RECENT ADVANCES IN POST SYSTEMS -A REVIEW

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ABSTRACT

Preservation of natural tooth in dental arch is ultimate objective of dental treatment. After endodontic treatment, tooth becomes brittle and prone to fracture which results in reduction of strength of crown causing fracture of cusp or sometimes weakness of the roots. In order to strengthen crown some anchorage within teeth has to be made and that anchorage and support is gained by rigid structure which is known as post. This article focuses on recent advances in post systems and their application, merits and demerits in endodontics.

INTRODUCTION

The longevity of endodontically involved teeth has been greatly enhanced by continuing developments made in endodontic and restorative procedures.1,2 Endodontic treatment saves the tooth from extraction, but only adequate restoration is essential for its durability. The endodontically treated tooth must be restored in such a way that it will withstand masticatory forces acting in vertical and lateral direction without being prone to fracture. To reinforce the treated tooth and protect against vertical fracture, some type of stabilization is required that will fasten the restoration to the remaining tooth structure. This is accomplished by using a post (also referred to as a dowel), preferably with a core or coping and a crown or onlay as superstructure to give coronal-radicular stabilization. A variety of materials have been used for posts ranging from wooden posts of the 18th-century to metal posts and, more recently, carbon fiber, glass fiber and ceramic posts.3,4 With a variety of post systems available and by the fact that new posts are introduced before existing ones are fully evaluated in laboratory and clinical studies; it becomes often difficult to decide which one to use.5,6 Newer post systems are continuously being introduced into the market. The general trend is towards more aesthetic dentistry and a keen interest to achieve good appearance and translucency due to which the restoration should mimic that of a natural tooth.

CLASSIFICATION

Since past, cast or prefabricated metal posts have been used exclusively as foundations for indirect restorations. But with the emphasis on aesthetic outlook, posts and core with composite and ceramic materials having dual function and double taper have been introduced as alternatives.

Posts can be classified in a number of different ways:

1) Active or Passive
2) Parallel or Tapered
3) By their material composition7

1) Depending on how retention is achieved, posts can be divided into two main subgroups-

-Active posts

-Passive posts

Active posts derive their primary retention directly from the root dentine by the use of threads whereas Passive posts gain retention as their name suggests by passively seating in close proximity to the post hole walls, and rely primarily on the luting cement for their retention.5

2) According to its general shape, each post can be divided into either

-Tapered or
-Parallel sided

In general, active posts are more retentive than passive posts of a similar method of configuration, and parallel- sided posts are more retentive than tapered posts.5

BASED ON COMPOSITION

Other classification of posts is based on composition.
- Composite Materials
- Ceramics7

BASED ON COMPOSITE MATERIALS

Composite materials are composed of fibers of
-CARBON
- SILICA

These fibers are surrounded by a matrix of polymer resin, usually an epoxy resin. They also include light transmitting posts & ribbon fibre post.8

The various types of composite materials post can be grouped as:

- Silica Fibre Post8
- Aestheti Post
- Aestheti Plus
- Para Post
- Snow Post

Light Transmitting Post8
- Double Taper Light Post
- Luscent Anchor Post
- Twin Luscent Anchor Post

Ribbon Fibre Post8
- Ribbond

Based on Ceramics8
- Cosmopost

Fiber-Reinforced Resin Post Systems
Fibre-based post systems have been the subject of a recent systematic review by Bateman et al 2003.9 These posts are made of carbon, quartz or glass fibres, embedded in a matrix of epoxy or methacrylate resin. The adhesion between quartz or glass fibres and resin matrix is enhanced by fibre silanization prior to embedding.5 The main advantage of these posts is that by flexing slightly under load, they distribute stresses to the root dentine in a more favorable manner than metal posts.5 The addition of fibers to a polymer matrix; have enhanced mechanical properties like strength, fracture toughness stiffness and fatigue resistance.

