Benefits of Fiber Posts: Clinical Application of a New Post System by Dr. Dan Fischer

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When the only tool you have is a hammer, every problem looks like a nail. For many decades we dentists have been restoring teeth with materials that are mechanically or otherwise inappropriate, all for lack of viable alternative material compositions or attachment techniques. Throughout my career, I've felt it imperative that we seize the technological advances afforded to us to move to a higher plane. Particularly for the patient, it is imperative that we do.

More and more endodontically treated teeth are being restored using fiber reinforced composite posts (fiber posts), primarily because they are safer, more easily removed, aesthetic, conserve tooth structure, and provide improved fracture resistance to these compromised teeth. As this article will explain, fiber posts behave differently than metal posts, and because of those differences, some of the rules that dictated and limited our techniques and abilities have changed, and for the better.

The first fiber posts were developed and patented in France. These first generation carbon fiber posts (ComposiPost/C-Post) were anything BUT aesthetic and were not radiopaque, but their principal mechanical properties—high strength, fatigue resistance, and low elastic modulus—gave them many advantages. Most importantly, because their elastic modulus is similar to dentin, fiber posts tend to absorb and dissipate stress (masticatory and traumatic) like natural dentin, thereby protecting the root from fracture.[1-4] So, if there is ever a failure of the post/core, fiber posts allow for further treatment.[5-8]

THE POSTUS CASTUS DINOSAUR

Cast post/crowns were described by Fauchard as early as 1740, and this technique is still taught in some United States dental schools to this day. Yet, in a recent poll[9], 87% of dentists reported using cast posts less than 10% of the time (when they use a post) or not at all. Why? Sorensen[10] concluded in 1990 that with cast posts and cores, a precise adaptation increases fracture resistance, but at the same time increases the severity of the root damage. More recent in vitro studies generally tend to confirm this.[11-12] In a 4-year clinical study comparing fiber posts and cast posts (N = 100) the cast post group had 9% root fractures, while the fiber posts had no root fractures and a 95% success rate.[13]

THREADED POSTS: ANOTHER RETRO-WEAPON?

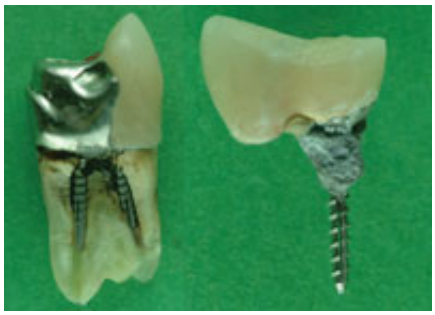

Figure 1. Aggressive, threaded metal post failures. The crowns served their purpose, the posts did not protect the roots.

"Active" screw-type posts were introduced to assure the greatest macro-mechanical retention possible. In function, however, and corrosion potential aside for the moment, both photoelastic imagery and clinical observations clearly show the stress and damage caused by the gouging effect.[14,15] In a study-analysis of 154 teeth extracted due to vertical root fractures, 62% contained posts; 67% of the posts were threaded, screw-type posts.16 Attempts to mitigate that propensity for damage with a "split-shank" type design (Figure 1) simply do not do so.[17]

CONCEPTS DESERVING SERIOUS CONSIDERATION

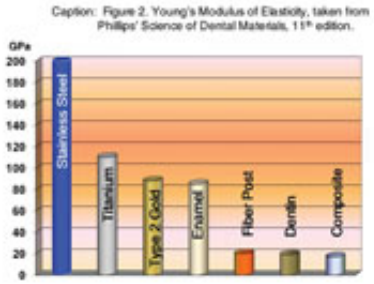

Figure 2. Young's Modulus of Elasticity, taken from Phillips' Science of Dental Materials, 11th Edition, Anusavice KJ, Saunders, 2003.

Modulus of Elasticity (Young's Modulus) is an inherent property in a material, and does not vary with diameter, width, etc.[18] Figure 2 shows the elastic modulus of dentin and a variety of materials we have been using routinely for endodontic restorations. Numerous in vitro studies demonstrate that using a combination of materials with an emodulus similar to that of the dentin for the post/core reduces or eliminates root fracture.[1-4] A clinical study following 3 generations of fiber posts over a span of 7 to 11 years confirms the expected success of fiber posts.[19]

This leaves clinicians with an opportunity to facilitate better care, expand our options, respect the tooth structure, and save us time, through the important concepts and benefits that follow.

