A New Perspective on the Endodontic Restorative Continuum

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The introduction of rotary nickel titanium (NiTi) instrumentation to the endodontic armamentarium has provided an inherent capacity for the maintenance of a greater degree of dentin thickness. As such, preservation of tooth structure in the critical buccolingual direction is maximized. The use of posts for the rehabilitation of endodontically treated teeth remains fraught with increasing uncertainty as new instrumentation protocols abound and the adhesion era in dentistry flourishes, resulting in more conservative, noninvasive protocols. Retrospective studies have demonstrated that nonmetallic post systems will produce significantly more positive results than prefabricated metallic posts.[1,2] As the developments in adhesive restorative technologies and techniques enable functional and aesthetic reconstruction of debilitated tooth structure without traditional post-and-core construction, a more conservative noninvasive rehabilitation to rebuild the integrity of the residual tooth structure is possible.

All these advances raise highly relevant questions, including:

- Are posts still necessary?
- Are resin-reinforced fiber posts evidence based?
- Are chairside-fabricated resin-reinforced fiber post systems preferable?
- Are restorations without posts reliable and predictable?
- Are there other ways to reinforce teeth?
- What parameters apply to the choice of reinforcement?
- What is the ideal adhesive restorative procedure for endodontically retreated teeth?

The need for post placement remains in question. Adhesion of the newest generation of composite core materials to the remaining tooth structure has been shown to be more effective without post placement than with post

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FIGURE 1. CASE 1. Occlusal view immediately following complete endodontic access and instrumentation of a mandibular molar.

FIGURE 2. A self-etching primer (Nano Bond, Pentron Laboratory Technologies, Wallingford, CT) was applied to the dentin structures.

FIGURE 3. A glass fiber (Splint-It, Pentron Laboratory Technologies, Wallingford, CT) was used to reinforce the missing walls of the build up.

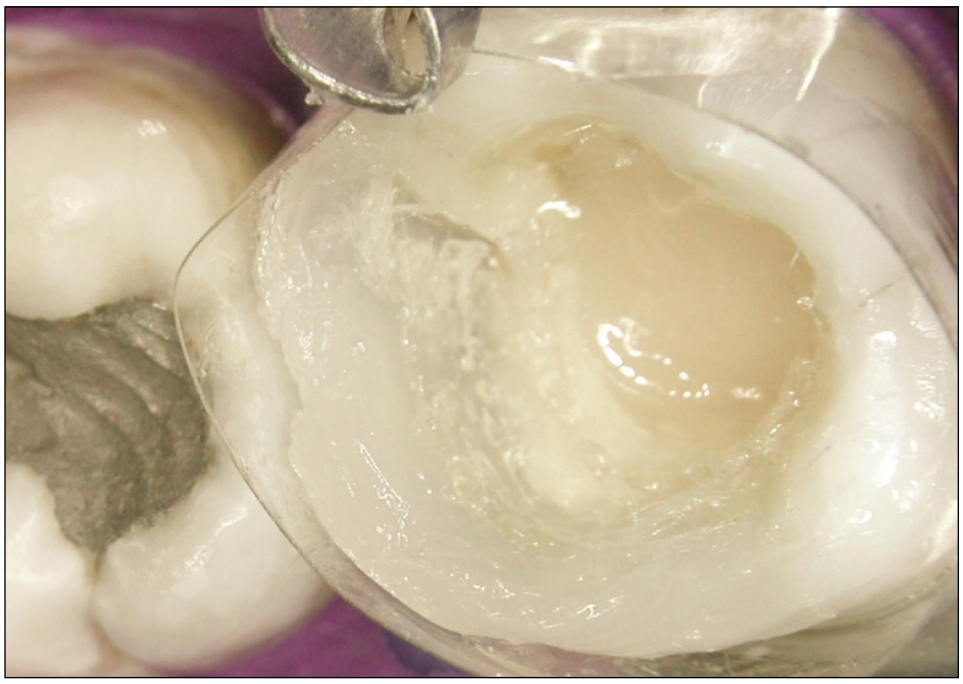

FIGURE 4. Following placement of a transparent matrix, the proximal wall was rebuilt with a condensable resin (Simile, Pentron Laboratory Technologies, Wallingford, CT). A second glass fiber was subsequently placed.

