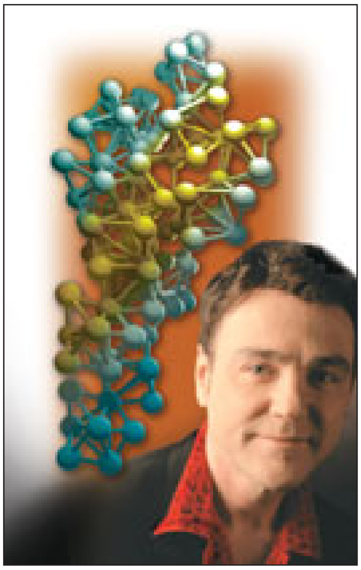
Restoring the Intraradicular Space With Direct Composite Resin: Fiber-Reinforced Post-and-Core System

Douglas A. Terry, DDS*

Rehabilitating the roots of teeth to retain restorations has been described in the literature for over 250 years.[1] During this evolution, the reconstruction of endodontically treated teeth has presented restorative and aesthetic challenges for the technician and clinician. The failure of these post-retained crowns has been documented in several clinical studies.[2,3] Many of these studies indicate that the failure rate of restorations on pulpless teeth with post and cores is higher than that for restorations of vital teeth.[3,4] Several main causes of failure of post-retained restorations have been identified. These include recurrent caries, endodontic failure, periodontal disease, post dislodgement, cement failure,post-core separation, crown-core separation, loss of post retention, core fracture, loss of crown retention, post distortion, post fracture, tooth fracture, and root fracture. Also, corrosion of metallic posts has been proposed as a cause of root fracture (Figure 1).[4-6]



Design Considerations

Clinical failures and new discoveries provide answers to the technician and clinician that enable each to move forward from the views of the past. Thus, these failures have yielded design principles that should be considered when selecting and using any post-and-core system for a specific clinical situation, including:

- Maximum post retention and core stability
- Inherent anti-rotation of the post-and-core complex by placement of a 2-mm ferrule around the circumference of the preparation on sound tooth structure
- Minimal removal of tooth structure
- Morphological intraradicular adaptation
- Optimal aesthetics
- Inherent resistance to catastrophic root failure
- Lack of corrosiveness
- Posts with a similar modulus of elasticity as root dentin to distribute applied forces evenly along the length of the post
- Restorative materials with flexural and tensile strength characteristics similar to root structure
- A system with uninterrupted bonding at all interfaces resulting in increased resistance to fatigue and fracture, enhanced retention, and a reduction in microleakage and bacterial infiltration.[7-10]

At present, an increased demand for clinically convenient post-and-core systems to replace lost tooth structure has provided the clinician with a plethora of simplified "one-visit" post-and-core restorative options.[8] In view of the previous design considerations, it is understandable that clinicians have uncertainties regarding selection of restorative materials and techniques to

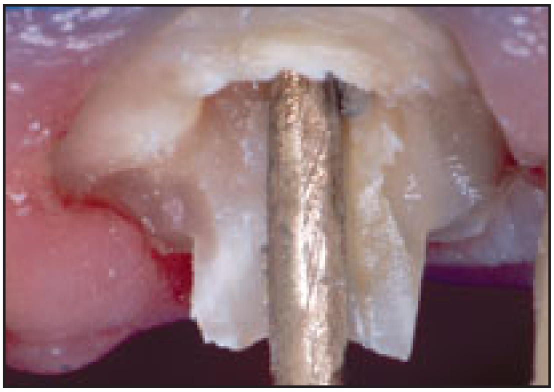


Figure 1. Failure of a post-retain system from dislodgment.

Figure 2. The completed post and core with an ideal coronal preparation dimension.

achieve optimal results for post-and-core build-up procedures.[11] Although the quest for the ideal material to restore lost tooth structure continues to be a focus of modern dental research,[12] many post-and-core techniques are available for a variety of clinical procedures and each clinical situation should be evaluated on an individual basis.[13] The direct fiber-reinforced composite resin post-and-core system provides one alternative solution for the reconstruction of the post-endodontic channel.

