SCIENTIFIC ARTICLE

Evolution and Integration of Current Restorative Endodontic Concepts

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Dr. Enrique Kogan received his dental degree from the Universidad Tecnologica de Mexico in 1978. He went on to complete a specialty program in fixed prosthodontics at the University of Missouri-Kansas City from 1978 to 1980. From 1980 to 1998 he was a professor at the Universidad Tecnologica de Mexico, and from 2004 he was a visiting professor at the Nova Southeastern University School of Dentistry in Ft. Lauderdale, FL. Dr. Kogan has lectured nationally and internationally on adhesive dentistry, cosmetic dentistry, periodontal prosthesis, implant prosthodontics, and restoration of endodontically treated teeth. He is responsible for the design of the PeerlessPost system. Dr. Kogan has published articles on different dental themes.

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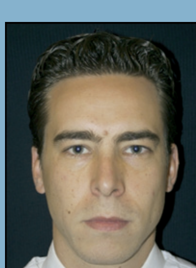

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Dr. Gad Zyman received his dental degree from the Universidad Tecnologica de Mexico in 2003. He went on to complete a specialty program in prosthodontics at Nova Southeastern University from 2002 to 2005. Since then he has been in private practice. Dr. Zyman has published articles on endodontic posts in conjunction with Dr. Kogan.

The restoration of endodontically treated teeth was advocated by G.V. Black in 1869[1] followed by a one-unit post and crown by Richmond[2] in 1878. Engineering principles indicate that structural strength on endodontically treated teeth is decreased by the removal of the roof of the pulp chamber, canal enlargement, and hence loss of integrity. The intrinsic strength of dentin can be diminished as a result of root canal treatment originated by decay, pathology, or trauma. When endodontic treatment is indicated, one must consider that the resulting anatomy and configuration of the canal(s) can vary according to its original anatomy, canal access, canal enlargement, and chemomechanical preparation. In addition, intrinsic dentin strength may be adversely affected by the absence of a pulp that results in a decrease of moisture content of dentin[3,4] and consequently becoming more susceptible to fracture than vital teeth (Figure 1).[5–9]

The need to provide internal support to the endodontically treated tooth before placement of a coronal restoration is clearly documented,[7,8,10,11] as well as for coronal stabilization.[5] In the past it was advocated to conservatively restore pulpless posterior teeth with pins and amalgam. Such technique, because of the friction and self-threading of the pins, produced stresses and strain unto the dentin because of the wedging action, resulting in minute fracture lines and crazing.[12–16] Lovdahl[17] described in 1977 that endodontically treated teeth with a conservative root canal filling and intact coronal structure were found to be stronger than root canal–filled teeth with cast-gold dowel cores or pin-retained amalgam cores.

Before restoration, a thorough evaluation of the affected tooth or teeth and its remaining tooth structure most be made to form an accurate diagnosis. This should include the following considerations: (1) Is the tooth restorable? (2) What is the health of supporting bone and periodontal tissues? (3) What is the mobility? (4) Is at least 2 mm of sound tooth structure available for a ferrule effect? (5) Are the quadrant, arch, and entire dentition restorable? (6) What is the relation of the tooth to the occlusal plane? (7) What is the importance of the tooth to the overall treatment plan? (8) Endodontic complications can lead to apicoectomy treatment; therefore, apical seal and post reconstruction techniques can influence long-term prognosis. (9) What is the cost?

For several years cast post and cores were used to rebuild missing tooth structure, either with an indirect tech-

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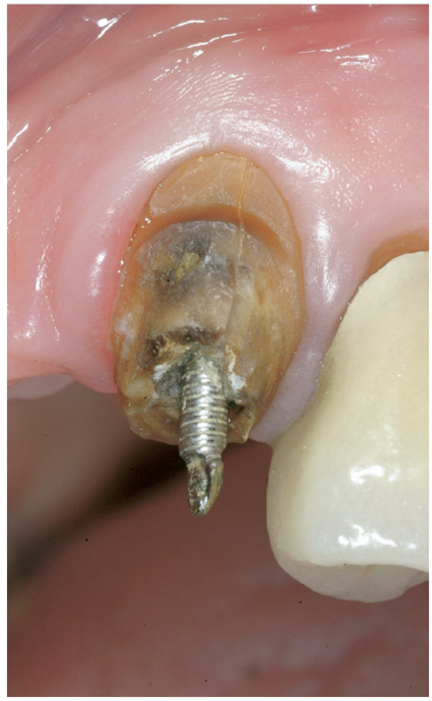

Figure 1. Vertically fractured root with prefabricated stainless steel post.