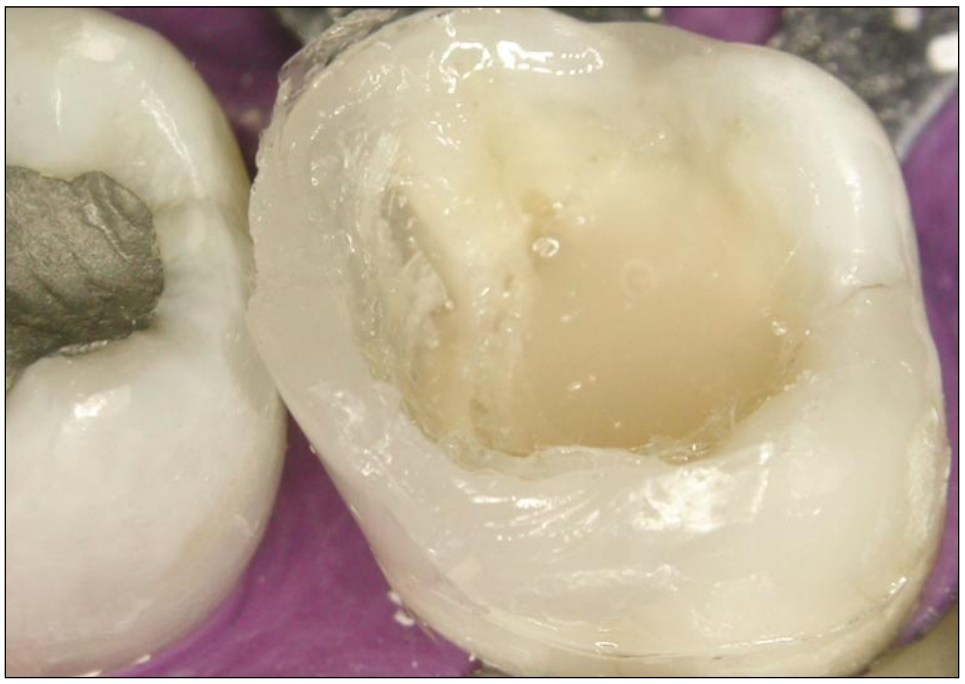

FIGURE 5. A flowable resin was then used to conceal the glass fiber.

FIGURE 6. The cusps of the restoration were sequentially layered using composite resin.

FIGURE 7. Postoperative appearance of the definitive restoration demonstrates natural contours and strength following endodontic treatment and fiber reinforcement.

placement, provided the placement protocol is exacting.[3] Numerous studies have proven that fiber-reinforced posts demonstrate reduced stress vectors with a distribution approaching that of a tooth without a post. Increasingly, the literature has validated the use of fiber-reinforced posts as a preference to metal systems.[4,5]

Chairside-fabricated fiber posts are an alternative to customized systems (Figures 1 through 7).[6] Using improved restorative materials that stimulate the physical properties and other characteristics

Developments in adhesive restorative technologies enable reconstruction of debilitated tooth structure with a more conservative noninvasive approach to rebuild the integrity of the residual tooth structure.

of natural teeth in combination with the proper design principles, the clinician can develop a tooth-restorative complex with optimal functional and aesthetic results.[7,8] Restorations completed without customized posts are also reliable and predictable in special cases and represent a viable option to traditional post-and-core construction (Figures 8 through 15).

The American Association of Endodontics (AAE) has provided

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guidelines for the selection of a post-and-core endodontic restoration, which 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).

The AAE's philosophy further states: "The primary purpose and 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."

The AAE's policy with regard to the endodontic-restorative continuum is as follows: "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. In posterior teeth, contemporary thought, in both research and clinical practice, supports the placement of a protective restoration with full cuspal coverage." The research, however, continues to question the concepts espoused. Macpherson and Smith have shown that combining materials to reinforce

FIGURE 8. CASE 2. An endodontically treated maxillary molar was scheduled for reinforcement and restoration.