Direct Fiber-Reinforced Post-and-Core System

The direct fiber-reinforced composite resin post-and-core system offers several advantages: no laboratory fees, a one-appointment technique, no corrosion, negligible root fracture, a traumatic retrievability, increased retention resulting from microretentive bonding surfaces, conservation of tooth structure, biomechanical properties similar to the host dental tissue and no negative effect on aesthetics. Disadvantages of the technique include technique sensitivity, the need for a careful adhesive protocol, and the need to maintain an inventory of the reinforcement materials.

There are two methods for the fabrication of the direct fiber-reinforced resin post system: one uses a polyethylene woven reinforcement fiber and the other a prefabricated fiber-reinforced composite post. Prefabricated fiber-reinforced resin posts flex with the tooth structure, are easy to remove if retreatment is required and have no negative effects on aesthetics. The adaptation of the prefabricated post to the canal wall is important for retention, however, and in some cases, the canal must be enlarged to fit the configuration of the selected post, thus requiring removal of more tooth structure to achieve optimal adaptation. Therefore, these prefabricated posts have optimal adaptation and function in teeth with small circular canals.[14] The prefabricated system is contraindicated in root canals with irregularly shaped flared canals because of the improper adaptation and the required thickness of the resin cement.

The direct fiber-reinforced resin post-and-core system includes four components: the post material, an adhesive bonding agent, luting agent, and the core buildup. The first component of the fiber-reinforced post-and-core system is the post material, which uses either a bondable reinforcement fiber (ie, Ribbond, Seattle, WA; Construct, Kerr/Sybron, Orange, CA), or a prefabricated fiber-reinforced composite post (eg, Æstheti-Plus, D.T. Light-Post, Bisco, Schaumburg, IL; ParaPost Fiber White, Coltene Whaledent, Cuyahoga Falls, OH; FRC Postec, Ivoclar Vivadent, Amherst, NY) that is classified according to its geometry (shape and configuration). These reinforcement materials enhance the mechanical properties of the tooth-restorative complex by increasing flexural and tensile strengths.[15] The second component of the system is a fourth-generation bonding agent (eg, OptiBond, Kerr/Sybron, Orange, CA; All-Bond 2, Bisco, Schaumburg, IL) that reduces the undesirable contraction gap at the dentin-resin interface and thus

Figure 3. The completed post and core after placement of dual-cure core buildup material.

Figure 4. The radiopaque fiber-reinforced composite post provides an adhesive integration at all the interfaces.

may reduce or eliminate microleakage and bacterial infiltration at the coronal end of the root.[16] The third component, a dual-cure hybrid composite luting agent (eg, Variolink II, Ivoclar Vivadent, Amherst, NY; Nexus II, Kerr/Sybron, Orange, CA; Duo-Link, Bisco, Schaumburg, IL) has a physical and, potentially, a chemical interaction with the post material and the dentin that enhances the adhesive interfacial continuity. The use of a resin luting cement to line and strengthen the canal walls actually reinforces the root and supports the tooth-restorative complex.[17] The final component is a dual-cure hybrid composite core buildup (eg, Bis-Core, Bisco, Schaumburg, IL; CoreRestore 2, Kerr/Sybron, Orange, CA; LuxaCore Dual, Zenith/DMG, Englewood, NJ) and when utilizing all-ceramic or composite restorations the selection of a tooth-colored restorative material for the substrate can significantly influence the final aesthetic result. Furthermore, when considering the core buildup, the placement of a 2-mm circumferential coronal tooth "collar" provides a mechanical resistance for the endodontically restored tooth complex (Figures 2 through 4).[18]

Conclusion

The modern technician and clinician have many of the same challenges and uncertainties about selection of restorative materials and techniques as their colleagues of the past. Integrating the knowledge of the past with new restorative materials and accompanying techniques should be used to complement our existing repertoires.

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