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Review Article

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Choice of Post and Core Systems in Endodontics

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Abstract:

The restoration of the endodontically treated tooth is an important aspect of dental practice involving a range of treatment options of varying complexity. Modern dentistry aims at preserving pulpal vitality. However, if endodontic therapy is unavoidable, then the conservation of the remaining tooth structures is most important. In general, endodontically treated teeth have already undergone significant coronal destruction, loss of radicular dentin, reduced level of proprioception and an overall reduction in the capability of the tooth to resist the myriad of intraoral forces. The aim of this review article is to outline the important aspects while choosing an appropriate post and core system in endodontics.

Key Words: Endodontic therapy, intraoral forces, post and core system

Introduction

The endodontically treated tooth must be fortified in such a way that it will withstand both vertical and lateral forces and not be amenable to fracture. Vertical support must be added to the restorations so that they may be strong enough to protect the treated tooth from horizontal fracture.[1-4]

In the present era of esthetic, conservative, and adhesive dentistry, esthetic and functional restoration of a pulpless tooth is a demanding challenge. The post endodontic treatment of teeth presents the dental practitioner with the dilemma of selecting from a large array of materials, technique, and designs.

Objectives of Post and Core Treatment

The primary objective of the post and core buildup is to replace the missing coronal tooth structure sufficiently to provide the required retention and resistance form for the final restoration (the crown).[5]

The main function of the post is to anchor the post and core complex within the radicular portion of the remaining tooth. A post that can be bonded to tooth structure improves its ability to retain the entire foundation. The rationale for the use of resin cements in this function is well established. The adhesive, tensile, and shear strengths of resin to both tooth and post materials assure the predictability and longevity of the restoration.[6]

The post does not reinforce the root, nor does it extend any strength to the fragile remaining dentin. Therefore, it is important to select a post system that provides maximum retention, yet removes as little as possible of the remaining subgingival tooth structure.[7]

In general, the core can be thought of as a supragingival extension of the post. The main functions of the core are to provide a visible and accessible platform for, to improve the retention of, and to strategically manage the transfer of forces from the final restoration. The dentist using current adhesive techniques and materials can create a monoblock, a multilayered structure with no inherent weak inter-layer interfaces. The dentin is bonded to the resin cement, which is bonded to both the post and core materials. The prepared core and remaining peripheral tooth structure are then bonded to the final restoration through dual-cure resin cement. Thus, every component of the tooth or restorative material is directly or indirectly bonded to every other component. The bonding strength at each interface is stronger than the bond of the tooth to itself. Therefore, the integrity of the final endodontic-restorative continuum monoblock approaches that of the original healthy tooth itself (Figure 1).

An additional advantage of the bonded post is its ability to distribute stresses placed on the restoration over a larger radicular surface. The greater the transmission of forces to the remaining natural tooth, the greater the likelihood of subsequent root fracture and thus, restorative failure. In comparing the stresses transmitted by cemented nickel-chrome, cemented titanium, and bonded carbon fiber posts, it was found that the bonded post transmitted less than two-thirds as much stress as the titanium post, and less than one-third as much as the nickel-chrome variety (Figure 1).[8]

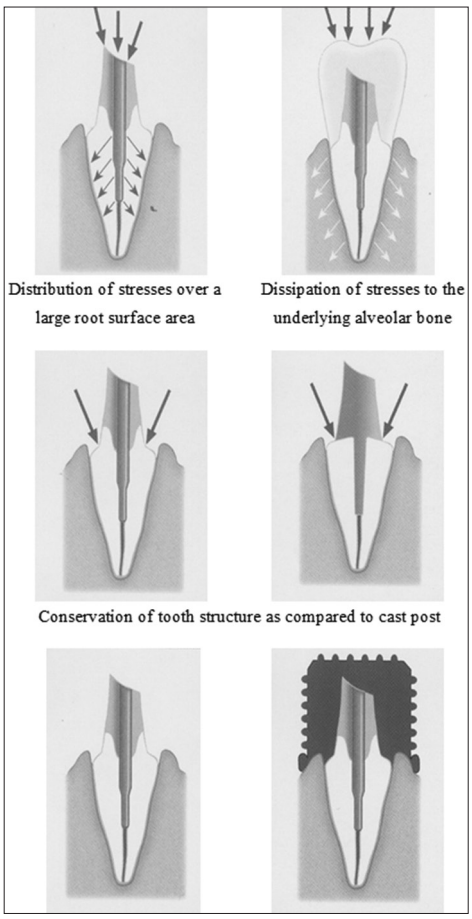

Figure 1: Formation of a monoblock.

Another important issue that has not been considered until recently is retrievability. When metal post fractures or otherwise fails, it is virtually impossible to remove the residual post from the radicular structure of the tooth without greatly compromising the remaining dentin.[9] Most current techniques involve enlarging the channel around the residual post until it can be manipulated or seized by a hand instrument. The channel enlargement usually removes so much dentin that the long-term prognosis for the tooth is quite limited.

