure. Absolutely no adverse clinical signs or symptoms should be present. Radiographically, a dense, three-dimensional filling should extend as close as possible to the cementodentinal junction, without gross overextension or underfilling.

When a paste fill is present, retreatment of the canal is always recommended prior to post placement. If a silver cone is present and a post is necessary to accomplish the restorative treatment plan, it is always preferable to remove the silver cone and retreat the canal as opposed to removing the coronal portion of the silver cone with a bur. The latter approach has been shown to loosen the silver cone and often leads to root gouging or perforation. When treatment planning, if a practitioner is considering a thermoplasticized gutta-percha filling technique using a metal or plastic carrier, the plastic carrier is recommended when post space is required.

NOTE: When endodontic therapy is performed through an existing cast restoration, filling the access cavity and restoring the occlusal surface is sufficient. Placement of a post through an existing crown does not enhance retention of the crown and, in fact, risks root perforation.

Cementing media for posts

All posts, whether cast or prefabricated, are cemented inside the root canal. The cementing medium enhances retention, aids in stress distribution, and, ideally, seals microgaps between the tooth and the post.

Historically, zinc phosphate was the cement of choice, yielding higher retentive values than polycarboxylate or standard resin cements. Recent studies have advocated the use of a low viscosity resin cement in combination with removal of the smear layer from the canal walls. This permits a movement of the resin into the exposed, patent dentinal tubules. This process, commonly referred to as "dentin bonding," yields an increase in post retention when compared to zinc phosphate.

With regard to cements, the practitioner must keep in mind that coronal leakage is a major factor in endodontic failure. All contemporary cements are susceptible to dissolution in the presence of saliva. Therefore, the importance of close marginal adaptation of crown to tooth for protection of the cementing medium cannot be over emphasized.

Occlusal Equilibration

On a final note, one of the overall clinical goals of endodontic treatment is to retain teeth in a symptom-free functional condition. Often overlooked is the need to ensure proper occlusal equilibration during and following endodontic and restorative treatment. Recently endodontically treated teeth tend to be sensitive, even to minor occlusal irregularities, due to lingering inflammation of the periapical tissues. Careful attention to occlusion can routinely provide the patient with a comfortable and functional restored tooth.

Summary

It is impossible to guarantee success in every case. However, predictably successful endodontic therapy cannot be achieved without properly designing and executing restorations with careful consideration of potential periodontal complications. When prosthetic and periodontal considerations are addressed concurrently with endodontic treatment, patients leave the office with the best possible prognosis for teeth that would otherwise have been lost.

The information in this article is meant to aid dentists in the restoration of endodontically treated teeth. Practitioners must always use their best professional judgment, taking into account the needs of each individual patient when choosing a restorative plan. The AAE neither expressly nor implicitly warrants any positive results nor expressly nor implicitly warrants against any negative results associated with the application of this information.

If you would like more information on restorative considerations for endodontically treated teeth, call your local endodontist or contact the American Association of Endodontists, 211 E. Chicago Ave., Ste. 1100, Chicago, IL 60611-2691, 312/266-7255, fax 312/266-9867. References are available upon request.

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On the Horizon ...

Guided Tissue Regeneration in Endodontics

For almost a decade, periodontists have employed the principles of guided tissue regeneration (GTR) in their surgical techniques. Used primarily in areas of Class II furcations and two- and three-walled infrabony pockets, GTR involves the placement of barrier membranes over a periodontal defect to protect the root from the downgrowth of gingival epithelium and the ingrowth of gingival connective tissue during healing. This creates a space between the barrier and the root to allow for the growth of a new attachment apparatus—cementum, periodontal ligament, and bone. These procedures have become an integral part of periodontal treatment planning.

Because endodontists sometimes encounter similar osseous defects when performing corrective radicular surgery, researchers have investigated the adjunctive use of GTR technique in endodontic surgical cases. Successful results have paved the way for the possibility of providing combined endodontic treatment and regenerative therapy in a single surgical procedure. With appropriate training, some endodontists have begun to use grafting materials and membranes selectively where indicated.

The original GTR membrane material was non-resorbable, requiring a second surgery for removal. As use of GTR has progressed, several varieties of resorbable materials have been introduced, obviating the need for a second surgery. However, the non-resorbable material is still used for those procedures where long-term membrane retention is desirable.

As some endodontists have gained experience with GTR materials, expanded applications in endodontic surgery have been explored. Grafting and membrane placement have been used extensively after extraction and root removal under bridges as well as in some cases of hemisection and root resection in order to maintain alveolar ridge height.

Currently, the American Association of Endodontists is cosponsoring training programs for endodontists in the use of GTR. As experience with GTR technique and materials increases, the endodontic community should be able to provide more efficient and reliable treatment options for many cases previously thought to be marginal or hopeless.

Comments?

Did you enjoy this issue of *ENDODONTICS*? Did the information have a positive impact on your practice? Are there topics you would like *ENDODONTICS* to cover in the future? We want to hear from you! Send your comments, questions and suggestions to:

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