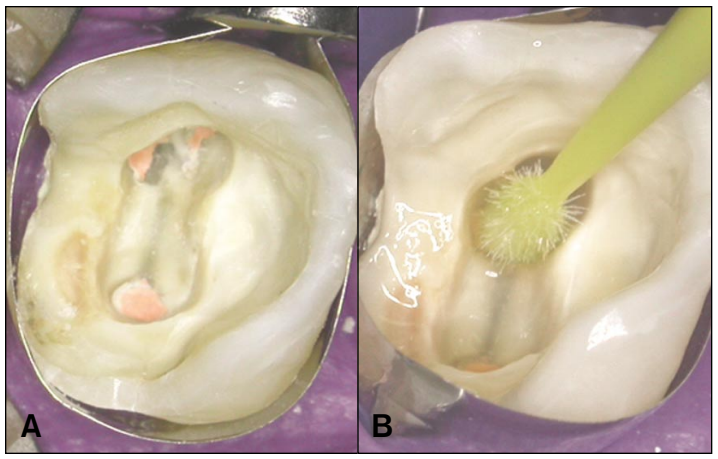

FIGURE 9A. A matrix band was secured to ensure proper interproximal buildup. **9B.** A self-etching primer was used to condition the dentin and air dried prior to application of the bonding material.

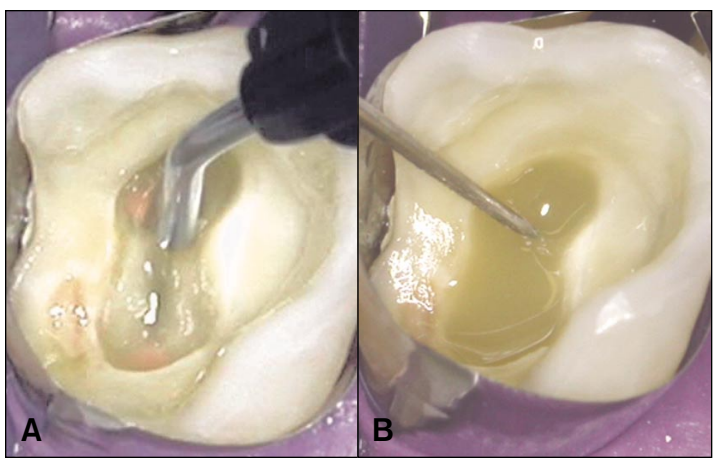

FIGURE 10A. A flowable resin (Tetric Flow, Ivoclar Vivadent, Amherst, NY) was applied. **10B.** An explorer was passed through the resin to minimize the creation of voids.

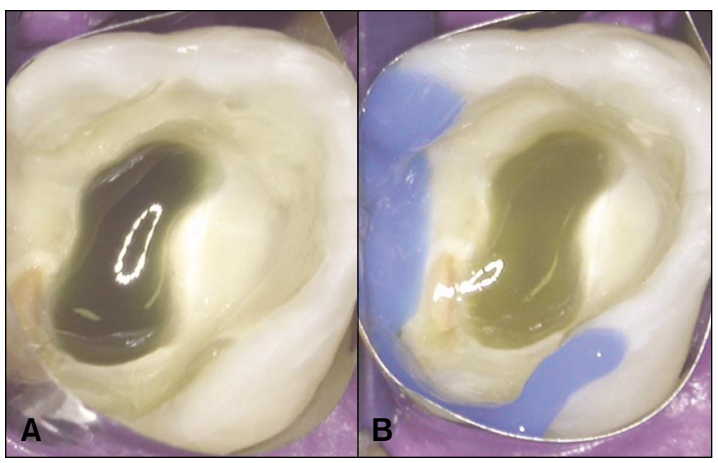

FIGURE 11A. The flowable resin was light cured. The discoloration that occurred following polymerization was eventually neutralized. **11B.** A 37% phosphoric acid was used to etch the enamel margins.

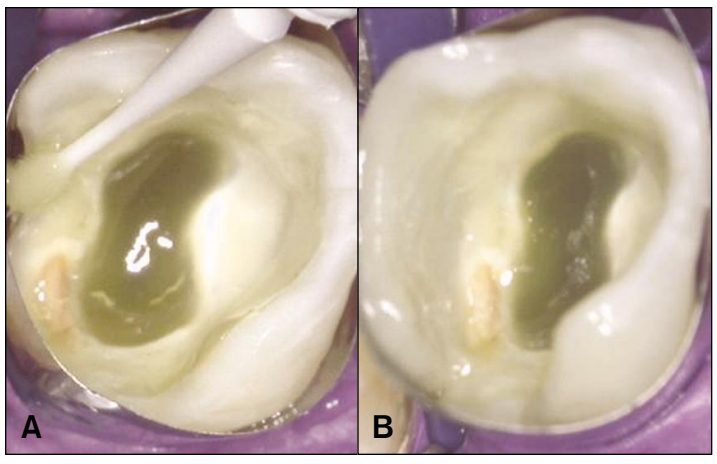

FIGURE 12A. A primer and bonding agent were subsequently applied (Optibond FL, Kerr/Sybron, Orange, CA). **12B.** The proximal wall was then built up (Point 4, Kerr/Sybron, Orange, CA).