Figure 2. Semidirect technique for fabrication of an acrylic pattern to be casted in type 3 gold. (A) Gold cast post cemented with a modified resin glass ionomer cement. Dentistry by Sergio Rubinstein, DDS.

nique when an impression is taken and a wax pattern is created and cast in type 3 gold or semidirect technique in which the pattern is created in the mouth (Figure 2). In either case, critical steps include the creation of a wax or acrylic pattern to be completed with proper control of volumetric changes and compensation from all materials used, such as impression material, stone, wax, or acrylic, investment, casting technique, and alloy used. It is of utmost importance that the attained result creates a post and core with a passive fit onto the root or tooth. Otherwise, undesirable stress will be immediately transferred into the root, which could lead to eventual vertical fracture and loss of the tooth.

CURRENT CONCEPTS FOR RESTORATIVE SUCCESS WITH ENDODONTIC-TREATED TEETH

Once endodontic success is determined,[18] current concepts are to reinforce such teeth with a bonding protocol as the lost tooth structure is being replaced with a proper fitting and passive post which includes a self-retentive head to support a core.[19]

Fiber posts have been used in the restoration of endodontically treated teeth since their introduction in the late 1980s (COMPOSIPOST/C-POST; Recherches Techniques Dentaires, Grenoble, France).[20]

These fiber posts have shown good clinical behavior in different studies: 99% success rate in 236 patients after 2 to 3 years,[21] 99% in 94 teeth after 1 year,[22] 95% in 1304 cases between 1 and 6 years,[23] and 200 cases in 4 years,[24] 99% in 180 posts after 18 months,[25] and 89.6% in 52 teeth after 6 to 48 months.[26] No catastrophic failures (root fractures) were reported.

One author's (E.K.) personal clinical data showed 95.4% success rate in 454 fiber posts placed over a period of 6 years (February 2000 to January 2006). The posts placed

Figure 3. Fracture upper first premolar.

were 14 C-Post (RTD-Bisco) (case 1; Figures 3-9), 8 DT Light-Post (RTD-Bisco) (case 2; Figures 10-15), 216 ParaPost Fiber-White (Coltene/Whaledent) (case 3; Figures 16-22), and 216 of the new Peerless Post (SybronEndo) (case 4; Figures 23-30). Of the 21 failures (4.6%), 8 (4 Fiber-White and 4 Peerless Post) were de-bonded and 13 (6 Fiber-White and 7 Peerless Post) were post fractures.

A review of the literature of currently marketed post systems, along with our own clinical experience and the effect that post design has on clinical success, all lend themselves to a rationale for a new post design: The PeerlessPost system by SybronEndo.

With current evidence-based research, this article describes the simplicity, efficiency, and safety aspects of the Peerless Post system.

Figure 4. Pre-op x-ray.

Figure 5. Carbon fiber posts (C-Post -Bisco, Inc) and respective drills.

Figure 6. Carbon fiber post in place.

IDEAL POST DESIGN

The ideal post system or design must consider endodontic as well as restorative principles and include the following.[27–31]

Figure 7. Composite core build-up.

Figure 8. Final ceramic restoration.

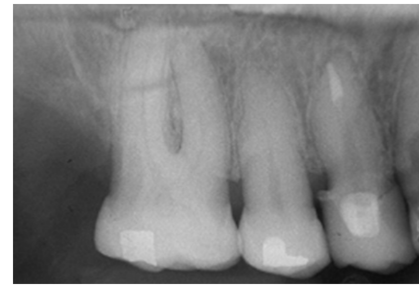

Figure 9. Postoperative x-ray, showing nonradiopaque post. Dentistry by Enrique Kogan, DDS.

Anatomical form similar to the lost dental volume

The overall, essential shape of the post is tapered, to mimic the root canal treatment (Figure 31).

Figure 10. Clinical view of destroyed central incisors.

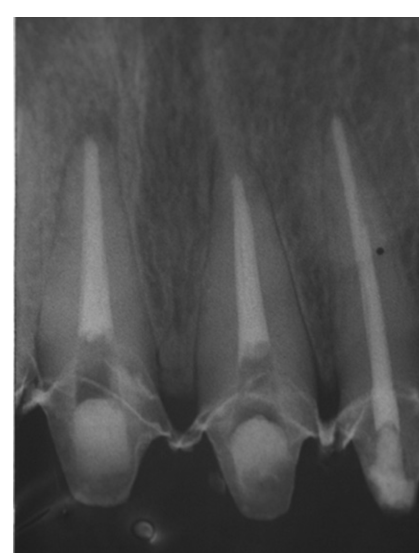

Figure 11. Preoperative x-ray.

