



Review Article

Contemporary posts for varied canal shapes- An update

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Abstract

Endodontically treated teeth that are structurally compromised often present significant restorative challenges, especially when the root canals are flared or excessively wide or oval in shape. The use of post and core systems remains a common and effective strategy to restore structural integrity in such teeth and provide retention for the final restoration. However, morphological variations- like ribbon-shaped, oval-shaped, or kidney-shaped canals—may complicate the clinical approach due to the difficulty in achieving adequate adaptation and support with standard restorative techniques. Traditionally, custom-cast dowel cores have been recommended in such cases due to their ability to conform to irregular canal anatomy. However, these systems pose notable drawbacks. The high modulus of elasticity of cast metal posts (often up to ten times that of natural dentin) - can lead to stress concentrations at the post-dentin interface, increasing the risk of root fracture. Furthermore, metal posts are limited in their esthetic performance, particularly in anterior regions. On the other hand, while prefabricated single fiber posts offer better esthetics and closer elastic compatibility to dentin, they often fail to adapt adequately to the wide, irregular canal shapes. In this context, this article would discuss contemporary alternatives, such as anatomical post techniques, bundled fiber systems, or custom-fabricated fiber-reinforced composite posts etc., which provide improved canal adaptation, better stress distribution, and enhanced esthetic outcomes, making them more suitable for restoring structurally compromised, flared, or irregularly shaped root canals.

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1. Introduction

For a tooth that is structurally compromised due to decay or trauma, a combination of effective endodontic therapy with a good post – endodontic restoration is imperative for a successful outcome. With more such teeth being preserved through endodontic treatments, dentists must have the necessary skills and knowledge for their restoration. The extent of tooth damage determines the choice of materials and techniques required for a successful restoration.¹

When severe damage occurs, intra-radicular posts combined with core buildup and crowns are the preferred treatment. The missing tooth structure can be reconstructed using custom-made or prefabricated posts.²

A post and core restoration is recommended for teeth with significant structural loss, typically exceeding 50% of the crown. It is particularly beneficial for teeth prone to cervical fractures, cases involving the loss of two or more

proximal surfaces, and teeth with inadequate retention due to shortening.³

The success of a post and core restoration largely depends on how well the post adapts to the root canal, which is influenced by the canal's shape and size.⁴ Posts are available in various types, including preformed or custom-made, rigid or non-rigid, stiff or resilient, and esthetic or non-esthetic. They are made from a range of materials, both metallic—such as stainless steel, nickel-chromium, cobalt-chromium, and titanium and non-metallic, including ceramic, composite, polymer-based, zirconia, and fiber-reinforced materials.⁵ However, no commercially available post currently fulfills all the ideal biological, mechanical, and esthetic requirements.⁶ Additionally, one type of post may not be suitable for all clinical conditions. However, recent advancements have introduced various systems designed for specific clinical situations like flared, oval, ribbon or kidney shaped canal which would be discussed in this article.

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2. Discussion

2.1. Posts for flared canal

1. Anatomic Post and core
2. Fiber Augmented Post
3. Individually formed fiber bundle post
4. Accessory Post
5. Biologic Post

2.2. Post for oval canal

1. Oval Fiber Post
2. Circular Post

2.3. Post for kidney shaped canals (C- shaped)

1. Fiber Augmented Post
2. Individually formed fiber bundle post

2.4. Post for ribbon shaped canals

1. Single adjustable post
2. Pin post

2.5. Posts for Flared canal

2.5.1. Anatomic Post ("Relined" post") Medicept (UK-based dental company)

This is an indirect technique that utilizes a hybrid composite resin which is applied on the exterior of a pre-manufactured fiber post to customize it to the particular canal shape. Traditional posts may not always fit well within the canal, leading to stress concentration and potential root fractures. The anatomic post and core technique helps overcome these limitations by customizing the post to better fit the canal anatomy (**Figure 1**).⁷

2.5.1.1. Advantages

1. Reduced microleakage compared to fiber posts.⁸
2. Improved bond strength.⁹
3. Lower risk of catastrophic failure.⁹
4. The technique does not require any special materials or equipment.¹⁰

According to Chandekar SV *et al* (2018),¹¹ anatomical post serves as a good clinical option for restoring both the crown and root portions of endodontically treated teeth that have experienced extensive dentin loss. Beyond restoring the tooth's structure, this approach helps achieve an even distribution of masticatory forces, thereby protecting the remaining tooth structure and reducing the likelihood of root fractures.

