ESTHETIC POST-AND-CORE TREATMENT

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The postendodontic treatment of teeth presents the dental practitioner with the dilemma of selecting from a large array of materials, techniques, and designs. Even the basic underlying scientific principles of post-and-core technology are fraught with confusion. In addition, increasingly sophisticated dental materials constantly are being introduced, serving to alter not only the procedures, but the very paradigms of treatment.

Overall, the patients benefit from the evolving treatments that help to salvage teeth previously condemned to extraction. New patient concerns, however, have surfaced. They include minimal invasiveness of the remaining post-endodontic dentin, the biocompatibility of the restorative materials (posts, cores, and cements) to the remaining natural tooth structures, and the esthetic compatibility of both the post and the core.

SOME COMMON MISCONCEPTIONS

Over the years, dentists have routinely accepted some traditional concepts that have little, if any, scientific backing. The primary concept in question is the need for a post in the first place. One study in 1984 found no significant difference in teeth restored with or without posts (only cemented metal posts were evaluated). Another is the concept that a post improves the structural integrity of an endodontically treated tooth that has been weakened by decay or overpreparation. In fact, there is ample evidence in the current literature indicating the strength of the remaining tooth structure is related directly to the bulk of the...
remaining dentin,11, 13, 14, 20, 24 and that fracture resistance increases with an increase in dentin thickness.

Historically, cast metal posts-and-cores were the only viable and available choice. Even today, they are the treatment of choice in postendodontic situations for many dentists; however, cast metal posts fail twice as often as prefabricated metal posts,23 and tend to cause nonsalvageable root fractures.2, 12

Still another misconception in the postendodontic armamentarium is the use of nonadhesive cements. Although zinc oxyphosphate is an excellent luting agent, it bonds to neither tooth structure nor restorative materials. Resin cements, on the other hand, bond strongly to both dentin and enamel, as well as composites and other dental materials.7, 15

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).18

This becomes a mechanical issue, dependent on the remaining supragingival tooth structure that is available for restoration. If there is sufficient tooth structure available, there is little need for a post-and-core buildup. On the other hand, where the supragingival tooth structure is largely missing, the post-and-core foundation buildup is an essential prerequisite to crown fabrication.

The main function of the post is to anchor the post-and-core complex within the radicular portion of the remaining tooth.5 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 adhesive17, tensile3, 10 and shear strengths1, 16 of resin to both tooth and post materials assure the predictability and longevity of the restoration.

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.

Generally, the core can be thought of as 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 monobloc, a multilayered structure with no inherent weak inter-layer interfaces.22 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 a dual-cure resin cement. Thus, every component of 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 monobloc approaches that of the original healthy tooth itself.

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.8

Another important issue that has not been considered until recently is retrievability. When a 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. 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.

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 were 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 semitranslucent restorations.6 This is an esthetic compromise that most patients will not accept.

Generally, the ideal core shade is somewhat yellowish, very much like the dentin that it is intended to replace. The yellow tint is faintly visible through the all-ceramic restoration, providing a natural appearance to the restored tooth. The easiest way to visualize this is to think of the core composite material as the dentin, and the overlying ceramic as the enamel.

THE IDEAL POST-AND-CORE SYSTEM

The ideal post-and-core system today consists of three distinct components. These materials fulfill the objectives that are discussed above. They also avoid the errors that were predicated by some of the long-standing common misconceptions in this area of dentistry.

The resin fiber post is more similar in its characteristics to natural dentinal structure than any previously used post. It has 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 strong bonds to remaining tooth structures, bondable posts, resin cements, and ultimately, the final restoration, creating the monobloc. Composite resin is easy to prepare to an ideal foundation for the final restoration, and it is available in a variety of colors for maximum esthetic benefit.

The newest composite core materials are provided in automix cartridges. These cartridges guarantee a 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 a 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 to 5 minutes. Marginal areas that are exposed to the curing light will set within 20 to 40 seconds, 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 postendodontic 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.1,2,5 The posts themselves may be parallel sided or tapered, depending on the shape of the root and the preference of the practitioner.

CLINICAL TECHNIQUES

Several clinical techniques are available to the practitioner for the restoration of the endodontically treated tooth. In some respects they are similar, but each procedure has particular advantages and specific applications. Assuming that the post-and-core is the selected course of treatment, the first clinical decision depends on the size and the shape of the post-endodontic tooth. In those cases where the post-endodontic canal is relatively conservative, the dentist can choose one of several restorative systems. In situations where the prepared canal is quite wide, intraradicular rehabilitation is the treatment of choice.4

Intraradicular Rehabilitation

Occasionally, the post-endodontic presentation of the canal may be too wide for routine direct restoration (Fig. 1). This may have occurred as a result of extensive decay or aggressive instrumentation of the canal. The patient may be young with large canals. Simply placing a post in this canal (Fig. 1B) would leave a very thick layer of cement. It is also difficult to position the post in an ideal location for the subsequent restoration. The Luminex Light Transmitting System (Dentatus, New York, NY) (Fig. 2) is used to rehabilitate this canal to an ideal size and shape.