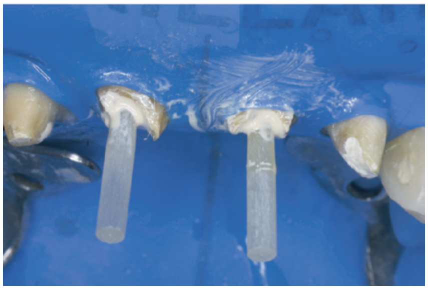

Figure 12. Fiber post (DT-Light, Bisco Inc) in place.

Minimal (conservative) preparation
The post can be placed in the canal without further preparation after the endodontic therapy.

Figure 13. Post-op x-ray after post cementation.

Figure 14. Composite build-up.

Figure 15. Final ceramic restorations. Dentistry by Enrique Kogan, DDS.

Adequate material
Prestressed fibers are homogenously distributed in a resin matrix to avoid structure defibration and deterioration (Figure 32).[32]

Resistance to fatigue
Testing indicates that posts with higher content (more than 60%) of prestressed quartz or glass fibers resist cyclic fatigue better than posts with less fiber (less than 50%).[33] The PeerlessPost has more than 60% of Glass Fibers.

Figure 16. Destroyed lower left first premolar.

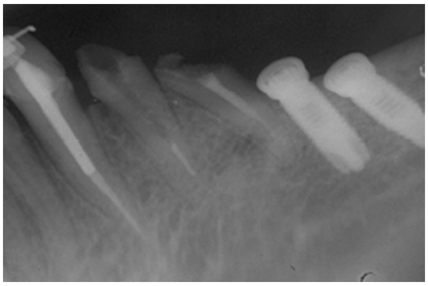

Figure 17. Pre-operative x-ray.

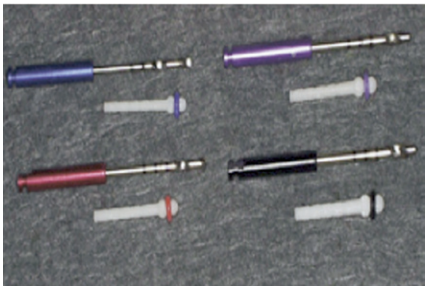

Figure 18. Fiber Glass posts (Coltene-Whaledent, Inc) and respective drills.

Elastic modulus similar to dentin
The elastic modulus should be 15 to 40 GPa.

Noncorrosive
Unlike base casting metals and stainless steel, fiber post material cannot corrode.

Retentive (post and head)
The design should offer a self-retentive body and a self-retentive, antirotation head (Figure 33).

Easy to adjust and fit
The post should allow adjustments in the apical area as well as the

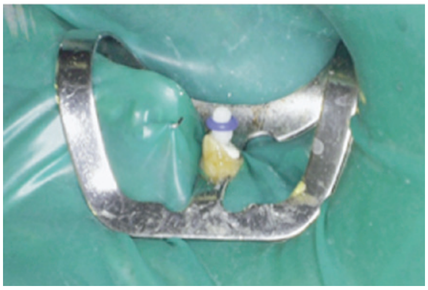

Figure 19. Fiber post in place.

Figure 20. Composite core build-up.

Figure 21. Temporary restorations for orthodontic treatment.

coronal area, at the clinician's discretion and without compromising lateral adaptation in the canal. Because of the mechanical properties of the fiber posts and the reliability of adhesive cementation techniques and materials, the depth of a fiber post can be equal to or slightly greater than the length of the clinical crown (Figure 34).[34]

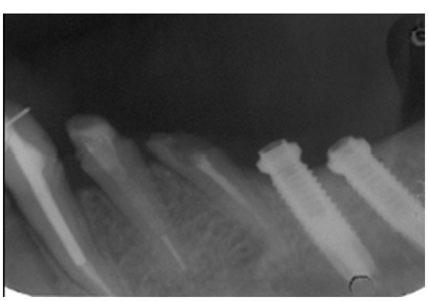

Figure 22. Postoperative x-ray. Dentistry by Enrique Kogan, DDS.

Figure 23. Lateral view showing the amount of core or clinical crown to be rebuilt.

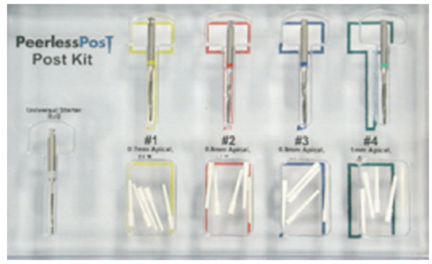

Figure 24. PeerlessPost Kit (SybronEndo)

Radiographically detectable

The post should be detectable by radiography (Figure 35).

