Esthetic Fiber Reinforced Composite Posts

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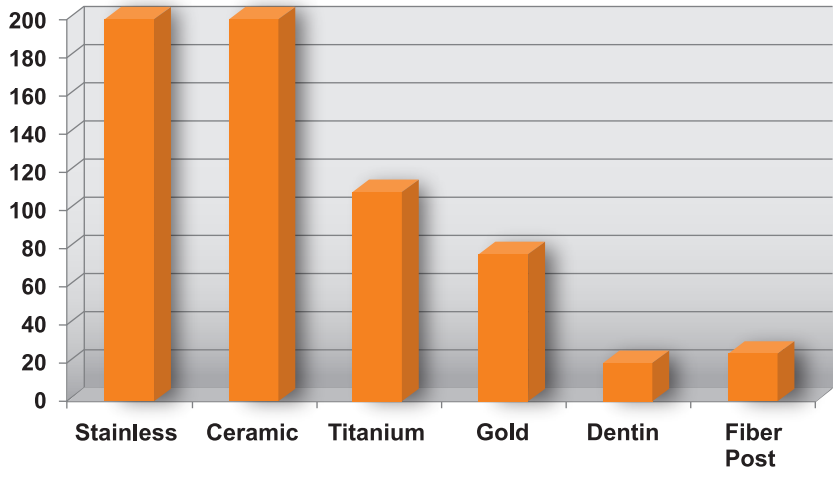
The introduction of esthetic fiber reinforced composite posts, in the 1990s, challenged conventional treatment modalities in the same way posterior composites threatened amalgam alloy. As with composites, it took several years for dentists to realize that these esthetic posts were more than "just a pretty face". The higher quality products that have evolved in both categories clearly offer mechanical, functional and clinical advantages for the dentist and patient which more than compensates for any time required to learn new techniques. Furthermore, both materials also overcome the drawbacks that were inherent in their metallic predecessors. Both techniques are less invasive, more easily repairable/re-treatable, non-galvanic/non-corrosive and when properly bonded, are polymerically sealed at the margins to prevent microleakage.

As an example, during the metal post era, *in vitro* studies concluded that parallel metal posts tend to provide better retention than tapered metal posts[1], but all too often at the sacrifice of additional interior dentine, and than tapered metal posts (screw-type or otherwise) are more likely to induce root fracture.[2]

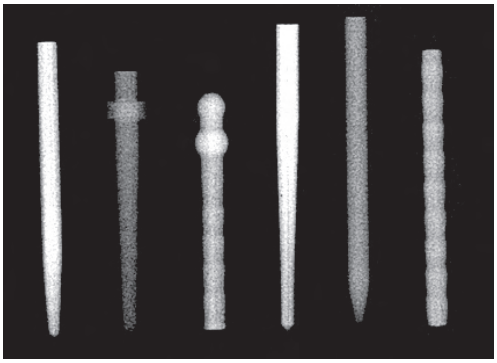
Even with custom cast posts, the combination of inherent rigidity (Young's Modulus of Elasticity) and a tapered "wedge" shape, naturally predispose to root splits according to *in vitro* studies[3-5] and in clinical evaluations comparing fiber posts and cast posts.[6] This performance, along with the added expense, multiple appointments, corrosive and galvanic potential (bi-metallism) and lack of esthetics, severely limit the appeal of cast posts in contemporary practice. There are just too many other good, safe alternatives.

There is a comprehensive, consistent and growing body of evidence (*in vitro* and clinical) that supports the substitution of metal and ceramic posts with fiber posts. Some of these will be cited in this paper. While the differences between brands will be illuminated later, there a number of functional and clinical benefits associated, in the literature, with fiber posts. These are "in general":