2.5.2. Fiber augmented post

A fiber augmented post is a non-metallic post system used in endodontically treated teeth to provide reinforcement and support for the final restoration. This technique replicates the

earlier described anatomic post method but utilizes unidirectional, pre-wetted reinforcing fiber such as glass fiber, quartz fiber, or carbon fiber, embedded in a resin matrix to shape the composite. These posts are known for their high flexural strength, improved stress distribution, and aesthetic advantages compared to traditional metal posts (**Figure 2**).¹²

2.5.2.1. Advantages

1. Offers enhanced resistance to fractures when compared to restorations that rely solely on a fiber post

2.5.2.2. Disadvantages

1. Exposed fibers on the surface can lead to aesthetic and other issues
2. Manipulation and placement of bundled fibers is more difficult.¹³

2.5.3. Individually formed fiber "bundle" post

During the 1990s, custom-formed posts composed of polyethylene or glass fiber bundles or strips (like Ribbond®) were introduced as an alternative to standard prefabricated fiber posts. These materials, known for their low modulus of elasticity, offer suitable mechanical compatibility and have shown excellent long-term success rates (**Figure 3**).¹⁴

2.5.3.1. Advantages

1. Lower likelihood of microleakage when compared to metal and zirconia posts
2. Provides greater resistance to fractures than widely used preformed fiber posts, particularly in canals with an oval shape.¹⁵

2.5.3.2. Disadvantages

1. Handling the fibers can be challenging, as they tend to wrap around instruments and do not stay in the desired position
2. These materials have significantly lower fracture and flexural strength compared to prefabricated fiber post.¹⁴

Tomar *et al* (2021)¹⁵ in his case report observed that bundled glass fiber post is a quick and easy option as it adapts to the canal morphology, hence allows preservation of the tooth substance as there is no need for preparation of the post site to fit the size of tooth which can weaken the tooth.

2.5.4. Accessory post

The accessory post technique has been reported in the literature since 2007. These posts are manufactured from the same materials as standard fiber posts and exhibit comparable elastic modulus and radiopacity characteristics. Their elastic modulus ranges from 13 GPa to 50 GPa, typically measured at a 30-degree angle. Radiopacity varies by brand and post size, reaching up to six times the radiopacity of aluminum. Commercially available accessory posts have a tapered

design, with diameters ranging from 0.5 mm at the tip to 0.8 mm at the coronal end. When used in conjunction with a primary or "master" post, accessory posts can improve the adaptation of fiber posts in canals that are flared or oval in shape. This improved fit helps minimize polymerization shrinkage and reduces the risk of post loosening (**Figure 4**).¹⁷

Li Q et al. (2011)¹⁷ reported that incorporating an auxiliary fiber post can notably enhance the fracture resistance of excessively flared root canals; however, it does not seem to contribute to improved post retention.

2.5.5. Biologic post

Biological posts are made from the dentin of freshly extracted human teeth that have been sterilized through autoclaving.¹⁸ They are then cut and shaped to match the anatomy of the root canal in the tooth being restored (**Figure 5**).¹⁹

2.5.5.1. Advantages

1. Resilience is comparable to that of a natural tooth.²⁰
2. Demonstrates strong adherence to the tooth structure.²¹
3. Economical.²²
4. Biocompatible.²³
5. Bonding among the biologic post, the luting agent, and the tooth structure allows the clinician to achieve a unified monoblock system.²⁴

2.5.5.2. Disadvantages

1. Difficult to find a suitable tooth
2. Reluctant to accept a material derived from another individual²⁴

Falakaloglu et al. (2019)²⁵ and Shreshtha et al. (2023)²⁴ both highlighted the advantages of biologic dentin posts in root canal reconstruction, stating that biologic dentin posts effectively distribute stresses, reducing the risk of fractures under static and fatigue loading. These posts reinforce the remaining tooth structure, particularly in cases of excessively flared canals or extensive coronal dentin loss in addition to being esthetic.

2.6. Post for oval shaped canals

2.6.1. Oval Fiber Post

Creating a post space in an endodontically treated tooth with an oval-shaped canal can be challenging. Standard drills are typically used to remove filling material during post space preparation, but their circular design makes it difficult to uniformly shape all the walls in an oval canal. Consequently, significant areas of the canal may remain untouched, still lined with filling materials or debris. This limits the available dentin surface for effective adhesive bonding and cementation of fiber posts, potentially leading to post dislodgment and an increased risk of root fractures. To overcome these limitations, oval fiber posts have been developed. These posts conform more closely to the shape of

oval canals, minimizing resin cement thickness and improving post retention (**Figure 6**).