Versatile

We need different lengths, diameter, and tapers to fit most clinical situations (Figure 36).

Figure 25. Prefabricated post can be modified on either end without affecting the fit of the post and still maintain retention for the core.

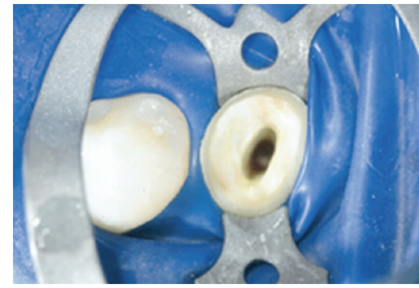

Figure 26. Lower premolar isolated with the rubber dam.

Easily removable

The removal of posts can be a major obstacle in the retreatment of teeth that have recurrent disorders. The use of fiber posts offers the advantage of an easy removal.[35]

CONCLUSIONS

Modern dental restorative treatment of endodontically treated teeth must consider the preservation of dental tooth structure. It is necessary that from the beginning (root canal treatment), we must use techniques

Figure 27. Prefabricated post tried with proper isolation.

Figure 28. Occlusal view of rebuilt tooth.

Figure 29. Buccal view in occlusion verifying interocclusal clearance.

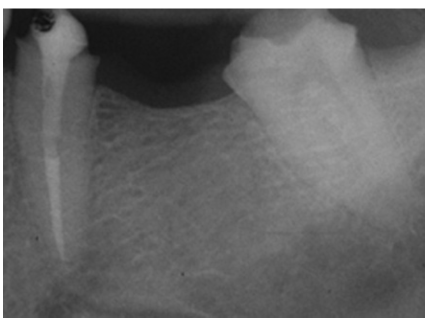

Figure 30. Radiographic view, showing excellent fit of post. Dentistry by Sergio Rubinstein, DDS.

Figure 31. Section of a post in place, showing the intimate adaptation between the post and the prepared canal.

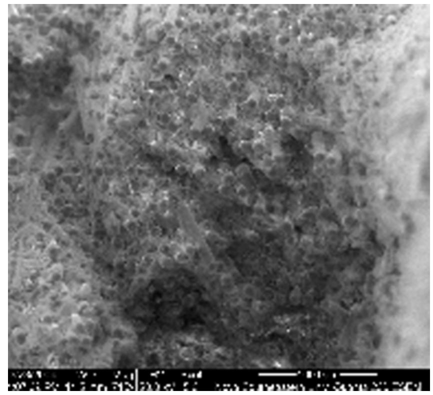

Figure 32. Cross-section showing fibers.

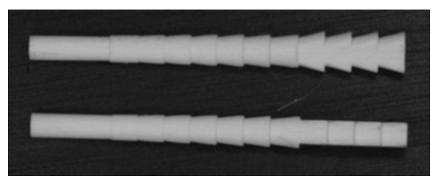

Figure 33. Self-retentive body and a self-retentive, antirotation head.

Figure 34. Post is measured to determine length of head for ideal core support to withstand forces during function.

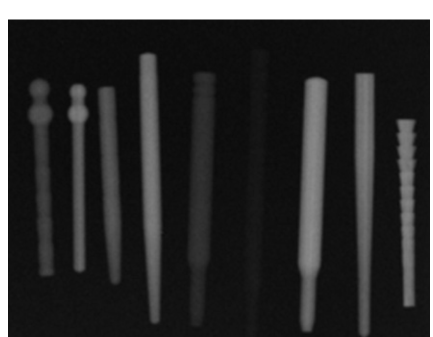

Figure 35. Radiopaque fiber posts.

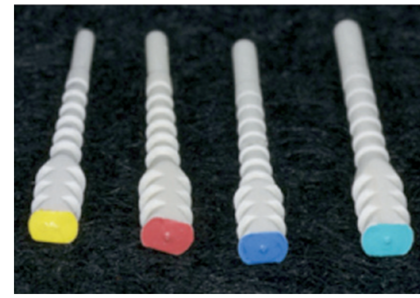

Figure 36. Color coded for easy identification of diameter and taper.

that do not remove much additional dentinal tissue, use posts that from its nonrigid nature reduce the risk of fractures both in the root and in the post itself, and that the adhesive cementation procedure be as simple as possible to obtain a final restoration with a high success rate. The PeerlessPost system is a new alternative to the fiber post concept that offers characteristics not found in any other systems.

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