# Clinical Predictability Using Fiber Posts

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The restoration of endodontically treated teeth is often compromised by the minimal amount of residual tooth structure remaining to support and retain the final restoration. This may be due to endodontic over instrumentation and flaring of the root canal during endodontic therapy, or to extensive structural defects from previous restorations, or the deleterious effects of the carious process.[1] Many of these teeth require the placement of a post and core restoration for retention, whether the tooth is restored directly or indirectly with full or partial coverage. The dental literature supports the fact that a circumferential ferrule in combination with an endodontic post results in better long term clinical success for crowned endodontically treated teeth.[2,3,4] However, many of these studies looked at cemented posts, while different ferrule designs have little, if any influence on the fracture resistance of teeth with fiber posts, with no significant change in the resistance of teeth with fiber posts regardless of which ferrule design is incorporated. This unique property of these types of posts is an additional advantage in clinical practice.[5]

The gold standard for many years was the cast gold post and core, however, "given the scientific literature that has appeared, the creation of a conventional cast post/post core, even if passively cemented is useless."[6] Goto *et al.*, when looking at crown retention, have shown that fiber-reinforced dowels and bonded composite cores under fatigue loading, provided significantly stronger crown retention than cast gold dowels and titanium alloy dowels with composite cores.[7] A four-year clinical study comparing fiber posts and the traditional cast post showed that the cast post group had root fractures in 9 percent of the sample, while fiber posts had no root fractures.[8] In a literature review by Heydecke, it has been shown that cast post and cores do not have a better performance than direct post and core restorations.[9] Therefore, it seems that the current use of cast post and cores is difficult to justify.

PULL QUOTE
to be determined

The use of metallic posts for retention has been studied extensively. Stiff metallic posts work against the natural function of the tooth, creating zones of tension and shear, both in the dentine, and at the interfaces of the luting cement and post.[10] For teeth restored with stainless steel posts, a significantly lower load resulted in failure, as compared with those teeth restored with glass fiber posts.[11] There is a worse mechanical performance in teeth restored using stainless steel posts, with a high stress concentration due to the significant difference between the elastic moduli of the steel and surrounding materials.[11,12] The use of fiber posts is preferable to titanium posts as well, with teeth restored with fiber posts exhibiting a significantly higher resistance to fracture than with titanium posts.[13] In both static and fatigue fracture testing under vertical or oblique loadings the fracture loads of the teeth restored with fiber posts were significantly greater than those of teeth restored with metallic posts[14] The more rigid metallic post can transfer more stress to the root than fiber posts, which increases the probability of vertical root fracture.[15] Because fiber reinforced posts have an elastic modulus that more closely approaches that of dentin,[16] fiber posts produce less stress on the root dentin around the post tip than do metal posts.[17] The non-metallic posts comply more satisfactorily with the requirements necessary to provide a mechanical behavior more similar to that of the dental structure, the compatibility among the mechanical properties found in these systems and the dentin providing a biometric behavior reducing the risk of failure, or fracture of the root.[18] If fracture does occur, fracture with metal posts is usually catastrophic, while fracture of teeth restored with fiber posts show fractures that would allow repeated repair.[19] In a literature search looking at 1,984 abstracts on the failure modes of post systems, Fokkinga concluded that the fiber reinforced post system more frequently showed favourable failure modes compared to metal posts.[20]

Many metallic posts are parallel, which can require the removal of significant amounts of root dentin in the apical half, while not adapting well to the coronal aspect of the root structure. In contrast an anatomical fiber post, requires minimal tooth structure removal during canal reshaping, and allows for greater post-to-canal adaptation in the apical and coronal half of the canal, with an esthetic nature. This provides a favourable foundation for eliminating discoloration caused by a metallic post placed under all ceramic crown systems.[21]

As an added clinical benefit, fiber posts can have twice the fatigue resistance of ceramic or