2.6.1.1. Advantages

1. Enhanced exposure of open dentinal tubules and improved bonding effectiveness.
2. A diamond-coated ultrasonic tip, offering a minimally invasive approach, can be used in place of conventional rotary instruments to shape the space for an oval fiber post.²⁶

However, studies have shown contrasting results regarding the efficacy of oval posts.

Coniglio et al. (2011)²⁷ found that circular and oval posts exhibited similar retentive strengths in oval-shaped canals, while Munoz et al. (2011)²⁸ reported no significant differences in adaptation between the two. Interestingly, the cement thickness around oval posts was found to be significantly lower than around circular posts.

In an *ex vivo* study, Scotti et al. (2014)²⁹ investigated the bond strength and fit of fiber posts with circular and oval cross-sections placed in prepared post spaces of oval canals. Their findings showed that both types of posts demonstrated improved adaptation in the apical region. However, in the coronal area of oval canals, significantly higher bond strength was observed when post space preparation was carried out using a specialized drill and an oval post was subsequently cemented.

2.7. Post for ribbon shaped canals

2.7.1. Single adjustable post

Single adjustable posts offer enhanced retention and adaptability for teeth that have ribbon shaped canals, reducing the risk of post-failure. It consists of only one drill, one post and one sleeve. Their ability to conform to different root canal anatomies eliminates the need for excessive preparation, preserving more tooth structure.³⁰ These posts distribute occlusal forces evenly, reducing stress on the root and surrounding structures (**Figure 7**).

2.7.1.1. Advantage

1. Suitable for use in narrow, medium, or wide canals due to its universal size.
2. Promotes a conservative approach by adapting the post to fit the canal, rather than altering the canal to accommodate the post.³⁰

Lopes LD et al. (2021)³⁰ in their study examined the push-out bond strength and failure patterns of single adjustable versus customized glass fiber posts. They found that the single adjustable posts exhibited higher bond strength compared to the customized ones. Additionally, the root canal level and the type of adhesive strategy used had no

significant effect on bond strength. The most common types of failures observed were adhesive and mixed.



Figure 1: Anatomic post and core



Figure 2: Fiber augmented post



Figure 3: Individually formed fiber "bundle" post
Courtesy- <https://ribbond.com/applications-post-and-core.html>



Figure 4: Accessory post

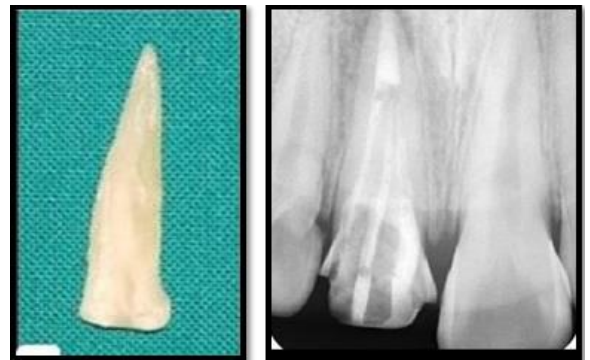


Figure 5: Biologic Post

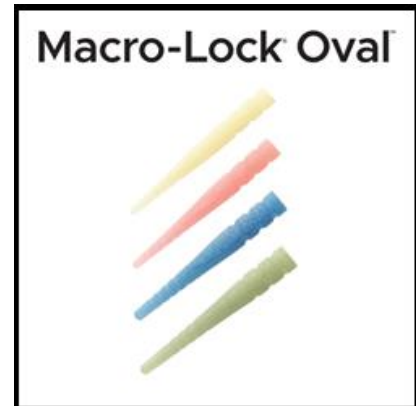


Figure 6: Oval Post

Courtesy- <https://www.clinicianschoice.com/product/macro-lock-oval-post/>



Figure 7: Single adjustable post

COURTESY- <https://souq.dental/splendor-sap-single-adjustable-fiber-post-system#:~:text=Description,low%20risk%20of%20root%20fracture.>

3. Conclusion

Managing varied canal shapes like flared, oval, ribbon shaped or kidney shaped canal with a post and core system requires careful selection of materials and techniques to ensure optimal retention, stability, and longevity of the restoration. Prefabricated or custom posts, along with adhesive bonding techniques, can help reinforce weakened canal walls. A well-adapted core buildup further supports the final restoration,

ensuring functional and aesthetic success. Proper case selection, meticulous preparation, and adherence to biomechanical principles and knowledge of contemporary post systems and their applications are essential for long-term success in such cases.

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None.

5. Conflict of Interest

The authors declare no conflict of interest.

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