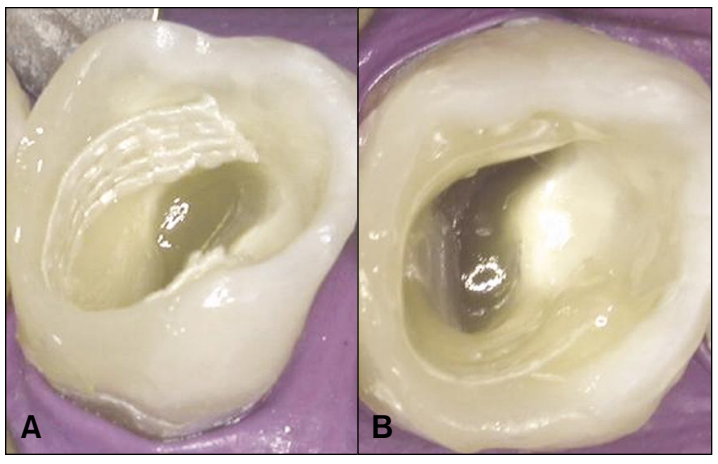

FIGURE 13A. The glass fiber reinforcement (Ribbond, Ribbond, Seattle, WA) was activated and positioned on the rebuilt external walls. **13B.** The glass fiber was secured with a flowable resin.

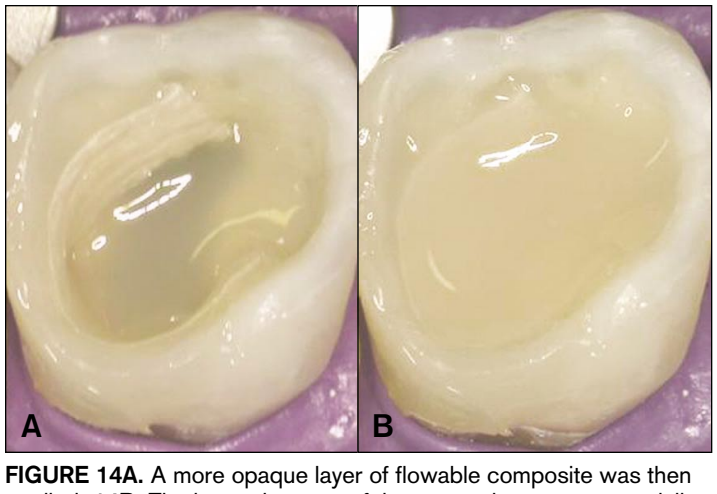

FIGURE 14A. A more opaque layer of flowable composite was then applied. **14B.** The internal aspect of the restoration was sequentially built up prior to development of the cuspal structures.

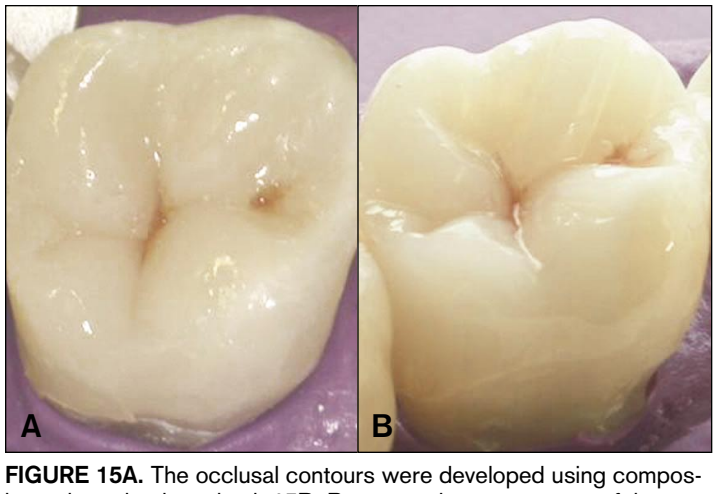

FIGURE 15A. The occlusal contours were developed using composite resin and polymerized. **15B.** Postoperative appearance of the definitive restoration following finishing and polishing.