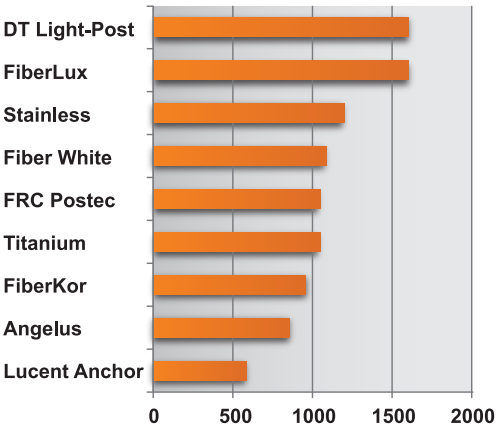
- Fiber posts possess a Modulus of Elasticity similar to that of dentin (Fig. 1). It is about 20 Gigapascals



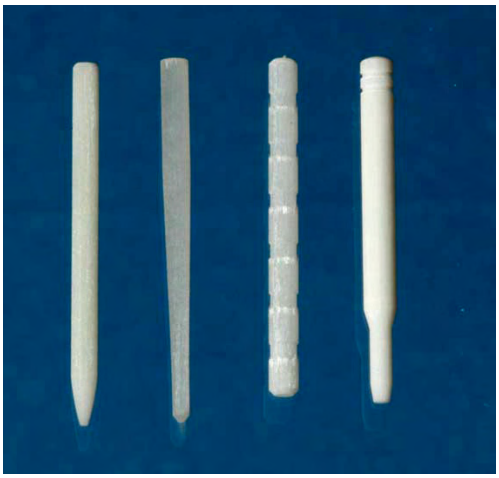
(Fig. 1) Young's Elastic Modulus (GPa)



(Fig. 2) Comparative radiopacity of several fiber posts



(Fig. 3) Flexural Strength per respective post manufacturers (in MPa)



(Fig. 4) Four Basic Post Shapes

which is about 10%-30% that of metals. They absorb and dissipate stress like the natural tooth structure[7-12] which in turn helps prevent root splits, and provides failure modes which are re-treatable.[13-17]

- Most fiber posts are esthetic; either tooth colored or translucent, eliminating the need for opaquers and making them suitable for use under all types of restorations, including composites and all-ceramic crowns.
- Fiber posts are, by nature, exempt from corrosion and galvanism. One study reported that of nearly 500 endodontically treated teeth with root splits, 72% of them involved bi-metal interaction between metal posts, cores and crowns.[18]
- While the flexural strength of some fiber posts is better than others, the strength of fiber posts tested indicates that "fiber posts can be used in any clinical situation where metal posts have been used".[19]
- Fiber posts can be atraumatically removed in a matter of minutes.[20-24]
- When properly bonded into place, fiber posts are as retentive (in some cases more retentive) than prefabricated metal and ceramic posts[25-28] and cast posts.[29-30]
- Certain fiber posts with composite core build-ups have also been shown to offer superior fracture resistance in restored teeth[31-35], or similar fracture resistance but with more favorable failure modes than with prefabricated metal and cast posts[36-39].
- Fatigue Resistance is the *in vitro* test which most realistically simulates the oral challenge and, therefore, most effectively predicts clinical performance. A Rotational Fatigue study in extracted teeth showed that all of the fiber posts included in the testing were more fatigue resistant than the Stainless Steel, Titanium and Ceramic posts. In fact, the fiber post with the highest fatigue resistance (DT Light-Post™, RTD, St Egreve, France) was more than twice as fatigue resistant as the Stainless Steel, Titanium and Ceramic posts.[40]

Fiber posts can also vary considerably from brand to brand in some very important aspects.