1. The canal is reamed to the desired depth (Fig. 3A) with a size-matched reamer. The reamer is correlated in size and shape to a corresponding light transmitting post and a Lucent Anchor (Fig. 4B).
2. The Luminex Light Transmitting Post (LTP) is tried in and adjusted for length (Fig. 4). The canal is then dried, etched, and rinsed.
3. A dual-cured fifth-generation bonding agent, Prime & Bond NT Dual Cure (Caulk-Dentsply, Milford, DE) is then applied to the internal surface of the canal, air blown to eliminate pooling, and light cured (Fig. 5A).
Figure 1. A, Occasionally, the post-endodontic presentation of the canal may be too wide for routine direct restoration. B, Placing a post in this canal would leave a very thick layer of cement.

4. A microhybrid, EsthetX (Caulk-Dentsply) is injected into the bonded canal and the Light Transmitting Post is pushed into the uncured composite resin (Fig. 5B) to its full depth.

5. The LTP and the composite resin are light cured together for 60 seconds (Fig. 5C). The Light Transmitting Post allows the passage of light through its body but does not bond to the composite material.

6. A hemostat is used to rotate and remove the LTP (Fig. 5D), leaving an ideally shaped and sized post space (Fig. 5E) for the size-matched Luscent anchor (Dentatus), which can be placed immediately.

At this stage the post space can be treated routinely. The post-and-core procedure will be predictable, and the prognosis for the tooth much improved.

Figure 2. The Luminex Light Transmitting System (Dentatus, New York, NY).
Figure 3. A, Canal is reamed to the desired depth with a size-matched reamer. B, The reamer (right) correlates in size and shape to a corresponding light transmitting post (center) and a Luscent anchor (left) (Dentatus, New York, NY).

Luscent Anchor Post Technique

The Luscent anchor post (Dentatus) is a fiber-glass, clear resin post that is designed to refract and transmit natural tooth colors for esthetic post-and-core foundations. The Luscent anchor is radiolucent, and identified on radiographs by the surrounding resin cement. Designed to be placed passively in prepared canals, it is available in three diameters, and is size integrated with the Light Transmitting Posts. The Luscent anchor is easily removed, if required, for endodontic retreatment.

1. Using the post space created in Figure 5E, A Luscent anchor is tried into the canal (Fig. 5F). If there has been no moisture contamination, the oxygen-inhibited layer is still available for the next restorative layer.
2. Luxacore (Zenith, Englewood Cliffs, NJ), an automixed, self-cured resin is injected directly into the canal (Fig. 6). The Luscent post is inserted
Figure 5. A, A dual-cured, fifth-generation bonding agent is applied to the internal surface of the canal, air blown to eliminate pooling, and then light cured. B, A microhybrid is injected into the bonded canal and the Light Transmitting Post (LTP) is pushed into the uncured composite resin. C, The Light Transmitting Post and the composite resin are light cured for 60 seconds. D, A hemostat is used to rotate and remove the LTP. E, An ideal post space. F, A Luscent anchor is tried into the canal.
Figure 6. A, Self-cured resin is injected into the canal. B, Resin will set within 4 minutes, at which point it can be shaped. C, Parallel-sided posts are readily removed should endodontic retreatment be necessary. D, The postendodontic canal is refined with a familiar, color-coded ParaPost (Coltene/Whaledent, Mahwah, NJ) drill. E, The ParaPost Fiber White post is tried into the canal. F, Bond is applied into the canal, air thinned, and then light cured. Illustration continued on opposite page
Figure 6 (Continued). G, Resin is injected into the bonded canal and the post is seated into the uncured composite to its full depth. H, The core can be built up immediately, and it is set within 4 minutes. I, The ParaPost Fiber White post-and-core is shown from the occlusal after the composite has set. J, The ParaPost Fiber White post-and-core is shown from the buccal after the composite has set. K, The FibreKor post (Jeneric/Pentron, Wallingford, CT) is tried into the post-endodontic space. L, A bonding agent is applied into the space.
Figure 6 (Continued). M, FibreKor post is seated to its full depth in the uncured composite. N, The core can be built up immediately. O, The post-and-core is ready for final prosthetic preparation.

into the uncured composite resin, and the core build-up is commenced immediately (Fig. 6B). The Luxacore will set within 4 minutes, at which point it can be shaped.
3. After preparation for a full crown, the Luscent anchor post-and-core is ready for the impression and provisionalization steps.