Benefit No. 1: Fiber Posts Should Be Bonded Into Place

Fiber posts are (optimally) placed using a bonding agent, followed by resin cement (preferably dual cure) and a composite for the core build-up. Brief exposure of light-cure energy from the occlusal aspect will initiate the cement catalysts. While polymerization will continue below the surface for a few minutes, the clinician can go directly to the placement of the core without waiting. This saves the few minutes you don't wait for the Civil Warera $ZnPO^4$ cement to set. Those few minutes you save pay for the post itself. Bonding the post with a resin cement builds a monobloc of "dentin-type strength," thus elevating fiber posts to a higher plane than metal.

Benefit No. 2: Micro-Retention Superior To Macro-Retention

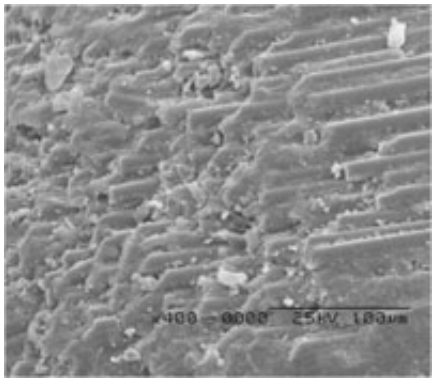

Figure 3. Micro-retentive surface of the UniCore Post, very similar to that of an etched veneer.

Once viewed as heretical, etching of natural dental substrates has changed dentistry as much as anything has over the last 100 years. Creating micro-retentive surfaces is the safest, most conservative way to increase surface area and therefore increase retention. With metal posts and even some fiber posts, macro-retentive features were absolutely necessary for reliable retention. These macro-retentive features induce stress concentration in either the post or the tooth or both.[14-15] Today, the best fiber posts are manufactured to provide a micro-retentive surface (Figure 3), one that doesn't require ridges and grooves for retention. This micro-retentive surface on bonded fiber posts is hard to beat.[20-22] When my veneers come back from the lab, they're etched to present a micro-retentive surface to receive my bonding materials, and I never give it a second thought. There is no macro-stress concentrating feature, so it works.

Benefit No. 3: Fiber Post/Core Is Minimally Invasive

Fiber posts are bonded and need only be seated to a depth of approximately one half of the root length, OR the equivalent of the length of the clinical or prosthetic crown.[23] In contrast, with metal posts, increased insertion depth should equate to higher retention. However, this naturally threatens the apical seal, increases the risk of perforation and dislodgement of the gutta-percha, and worst of all, transfers stress apically to the narrowest, most vulnerable part of the tooth.

Benefit No. 4: Tapered Is Now Better Than Parallel

Once upon a time, when only metal posts existed, and prior to the ability to predictably bond to both the post channel and the post surface, it was determined in vitro that parallel metal prefabricated posts provided superior retention to tapered metal posts (except screw types)[24] and that tapered metal posts demonstrated a propensity toward typical wedge-type activities (like splitting things in half).[25-26] Also, in too many cases this parallel shape condemned me to sacrificing more dentin just to get some surface interface/adaptation. Fiber posts can be obtained in either parallel or tapered design. If one uses predictable bonding techniques, and fiber posts are bondable, the tapered design provides the additional benefit of conserving radicular dentin and reducing functional stresses towards the apex, and all of this without compromising strength. A tapered post in a tapered root makes a lot of sense. Most everything we use in roots is tapered. For example, we use endo files and reamers that are tapered, not parallel, and GP cones, and paper points, and I have never made a rectangular RCT in a mature tooth.

Well fitting parallel posts maintain a close approximation to the sidewall of the post space from the very moment of initial penetration, throughout total movement, and to complete seating. They are like a piston. Because of this, they required a vertical channel or slot to facilitate venting of cement and/or air from the depth of the post channel. Without such, they would not fully insert or possibly "float back" once pressure for placement stopped. Tapered posts have the unique capability of being "self venting." This occurs because

significant space exists between the tapered channel preparation and the post for cement and/or air to flow from until the post finally comes to its fully seated position adjacent dentin. It's like an inlay. The architectural design, and hence strength of the post, is not compromised simply in the name of venting. The more we "listen to the needs of the tooth," complete with listening to its anatomical shapes and physical properties, the more important insights we gain towards optimum rehabilitation.

Benefit No. 5: Aesthetics Is Now A Standard, Not An Option

Excepting the antique carbon fiber post you might find somewhere, fiber posts are tooth colored or translucent. Either version will eliminate the need for the opaquing or masking often required over metal posts. This saves time and materials in direct operative composite restorations and all-ceramic fixed prosthodontics.