**FIGURE 1**—Pre-operative radiograph of tooth #21.

**FIGURE 2**—Clinical presentation of loose bridge.

**FIGURE 3**—Clinical presentation of failed abutments.

**FIGURE 4**—Rubber dam application prior to beginning endodontic treatment.

**FIGURE 5**—Occlusal view of endo access.

**FIGURE 6**—Removal of existing gutta percha.

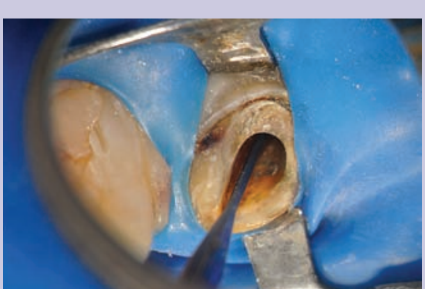

**FIGURE 7**—Ultrasonic tips used to open apical area of canal.

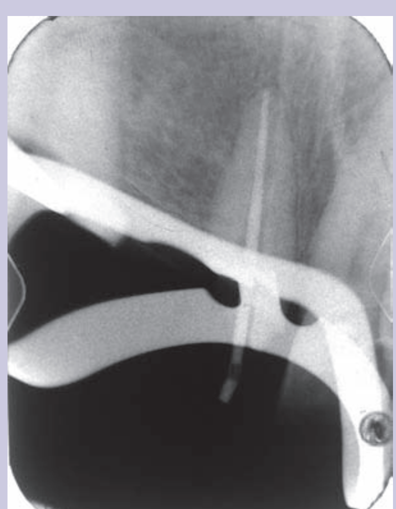

**FIGURE 8**—Trial cone radiograph.

**FIGURE 9**—Macro-Lock Illusion Post drill #4 used to create post space.

**FIGURE 10**—Measurement of post at 15mm.

**FIGURE 11**—Insertion of Macro-Lock Illusion Post.

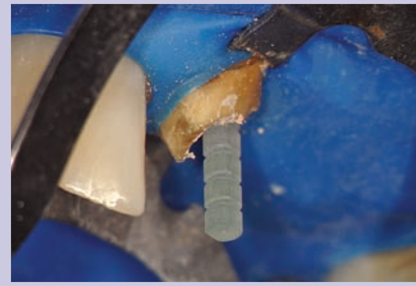

**FIGURE 12**—High power view of post try-in.

**FIGURE 13**—Trimming of the post with a diamond disc.

**FIGURE 14**—Ultra-Etch inserted into the canal from the apex coronally.

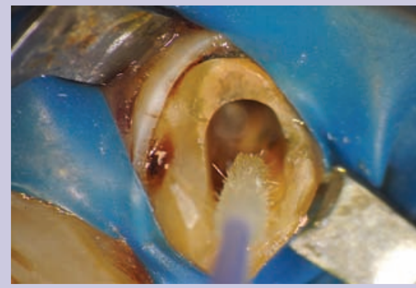

**FIGURE 15**—Placement of the adhesive into the canal.

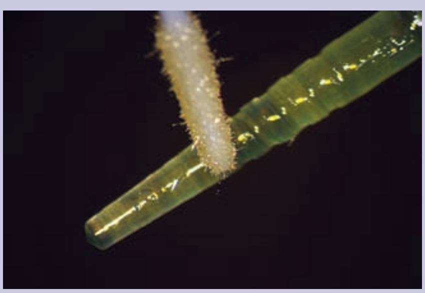

**FIGURE 16**—Placement of adhesive on the Macro-Lock Illusion Post.

**FIGURE 17**—Light cure of adhesive after evaporating solvent.

**FIGURE 18**—Placement of the dual-cure resin cement from apex coronally.

metal posts.[22] Statistically as well, resin supported polyethylene fiber and glass fiber dowels (posts) show the lowest coronal leakage when compared with stainless steel and zirconia dowels at all time periods.[23-25]

Not all fiber posts are created equal. In a study by Seefeld, looking at eight types of fiber posts, the fracture load of the tested systems ranged from 60 to 96 N and the flexural strength from 565 to 898 MPa. The differences in fiber diameter ranged from 8.2 to 21 microns and the fiber/matrix ratio from 41 to 76 percent.[26] These fiber posts can be: zirconia enriched, glass fiber, quartz fiber, glass fiber-zirconia enriched, and glass fiber and carbon fiber,[27] with quartz fiber posts recording significantly higher failure loads.[19] They can be translucent, white, dentin or colour changing translucent,[27]and for light transmission they can be excellent, good, fair or poor.[28] Posts with a high translucency facilitate excellent esthetic results, eliminating show-through and discoloration while allowing transmission of light polymerization energy.[29] Fiber posts can be tapered, double taper, parallel, parallel with a tapered end, parallel tapered, and serrated[27] with the double taper post closely imitating the post-endodontic shape of a radicular canal, leaving a thin and uniform thickness of cement at the post/canal interface. This improved adaptation of the post promotes the mechanical properties of the quartz fiber/epoxy material, instead of the weaker composite resin cement.[30] The quality, type, and volume of fibers, the way the fibers are silanated, and the type of resin affects the clinical performance of these fiber posts, with some failing in cyclic fatigue to fracture in a few cycles and others in over two million cycles (DT Double Taper Light-Post radiopaque — RTD St. Egreve France).[31]

A new addition to the RTD family of fiber posts is the Macro-Lock™ Illusion Post, which is fabricated with a high percentage loading of pre-tensed long continuous translucent unidirectional quartz fibers with epoxy resin, and is radiopaque. Quartz crystal is the world's purest form of silica, is homogeneous, non-porous[32] and