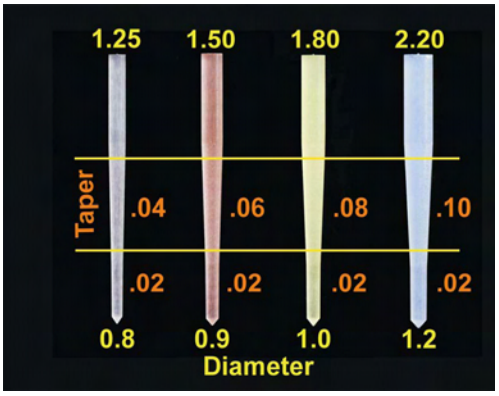
- Radiopacity- Some are more radiopaque than others. Greater Radiopacity provides greater contrast, and makes it easier for the clinician to identify the fiber post in situ (Fig. 2).
- Light transmission and conductivity- This can expedite the bonding-placement process by several minutes.
- Flexural strength - Manufacturers report flexural strength in their commercial literature /websites based on ISO Specification Testing (Fig. 3).
- Shape- Fiber posts are available in a variety of shapes and sizes, and the four basic shapes are: 2-stage, tapered, parallel and pointed (Fig. 4). Because of their E-Modulus, any of these shapes can be used without predisposing to root fracture. However, the ideal post shape would involve a tapered section inside the tooth, and a parallel section outside, under the core composite.[41]

Having observed superior performance with the first 3 generations of fiber posts (Table 1), the DT (Double-Taper) Light-Post design was developed

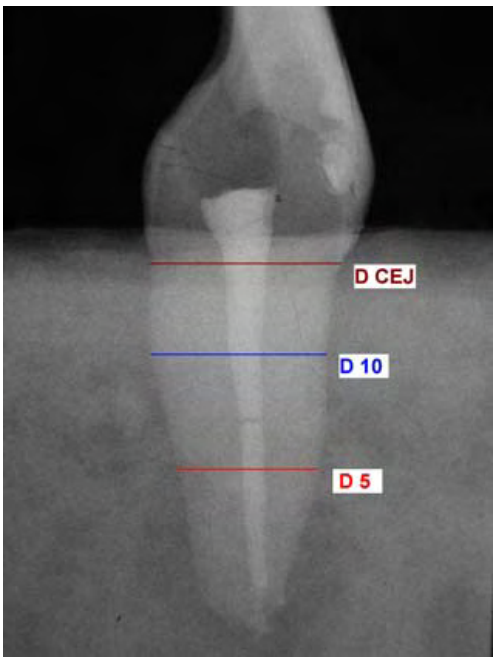
by Drs Sakkal and Boudrias of University of Montreal, reasoning that it was time for a post (made from this composition) that fits root canal treatments the way they are performed, as closely as possible, and with minimal dentin removal, as opposed to the historical adaptation of the root canal to accommodate the parallel or cast post. The specific tapers and diameters (Fig. 5) were distilled from measurements of nearly 1000 endodontically-treated teeth (all categories of teeth) at 5mm and 10mm from the apices, and at the cemento-enamel junction CEJ (Fig. 6). This field of study concluded that this "BEST FIT" would need to involve two separate tapers in each post (for optimal adaptation and minimal cement thickness) , with a parallel section protruding from the root to lend maximum bulk (therefore strength) to the core build-up.[42-45]

Introduced commercially in 2001, the DT Light-Post has by now been included in more *in vitro* studies than any other fiber post. Compared to the other fiber posts included in the respective *in vitro* tests, the DT Light-Post has been shown to exhibit:

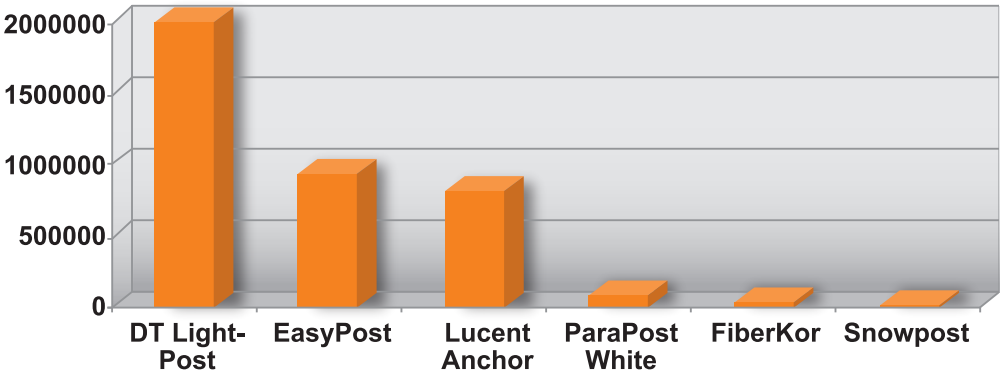
- Superior Flexural Strength.[46]
- Superior fatigue Resistance (Fig. 7).[47]
- Radiopacity higher than most others.[48]
- Comparatively high light conductivity.[19]
- Micro-mechanical retention that is superior to the macro-mechanical retention of ParaPost XP (a standard parallel stainless steel post by Coltene-Whaledent, Cuyahoga Falls, Ohio, USA) at 5mm and 10mm insertion depths.[49]