Benefit No. 6: Corrosion Is Removed From The Equation…For Good

Fiber posts, titanium alloys, and ceramic posts cannot corrode, but base casting metals and stainless steel posts all exhibit corrosion potential, especially in the presence of bi-metalism and/or moisture, which contributes to decementation and root fracture…smells bad, too. In a study of 468 teeth with vertical or oblique root fractures, 72% were attributed to electrolytic action of dissimilar metals used for the post and core; reaction between the tin in the amalgam core and the stainless steel post.[27]

Benefit No. 7: Remove The Post, Not More Dentin

As many as 15% to 20% of root canal treatments may require reaccess/retreatment.[28] This in and of itself is reason for us to seriously study our approach to root canal treatment. Approximately 25% of those will have a post in the way.[29] Fiber posts can be removed invitro in a matter of minutes[30-31] without further trauma to the tooth.

Benefit No. 8: Fiber Posts Are More Fatigue Resistant

Fatigue follows us everywhere. Put simply: "Fatigue is considered one of the principal causes of structural failure in restorative dentistry…restorations fail more often with repetitive loads that are below the mechanical resistance limit of the restoration itself than with the application of a single force, even if relatively greater."32 In a 2007 study, Wiskott33 demonstrated in vitro that the fiber posts tested proved more fatigue resistant than the stainless steel and titanium posts. This may be related directly to the fact that fiber posts are designed to flex slightly, when necessary, and some fiber posts have a greater flexural strength than stainless steel or titanium.

Benefit No.9: Fiber Posts Can Be Radiopaque…

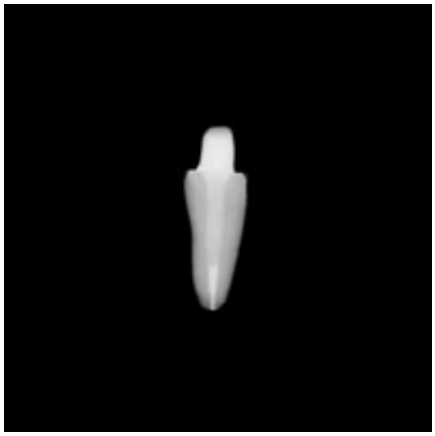

Figure 4. UniCore Post with a core buildup.

…and translucent at the same time. About half of the fiber posts on the United States market today are radiopaque, as compliant with ISO Spec No. 4049; equivalence to aluminum (Figure 4).

Introducing a New Paradigm

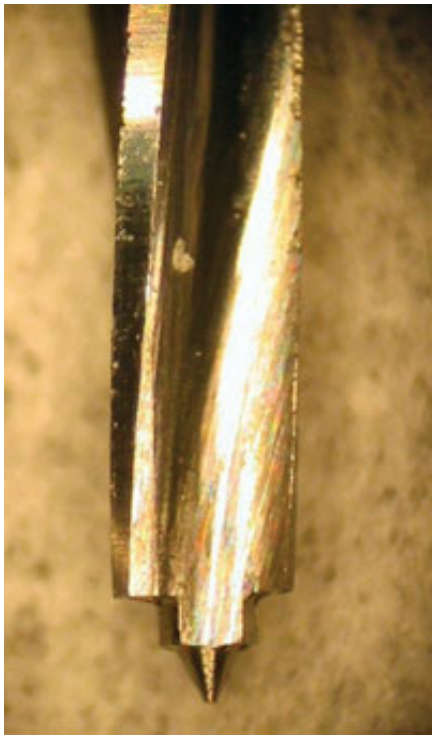

Figure 5. UniCore drills with a closeup of the patented tip.

Figure 6. UniCore Kit-of-Kits.

The UniCore Post and bonding system (Ultradent) was designed to embrace all of the above benefits. This, plus a unique drill design and syringe deliveries, provide for a safe preparation and a highly retentive, minimally invasive post and core rehabilitation when used with a strong adhesive system.

The patented 3-in-1 UniCore Post Drills afford unsurpassed safety in post canal preparation. The noncutting, heat generating tiny point on the end of the drill keeps the drill centered in the root as it melts the gutta-percha ahead of it. A novel high RPM, low torque (for slow speed) setting is used. This same design and high RPM facilitates fiber post removal for retreatment should it ever be required. The heat-generating drill tip softens the post matrix for penetration and removal. Then the "Lazy Flute" design scrapes the sides without engaging too aggressively (Figure 5). The third capability of this novel drill is for removing Thermafil. Any clinician who has tackled these situations before can appreciate the very meaningful benefit of this drill for this purpose.