weakened cusps is a worthy, cost-effective alternative to removing the cusp entirely and fabricating a crown or protecting the cusp with a gold inlay.[9]

The buccal cusps of endodontically treated mandibular molars reinforced with a combination of horizontal pins and dentin adhesive were not significantly weaker than intact teeth. Of the restored teeth, those that had buccal cusps reinforced with horizontal pins and those treated with complete cuspal coverage amalgam restorations exhibited the most favorable restorative prognosis following cusp fracture.[10] By using current generations of restorative materials that simulate the physical properties and other characteristics of natural teeth in combination with proper design principles, the clinician can develop a tooth-restorative complex with optimal functional and aesthetic results.

Vertical loading of the teeth did not generate harmful concentrations of stress. More challenging situations were encountered during working and nonworking micromotions, both of which generated inverted stress patterns. Supporting cusps were generally well protected during both working and nonworking cases (mostly subjected to compressive stresses). Nonsupporting cusps tended to exhibit more tensile stresses. High stress levels were found in the central groove of the maxillary molar during nonworking micromotion and at the lingual surface of enamel of the mandibular tooth during single-contact working micromotion. The occlusal load configuration as well as geometry and hard tissue arrangement had a significant influence on the stress distribution within opposing molars.[11]

It may well be that full cuspal coverage is not mandated for predictable restorative success of the endodontically treated tooth. For the moment, there is no substantive evidence to suggest that maximum reduction and restoration will provide optimal long-term success. As new materials with more dramatic properties and possibilities enter the marketplace, continued testing will invariably provide the answer to this conundrum. ■

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CONTINUING EDUCATION

CONTINUING EDUCATION EXERCISE

The 10 multiple-choice questions for this Continuing Education (CE) exercise are based on the article "A New Perspective on the Endodontic Restorative Continuum," by Liviu Steier, DMD. This article is on Pages 12-15.

This article discusses new concepts in composite core materials that could reduce the need for post placement. Upon reading this article and completing this exercise, the reader should:

- **Understand the role of post placement in endodontically restored dentition.**
- **Be aware of the advantages and disadvantages of post-and-core construction and their impact on restorative success.**

1. The introduction of what type of instrumentation allowed for the maintenance of a greater degree of dentin thickness?
a. NiTi.
b. Stainless-Steel.
c. Ultrasonic.
d. High-speed.

2. On which condition has contemporary composite core adhesion been shown more effective without post placement?
a. The composite material is of sufficient strength.
b. The placement protocol is exacting.
c. The post to be used is metallic in nature.
d. None of the above.

3. Studies have shown the metal post-and-core systems demonstrate reduced stress vectors with a distribution approaching that of a tooth without a post. Metal systems are often preferred over fiber-reinforced posts.
a. Both statements are true.
b. Both statements are false.
c. The first statement is true, the second statement is false.
d. The first statement is false, the second statement is true.

4. What type of case is conducive to the completion of a restoration without a customize post?
a. All cases.
b. Most cases.
c. Special cases.
d. Cases involving minimal tooth structure loss.

5. Which of the following are AAE guidelines for the selection of a post-and-core endodontic restoration?
a. Occlusal function and opposing dentition.
b. Amount of remaining sound tooth structure and position of the tooth in the arch.
c. Both a and b.
d. Neither a nor b.

6. Of restored teeth, which type exhibited the most favorable restorative prognosis following cusp fracture?
a. Horizontal-pin-reinforced buccal cusp restorations.
b. Traditional post-and-core restorations.
c. Restorations treated with complete cuspal coverage amalgam.
d. Both a and c.

7. Harmful concentrations of stress were encountered during:
a. Vertical loading.
b. Working micromotions.
c. Nonworking micromotions.
d. Both b and c.

8. High stress levels were found in the central groove of the maxillary molar during:
a. Vertical loading.
b. Single-contact working micromotions.
c. Nonworking micromotions.
d. Both b and c.

9. According to the AAE, posts do not reinforce endodontically treated teeth, and are not necessary when substantial tooth structure is present following tooth preparation.
a. True.
b. False.

10. High stress levels were found at the surface of enamel of the mandibular tooth during:
a. Vertical loading.
b. Single-contact working micromotion.
c. Nonworking micromotions.
d. None of the above.