Resin and resin fiber posts are retrieved easily when endodontic retreatment is necessary. The use of a Gates-Glidden drill through the existing post can rapidly and safely access the underlying Gutta-percha root canal filling. The post acts as a vertical guide for the drill, preventing the inadvertent instrumentation of the dentinal walls of the canal. When the Gates-Glidden drill reaches the Gutta-percha, the process of endodontic retreatment is routine. Once the canal is resealed, it is simple to rebond a new post in the canal. Post retrievability is thus rapid, routine, and predictable.[10]

The post and core materials also should be esthetically compatible. In the days of routine porcelain-fused-to-metal crowns with subgingival margins, core esthetics was never a concern. The metal of the crown covered and hid both the post and the core completely. Today, dentists are placing many all-ceramic restorations, crowns, onlays, and veneers, often with supragingival margins. A metallic or dark post or core will be readily visible through these semi-translucent restorations.

The Ideal Post and Core System

The resin fiber post is more similar in its characteristics to natural dentinal structure than any previously used post. It has the excellent transverse strength and acts as a shock absorber, dissipating much of the stress placed on the finished restoration, transmitting only a small fraction of these forces to the dentinal walls. The fiber post bonds to tooth structure, core materials, and resin cements. It is delivered to the patient in a single-appointment, chairside procedure. Most fiber posts are relatively tooth colored and do not pose an esthetic barrier to the final all-ceramic restoration.

The composite core has excellent adaptation to the remaining tooth structure. Because it involves a direct, chairside procedure, it is simple and predictable. The composite core will form stop, bonds to remaining tooth structures, bondable posts, resin cements and ultimately, the final restoration, creating the monoblock (Figure 1). Composite resin is easy to prepare to an ideal foundation for the final restoration, and it is available in a variety of colors for the maximum esthetic benefit.

The newest composite core materials are provided in automix cartridges. These cartridges guarantee perfect-mix chemistry every single time, making the procedure virtually foolproof. The automixed resin can be injected directly from the mixing tip into the canal and may be used as the resin cement as well as the core material.

The resin luting (dual-cured) cement exhibits high bond strength to tooth, metal, and ceramic. It is easy to use and predictable. Because it is dual curing, the set can be initiated by the curing light, but light access is not required. Those areas that are not exposed to light will cure chemically, usually within 4-5 min. Marginal areas that are exposed to the curing light will set within 20-40 s, minimizing the risk of moisture contamination, and simplifying the procedure.

The above components must be integrated into the remaining tooth structure under the rules of minimal invasiveness. This implies as little removal as possible of the remaining radicular dentin-usually accomplished by the selection of the largest post that will fit the post-endodontic dimensions of the canal, a size that requires a minimum of additional canal instrumentation.

To minimize stress on the remaining dentin, the posts must fit passively into the radicular structure. The posts themselves may be parallel sided or tapered, depending on the shape of the root and the preference of the practitioner.

Newer types of posts are the fiber-reinforced polymer posts. It is made of carbon, quartz, or glass fibers surrounded by a matrix

of polymer resin, which usually is an epoxy resin. The fibers are 7-10 μm in diameter and are available in a number of different configurations including braided, woven, and longitudinal. 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 l and 4 × 106 psi), on the other hand, measures closer to that of dentin (2 × 106 psi) and can decrease the incidence of root fracture. In the event of failure when restored with fiber-reinforced posts, teeth are more likely to be restorable.[10]

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. Scanning electron microscopic 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. Successful bonding also means that the shape (parallel vs. tapered) of the fiber-reinforced post may be less significant in relation to its retention than for a metal post.

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.

When choosing an esthetic post system, there are a number of criteria that the post must fulfill to guarantee clinical success:

- It has adequate light transmission to eliminate shadowing of the post within the tooth to maximize esthetics of the final restoration.
- It is bondable within the root canal for root reinforcement.
- It is tapered following the true shape of the root canal to avoid removing additional dentin to accommodate a parallel post, or does not require additional dentin preparation to achieve an apical seal.
- Its surface characteristics increase retention (e.g., serrations or a retentive design of the post, a retentive head design for the core).
- Able to absorb and dissipate impact, if the coronal portion of the tooth crown is traumatized.
- Ease of removal with an atraumatic technique if the post breaks or endodontic retreatment is necessary.
- Multiple sizes to fit different root canal diameters.
- Radiopacity.[11]

Conclusion

Off late, the restoration of endodontically treated teeth with the esthetic post system has been drawing the attention of a constantly growing number of the clinician. The progress in the technology of fiber-reinforced materials addressing structure, shape, and optical properties of the post has led to the development of material that has overcome some of the limitation of metallic posts (gold, platinum, or titanium) concerning esthetic appearance, mode of failure and clinical performance.

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