The color-coded packaging has been optimized, in a kit-within-a-kit system that makes for easy identification, saves time, and prevents mistakes (Figure 6). The entire module (box, posts, and drills) are autoclavable to prevent cross contamination. The drill and posts are secured in foam, preventing mishaps or confusion if dropped or spilled.

Figure 7. Canals have been filled with EndoREZ Sealer and the master points are inserted.

Figure 8. Dip accessory points into the EndoREZ Accelerator.

Figure 9. Passively harpoon the coated accessory points alongside the master points.

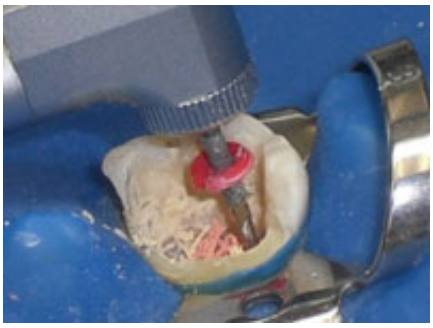

Figure 10. After 5 minutes, prepare the post space.

Figure 11. UniCore drill prepares the post space.

Figure 12. Trial fit the posts and determine desired length.

Figure 13. After etching and rinsing the canal and super-structure, place the adhesive on the moist tooth.

Figure 14. Placement of the dual purpose resin cement and core build-up material.

Figure 15. Final preparations. Note that the posts were placed over the centric cusps.

Clinical photography courtesy of Dr. Arturo Blanco and Dr. Phil Brown.

Historically, we obturate the root canal, temporize, and reappoint the patient for a definitive restoration visit, be that a post and crown or no post and restoration. This was typically done because endodontic sealers often take anywhere from 1 to 8 hours to completely set. Further, some quote the cost of temporizing and turning around the operatory at about $35.00 for a typical office.

Recently, a new product was introduced that allows the sealer to fully harden in less than 5 minutes, allowing a post (when needed), core, and crown prep to be accomplished in one visit. This saves time, maximizes office productivity, and coronally seals the root canal and avoids a leaky temporary material. Endo-REZ Accelerator, when used in conjunction with EndoREZ Sealer (both from Ultradent), reduces polymerization time to 5 minutes. This allows us to perform an entire endo/restorative procedure in a single sitting. The technique is simple: inject EndoREZ Sealer into each canal, place master gutta-percha points (Figure 7), then dip accessory points (No. 25 points were used in this case) into the Accelerator vial (Figure 8) and passively harpoon 2 to 3 dipped points alongside the master point (Figure 9). After 5 minutes, the post space can be prepared without any worry of uncured sealer being present. In Figure 10 note the dry appearance of cuttings around the drill, showing that the sealer has fully set.

Another clinical case with 2 premolars shows placement of the UniCore Post in the canals, after using EndoREZ Accelerator, under the centric cusp. When given a choice of multiple canals for the post, consider placing it in the canal most closely positioned under a centric cusp. Axial and occlusal surfaces are reduced, leaving margin placement to be accomplished after the core buildup. Preparing the super-structure before

placing the post allows for easy access and minimal use of core composite. In this case, post spaces are created in both teeth using the No. 1 UniCore drill (Figure 11). The fiber posts are tried in (Figure 12) then cut to length using a diamond disc. Retraction cord is placed, moistened with aluminum chloride for fluid control during bonding, plus it begins tissue separation for the final impression. Canals and super-structure are etched using a 35% phosphoric acid with the Endo-Eze tip to reach the bottom of the canal. The canals and preparations are rinsed and left moist for application of a dual cure bonding agent (Figure 13). Dual cured resin cement/core material (PermaFlo DC, Ultradent) is loaded into a small syringe equipped with an Endo-Eze needle tip. Beginning at the bottom of the canal, cement is injected to fill the canal, the self-venting UniCore post is inserted, and any excess cement is spread around the tooth (Figure 14). Light initiation of the cement/core material is accomplished, then additional PermaFlo DC is injected around the post, forming the core. A final light curing of the core is now performed, the margins are finalized, and tissue management procedures can begin (Figure 15).

CONCLUSION

A review of the benefits of fiber posts has been presented, and a new fiber post/core system and its associated clinical technique have been introduced.

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Disclosure: Dr. Fischer is President and Chief Executive Officer of Ultradent Products, Inc.