CARBON FIBRE POST
Carbon Fibre posts have been successfully used by dentists because of their strength and relative flexibility, ease of placement or ease of removal, if necessary, for endodontic retreatment. The black colour of carbon posts alter the aesthetic effect and hence they cannot be used in clinical situations in which subsequent non-metal and translucent crowns are planned.10

SILICA FIBRE POST
Glass fibre has physical properties similar to those of carbon fibre posts and now have been substituted to overcome the limitation of these above mentioned posts.10

Aestheti Post
It retains a core of carbon fibre bundle surrounded by quartz fibres similarly arranged longitudinally.10

Aestheti Plus
It is also composed entirely of Quartz Fibres. The traditional posts include white or clear quartz fibers.10

Para Post X Post System

This system includes prefabricated parallel side serrated posts. Each of the four posts incorporates a raised diamond retention pattern which provides increased retention and resistance to torque and oblique forces. Two passive posts, Parapost XP and Parapost XH are available. Parapost XH provides extra retention and safety especially in conditions requiring mechanical retention. Parapost XP casting kit has calibrated components in widely flared canals. All Para Post X systems can be used with standard

Para Post drills and the depth is now marked at 7mm, 9mm and 11mm from the apical end to help maintain proper post space depth. Figure 1 shows ParaPost XP System 12

Parapost Fiber White System

To enhance the features of the existing Para Post system, Fiber White has longitudinally arranged glass fibres. The post is essentially parallel and has small steps for

FIGURE 1 : PARAPOST X SYSTEM

mechanical retention of the luting cement. The post has white translucent color that minimizes shadowing. It is metal free and the fiber matrix strengthens the structure without compromising flexibility. The head of the Fiber

FIGURE 2 : PARA POST FIBRE WHITE SYSTEM

Snowpost

Professor Bois and his colleagues at Lyon, developed Snowpost by originally researching on carbon fibres. Snowpost is composed of 60% longitudinally arranged silica zirconium glass fibres in an epoxy resin matrix. Its shape is cylindrical and has a 3° tapered apex. Four diameters of sizes 1 mm, 1.2 mm, 1.4 mm and 1.6mm – are contained in the complete kit, together with matching burs. The tapered end is 4 to 6 mm long.[11]White post is antirotational and has two rounded sections to help in retention of the core material. It is available in diameters of 1.14 mm, 1.25mm, 1.4 mm and

mm. Each post has a removable color-coded ring around the head for identification. Figure 2 shows ParaPost Fibre White System..[11]

FIGURE 3: SNOWPOST

Double Taper Light Post

The capacity of different types of post-and-core to protect the prosthetic restoration from biomechanical failures varies greatly. The new DT- Post system (DT for double taper) was designed with the purpose of providing close canal adaptation with minimal tooth structure removal by providing a subtle taper. The DT light post system has fibre optic construction and can be cemented with light cure or dual cure materials.
It has translucent shade and a light transmission capacity of 9.1 mW/cm^2. It is radiopaque and is available in various sizes of 1.25mm, 1.5mm, 1.8mm and 2.2mm. It is tapered, made up of quartz fibre and has passive insertion. The translucency allows

the post to be used under all restorations without opaquers and radiopacity allows the post to be seen clearly in radiograph. Figure 4 shows Double Taper Light Post System.[14]

5: LUSCENT ANCHOR POST

Twin Luscent Anchors Light Transmitting posts

Twice the Invention, Twice the Retention!
Tapered, light-transmitting, fiber glass-reinforced resin posts with a unique groove that starts near the apical end, stops around mid-post, and then starts again. This causes the post to have an hour-glass-like profile, with subtle bulges in the apical and coronal sections and a narrow area midpost**.** This innovative design is visible assurance against accidental debonding of adhesive and resin-core
materials. The slim mid-section creates a "physical choke". By eliminating air resin entrapment, the vent groove prevents rotational dislocation. It all adds up-to a great combination of light transmission, attractive esthetics and twice the retention.[17]
It has the following features:
Aesthetic
Provides monobloc strength
Narrow midradial section which provides double retention
Longitudinal vent groove providing anti rotational resistance
Convenient and fast to use

The posts are available in four colors and sizes:
White is extra small with size of 1.26 mm
Yellow is small with size of 1.40 mm
Red is medium with size of 1.54 mm
Blue is large with size of 1.68 mm

FIGURE 6: TWIN LUSCENT ANCHOR POST

It has a low modulus of elasticity of 20.1 GPa and a flexural strength of 579 MPa. It has a light transmission capacity of 11.9 Mw/cm. Figure 6 shows Twin Luscent Anchor Light Transmitting Post.[17]