(Fig. 5)
DT Light-Post Illusion Dimensions



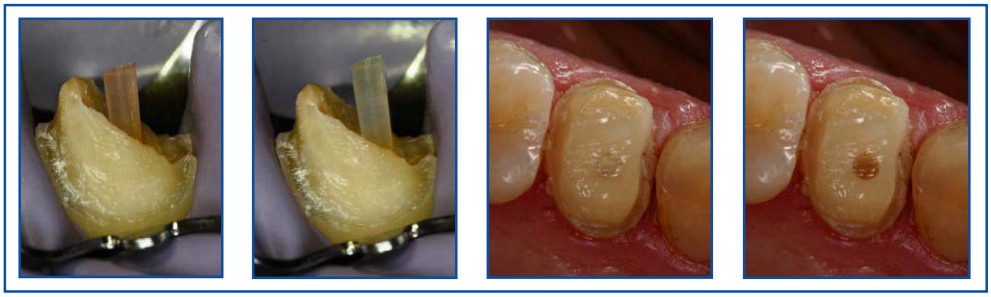
(Fig. 6)
Anatomical Measurement landmarks



(Fig. 7)
Fatigue Resistance (Cycles to failure)

Ferrari *et al.*[50], have published clinical data on 985 cases that utilized three prior generations of esthetic fiber posts (Composipost®, Aesthetic-Plus™ and Light-Post™). They demonstrated survival rates of 89-93% at 7-11 years, which makes metallic posts seem obsolete. The fiber posts in this clinical study were made in the same way, by the same manufacturer as the DT Light-Post, and have the same mechanical properties. So it is no surprise that the more recent, shorter term published clinical trials on the DT Light-Post [51–56] demonstrate similar outstanding clinical performance; enhancing the retention and/or fracture resistance of large MODs, crowns and bridgework, even in the absence of a complete circumferential "ferrule effect", and without root fractures.

The very latest generation of fiber-reinforced endodontic posts , involves a proprietary



(Fig. 8 a-d) Intrinsic post color disappears and re-appears as needed

Generation 1 (1989-2006) NOT Radiopaque, NOT Aesthetic	Generation 2 (1996-2007) Aesthetic, NOT Radiopaque	Generation 3 (2000-present) Aesthetic, Radiopaque
Composipost* C-Post**	Aestheti-Plus* Light-Post*	D T Light-Post* DT Light-Post Illusion**** Macro-Lock™* Macro-Lock™ Illusion****
	ParaPost® Fiber White***	FiberLux***, TaperLux***
	FibreKor®, FiberKleer***	Snowpost***, Snowlight***
	Dentatus Lucent Anchor*** Lucent Anchor Twin***	IcePost*** IceLight***
		Unicore***
		FRC Postec***, FRC Postec Plus***
		Achromat***
		Rely-X*** Post

(Table 1) Fiber Post Evolution

*Trademark of Recherches Techniques Dentaires (RTD), St. Egreve France

** Trademark of Bisco Dental Products, Schaumburg, IL USA

*** Not a trademark of RTD

**** Thermochromatic (Patent Pending)

(patent pending) means for thermo-sensitive pigmentation; DT Light-Post Illusion® and the Marco-Lock™ Illusion®. The disappearance of the post's intrinsic color during clinical placement helps the clinician identify the brand and size of the post before and after placement, if the post should ever require removal (Fig. 8a-d).

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