**FIGURE 19**—Post inserted into the uncured dual-cure resin cement.

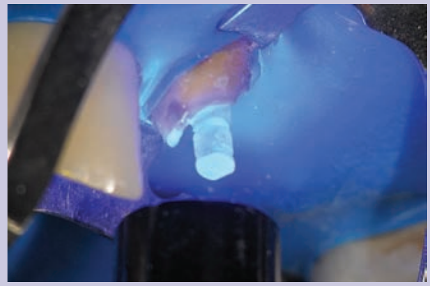

**FIGURE 20**—Light curing the resin cement.

**FIGURE 21**—Cosmecore buildup around the post.

**FIGURE 22**—Light curing of the Cosmecore build-up.

**FIGURE 23**—Preparation of the post and core for full coverage crown (note appearance of post when bathed in cold water).

**FIGURE 24**—Tooth #23 extracted and preparations of the abutments.

**FIGURE 25**—Temporization with Temptation and Cling 2 Temporary Cement.

**FIGURE 26**—Post-operative radiograph showing opacity of the Macro-Lock Illusion Post.

it has an interface treatment of the fibres to achieve a perfect match between the thousands of fibers and the organic resin matrix. Colour changing technology allows for the post to disappear when seated at oral temperature and for it to be visible under water spray if retrieval is ever necessary. The Macro-Lock Illusion post has high translucency for good light transmission, and has an elastic modulus as low as 13GPa (depending on the angle), and a flexural strength of 1600 MPa. It is unique in that it allows for micro and macro retention of the bonded core. A recent study by Dallari showed that the Macro-Lock post with its macro retention reached one of the highest results when testing the retention of quartz fiber posts.[33] No surface treatment of the post (etch, silane, sandblasting) is necessary before cementation.

## CASE PRESENTATION

A patient presented to the office with a failed bridge from tooth #21 to tooth #23. The patient was advised that the 23 was unrestorable and that one treatment plan option was to place a new five unit bridge from 11 to 24 with double abutments on the anterior two pontics. The preoperative radiograph Figure #1 shows a short endodontic filling requiring retreatment, prior to placement of a post and core.

Access was difficult to negotiate at the canal terminus and the use of ultrasonic tips eventually removed the calcification deep into the canal at the apex and the tooth was retreated endodontically. Figure #2 shows the pre-operative photograph of the loose bridge before removal. At removal of the bridge (Fig. 3), it was confirmed that the 23 was un-restorable necessitating extraction and the preparation of the 24. Figure #4 shows the rubber dam application on tooth #21 with the occlusal view of the access into the canal in Fig. 5. Twisted rotary endo files were used to remove the gutta percha (Fig. 6), and ultrasonic tips were used to open the apical part of the canal (Fig. 7).

The trial cone was inserted and verified with a trial cone radiograph (Fig. 8). A warm vertical downpack was achieved with the System B (Sybron Endo, Orange, CA) and the canal was backfilled with the Obtura 2 (Obtura Spartan, Fenton MO). The green Macro-Lock Illusion Post (Clinical Research Dental) post drill #4 was used to create the post space (Fig. 9). The post space depth was measured at 15mm on a 19mm root (Fig. 10). The post was inserted to verify fit and position (Fig. 11).

Figure 12 shows a magnified view of the Macro-Lock Illusion Post seated in the canal. The post was trimmed with a diamond disc (Fig. 13). The post space was etched with Ultra-Etch (Ultradent) for 15 seconds using an Endo-Eze tip (Ultradent) (Fig. 14) to reach the apex of the post preparation and inject from the apex to the incisal, so as not to entrap any air. The post space was thoroughly rinsed and a purple Capillary tip (Ultradent) was used to lightly dry the canal. A light cure adhesive, proven to be compatible with dual cure cements was applied to the canal with a tapered brush long enough to reach the bottom of the post space (Fig. 15), and at the same time the light cure adhesive was placed on the Macro-Lock Illusion Post (Fig. 16).

The solvent was evaporated with a light air flow and the bond cured in the post hole and the post (Fig. 17). A dual cure resin cement was injected into the canal space from the bottom up (Fig. 18) and the post was seated into the dual cure cement (Fig. 19). After curing the cement (Fig. 20) Cosmecore (Cosmedent) was used to create the core buildup (Fig. 21) followed by a cure of 20 seconds (Fig. 22). Figure 23 shows preparation of the Cosmecore/Macro-Lock Illusion Post post and core for full coverage (note the colour of the post when exposed to cold water). Teeth # 11 and 24 were prepared and tooth #23 extracted (Fig. 24). A provisional bridge was fabricated using Temptation (Clinical Research Dental) and cemented with Cling 2 Temporary Cement (Clinical Research Dental) (Fig. 25). A final post operative radiograph (Fig. 26) shows the opacity of the Macro-Lock Illusion Post. **OH**

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*Oral Health welcomes this original article.*

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