BONDABLE REINFORCEMENT FIBER POST (RIBBON FIBRE POST)

This method uses a bondable reinforcement fiber, a fourth-generation bonding agent and a dual-cure hybrid composite as the core build-up. The reinforcement material used for the post consists of polyethylene woven fibers that are treated with a cold-gas plasma. The use of cold gas plasma treated polyethylene woven fibers embedded in conventional resin composite has been advocated for corono-radicular stabilization of pulp-less teeth. For this technique to work well, there should be sufficient light to reach the depth of the post space.[18]
Ribbond Inc. suggest that their woven polyethylene fibre can also be used to construct a directly placed composite post and core.[8]

Ribbond maintains the natural strength of the tooth and eliminates the possibility of root perforation. It conforms to the natural contours and undercuts of the canal and provides additional mechanical retention. There are no stress concentrations at the tooth-post interface. The Ribbond post and core is passive and highly retentive[18].. Figure 7 shows Ribbon Fiber Post.

CERAMIC POST AND CORE

The primary ability of ceramic materials to mimic the appearance of tooth structure has been combined with improvements in strength and durability and has permitted the use of all-ceramic restorations in situations, where previously only metal-reinforced restorations would have been placed. The use of ceramic to provide a core and post retention continues the idea of using a tough but aesthetic material to support all ceramic units without affecting their optical properties. The introduction of zirconium oxide ceramics has provided a material with over twice the flexural strength of aluminous ceramic systems, which is therefore able to be used to construct posts of realistic diameters.[11]

Zirconia ceramics have been shown to be biocompatible. Building a core of ceramic directly onto the zirconia posts has not been possible owing to the different coefficients of thermal expansion of the core and post materials, which would result in fracture of the core.[11]

Zirconium root canal posts have been shown to be more rigid than stainless steel posts. Aesthetic zirconium ceramic posts are available in traditional shapes and can be used in round root cross sections. They are radiopaque, biocompatible and mechanically rigid and can be bonded to variety of ceramics using resin luting materials as well as composites.[13]

COSMOPOST

It is a ceramic post system and is indicated mostly in aesthetically important anterior region of maxilla and mandible. Cylindrically shaped with a conical tip, the Cosmopost is available in two relatively wide diameters (1.4 mm and 1.7 mm).[11,19] The 1.4mm post is generally indicated in the anterior region: only for the lateral incisors and in the mandible for the central and lateral incisors whereas the 1.7mm Cosmopost is used for which the diameter of the coronal part of the root or the coronal endodontium clinically indicates a 1.7-mm root canal post These teeth are usually the four canines and the central incisors in the maxilla.

Depending on the clinical situation, both the 1.7-mm and 1.4-mm Cosmopost can be used in the posterior region. Generally, the 1.4-mm post is used for maxillary and mandibular premolars, while the 1.7-mm post is used for molars (distal canal in the mandible, palatal canal in maxilla).

The posts, as manufactured, have a relatively smooth surface and are subsequently treated to roughen the surface, which increases the bond strength between the post and core, whether heat pressed or luted. Figure 8 shows Cosmopost Ceramic post system.

FIGURE 8: COSMOPOST

ADHESION TO FIBER POST SURFACE

Among the various treatments proposed to improve adhesion to the fibre post surface, **silanization** of quartz and glass fibre posts has been assessed in several laboratory studies, without providing any conclusive evidence.

Silane application would promote adhesion by increasing the post surface wettability, as well as by chemically bridging methacrylate groups of the resin and hydroxyl groups of quartz and glass fibres.

Silanization is not effective on resin posts reinforced by carbon fibres that do not present a sufficient number of hydroxyl groups on their surface.

Post-resin composite adhesion is also promoted by tribochemical treatment of the post surface. Such a procedure involves silicoating of the substrate, followed by silanization, and can be performed either in the laboratory (Rocatec system), or at the chairside (Cojet system).(20)

Coated glass fiber post

ENDOCROWN

Another recent technology for the restoration of ETT with extensive coronal destruction which induced by the development of dentin adhesives is endocrown as alternative to post-core system . In the past, the endocrown described as adhesive endodontic crowns and characterized as total porcelain crown fixed to endodontically treated posterior teeth .