ParaPost Fiber White Technique

The ParaPost Fiber White Post (Coltene/Whaledent, Mahwah, NJ) is a filled resin, mono-directional fiber matrix with a flexural modulus that very closely approximates that of the natural dentin. The color of the post is white translucent, designed to minimize shadowing under all-ceramic restorations. The parallel-sided posts are intended for passive seating in the canal, and the antirotational post head stabilizes the core materials. The ParaPost Fiber White is available in four diameters, color coded to matching drills. These posts are readily removed should endodontic retreatment be necessary (Fig. 6C).
1. The postendodontic canal is refined with a familiar, color-coded ParaPost drill (Fig. 6D).
2. The ParaPost Fiber White post is tried into the canal (Fig. 6E). The canal is dried, etched, rinsed, and left slightly moist.
3. One Coat Bond (Coltene/Waledent) is applied into the canal (Fig. 6F), air thinned, and then light cured.
4. Luxacore is injected into the bonded canal and the Fiber White post is seated into the uncured composite to its full depth (Fig. 6G). The core can be built up immediately (Fig. 6H), and it is set within 4 minutes.
5. The ParaPost Fiber White post-and-core is shown from the occlusal (Fig. 6I) and the buccal (Fig. 6J), after the composite has set. With the judicious application of build-up materials, the ideal crown foundation is closely approximated. It is now ready for the final crown preparation.

FibreKor Post Technique

The FibreKor Post (Jeneric/Pentron, Wallingford, CT) uses glass fibers bundled in a resin matrix. The bundles are in turn impregnated with resin, cured, and precision milled. The white color of the post blends in readily with dentin, eliminating the halo effect of metal or carbon fiber posts underneath all-ceramic restorations. The modulus of elasticity of the FibreKor Post is closely matched to that of dentin, helping to distribute impact forces more uniformly along the prepared canal interface. The post is available in three diameters with size-matched drills. Should endodontic retreatment become necessary, the FibreKor Post can be carefully extracted from the canal using conventional burs and drills.

1. The FibreKor post is tried into the post-endodontic space (Fig. 6K). The canal is refined with the color-coded drills until a satisfactory depth is reached. The canal is dried, etched, rinsed, and left moist.
2. Bond 1, a fifth generation bonding agent (Jeneric/Pentron), is applied into the post space (Fig. 6L) and allowed to sit undisturbed for 20 seconds. It is then gently air thinned and light cured for 40 seconds.
3. Build-it (Jeneric/Pentron), an automixed, dual-cured composite resin, is injected directly into the bonded canal, and the FibreKor post is seated to its full depth in the uncured composite (Fig. 6M). This layer can then be immediately light cured, preventing any possible contamination of the adhesive seal around the post.
4. The core can be built up immediately (Fig. 6N) and, within moments, the post-and-core is ready for final prosthetic preparation (Fig. 6O).

Aestheti-Plus Technique

The Aestheti-Post System (Bisco, Schaumburg, IL) is actually a series of posts that can be used in a variety of situations. The traditional posts are two-stage fiber posts, available in white or clear quartz fibers. There is also a tapered white fiber post. The posts have characteristics that are similar to their carbon fiber ancestors, including high flexural strength and a low modulus of elasticity. All the posts are retrievable if required for endodontic retreatment.
1. The evolution of the metal-free posts: C-Post (carbon fiber), Aestheti-post (white quartz fibers surrounding carbon fibers), Aestheti-Plus (all esthetic post) (Fig. 7).

2. The Aestheti-Plus post is tried into the postendodontic canal. The matched set of drills (Fig. 8) are used to prepare the canal for the two-stage posts. After the preparation is completed, the canal is dried, etched, rinsed, and left moist.

3. A fifth-generation adhesive, One Step (Bisco), is applied into the canal and cured.

4. Post Cement Hi-X (Bisco), a two-paste resin cement, is used to affix the post in the canal.

5. Light-Core (Bisco), a translucent, optical fiber-reinforced, light-cured, core build-up material completed the restoration (Fig. 9), which is now ready for the final crown preparation.

**SUMMARY**

The dilemma that confronts the practitioner in the area of post-endodontic rehabilitation is a positive one. The variety of products and techniques available offer practical solutions to most restorative problems. Patients have benefited
Figure 9. A translucent, optical fiber-reinforced, light-cured, core build-up material completed the restoration, which is now ready for the final crown preparation.

from recent developments in post-and-core technology, and continue to reap the benefits of research and development.

The ideal system of products for the endodontic-restorative continuum includes:

an esthetic resin fiber post
a composite core
an automixed resin luting cement
current techniques that combine the automixed resin luting cement and composite core into the same component

References


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