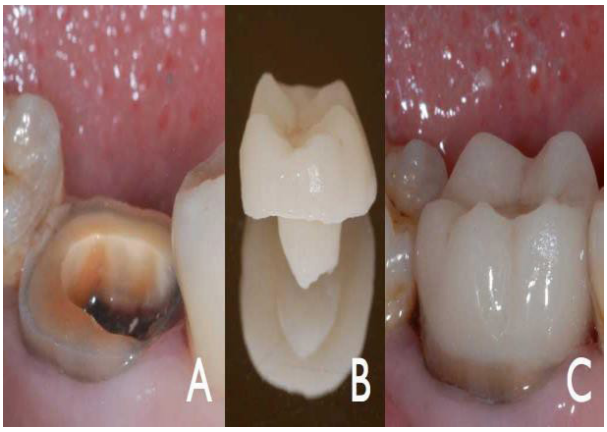
In recent study, endocrown, which could be fabricated from hybrid resin composite or ceramic , is a monolithic restoration bonded on ETT and using the entire extension of the pulp chamber and possibly the root canal entrances as a retentive resource instead of the intra radicular post.

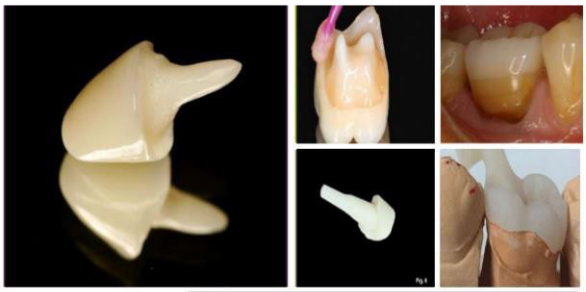
ADVANTAGES

One of the main advantage of endocrown is conservative with proper marginal stability that enhanced by retaining maximum enamel to improve adhesion.
This provides a good seal of the root canal opening, and prevent micro leakage which in turn affecting the long-term prognosis of ETT.

DISADVANTAGES

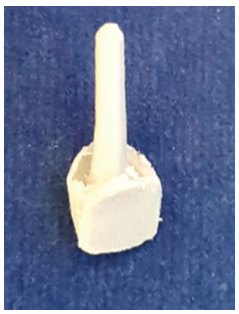
One of the major disadvantage of endocrown restorations is the high risk of fracture failure because of the absence of a metal or high-strength ceramic substructure as in conventional full-crown.





PEEK POSTS

A high-performance polymer, polyetheretherketone (PEEK) has recently been introduced in dentistry. It has been used for the fabrication of implant fixtures, fixed and removable dental prosthesis frameworks and for implant frameworks and restorative implant parts. Modified PEEK material containing 20% ceramic fillers (BioHPP; Bredent GmbH) has good mechanical properties and excellent biocompatibility**.** It can be used for the fabrication of prostheses either by injection molding or CAD-CAM procedures.



Post milling image of Post made from PEEK blocks
ADVANTAGES

Major advantage of this modified PEEK material is a 4- GPa modulus of elasticity, making it as

elastic as bone and allowing it to act as a stress breaker and reduce the forces transferred to the restoration and the tooth root accordingly.
Elimination of allergic reactions,

- Good wear resistance,
- Good polishing properties
- Low plaque affinity.
- Radiolucent, which may facilitate recurrent caries detection

DISADVANTAGES

- Microleakage
- Behaviour under fatigue loading is not clear
- Occlusal adjustments must be done
- This material cannot be polished easily, intraorally after definitive cementation which results in a dull occlusal surface.

SUMMARY

Various posts systems have been introduced in the market and the research indicates that they can be safely included in the clinical practice. The selected post and core technique must be conservative, morphologic, retentive, aesthetic and resist radicular failure.The available laboratory and clinical evidence validates the utilization of fibre posts as an alternative to metal posts an d preferably to other tooth-colored posts, such as zirconia dowels, in post-retained restorations. Each clinical situation will dictate to some degree what post system will be used and for those situations where there is choice, personal preference, familiarity and cost will influence the final decision.
However, clinicians are advised to follow guidelines and recommendations for post selection and core fabrication followed by crown design.

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