ADVANCES IN POST: A REVIEW

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Abstract

Metallic prefabricated posts have dominated the market for a number of years. Yet, in the past several years, polymeric, ceramic carbon or fiber-reinforced, and other novel systems have emerged into the post material market. These newer systems have focused on physical properties, such as modulus of elasticity (rigidity) to reduce stress concentrations within the root canal and reduce the incidence of fractures. An additional feature with the newer posts has been the esthetics with composite core materials. With the abundance of literature demonstrating that metallic posts have a greater number of disadvantages over selective modern technologies the guidelines for post selection in restoring endodontically treated teeth should become more defined and a general consensus may be reached.\textsuperscript{5}

Keywords:

Post; Endodontically treated teeth; Fiber-reinforced post
**Introduction**

A post and core is a restoration consisting of a post that fills a prepared root canal and a core inserted into the pulp chamber that establishes the proper coronal tooth preparation. The post and core is made with a rigid material which, when cemented into the root canal and pulp chamber provides a solid foundation restoration that is well retained in the tooth. The use of dowels or posts and cores seems to have two objectives. First, when there is enough coronal tooth structure, the post is used to reinforce the coronal portion of the tooth as well as the root against fracture. Second, when there is an insufficient amount of coronal tooth structure, the post and core is used to replace this missing tooth structure so that a restoration can be made.

**Historical Perspectives**

Restoration of endodontically treated tooth by a post to retain a crown dates back more than 250 years. In 1728, Pierre Fauchard described the use of “TE NONS” which were metal posts screwed into the roots of teeth to retain the prosthesis. Later, 1745 – Claude Mouton published his design of a gold crown with a gold post that was to be inserted into the root. 1830-1870 – Wood replaced metal as the material of choice for posts. 1839 Harris in proposed that gold and platinum were superior to brass, silver and copper which tended to corrode. 1849 Dr. F.H. Clark developed “spring loaded dowel” a retentive device consisting of a metal tube in the canal & a split metal dowel which was inserted into it. It was designed to allow for the easy drainage of suppuration from within the canal or apical areas. G.V. Black developed porcelain fused to metal crown held in by a screw inserted into a canal filled with gold foil. 1871 – Harries introduced wooden posts. However, they swelled & caused root fractures. “Pivot crown” – a wooden post fitted to an artificial crown and to root canal. In 1888, early restorations of pulless teeth were the Richmond and Davis crowns. Later, precious metal precision dowels fitted to reamed canals and threaded posts were used that were single piece post crown. More recently, cast gold dowel cores made from reinforced direct wax and direct acrylic resin patterns, as well as pin-retained amalgam cores, have been advocated. In 1966 prefabricated posts and composite resin cores came into use. During the last few years, there has been a major shift away from metal custom-cast posts and cores toward prefabricated metal posts and resin-based composite cores, and recently there is a clearly observable movement toward use of fiber reinforced resin-based composite posts used with bonded resin based composite build-up.

**When to Use a Post?**

Since a post does not strengthen an endodontically treated tooth and the preparation of a post space may increase the risk of root fracture and treatment failure, the decision whether to use a post in any clinical situation must be made judiciously. The evaluation of whether a post is needed is based on how much natural tooth substance remains to retain a core buildup and support the final restoration after caries removal and endodontic treatment are completed.
Many endodontically treated molars do not require a post because they have more tooth substance and a larger pulp chamber to retain a core buildup. When a post is required as a result of extensive loss of natural tooth substance, it should be placed in the largest and straightest canal to avoid weakening the root too much during post space preparation and root perforation in curved canals. The distal canal of mandibular molars and the palatal canal of maxillary molars usually are the best canals for post placement. When core retention still is insufficient after a single post is inserted, placement of pins can be considered for additional retention.

Premolars have less tooth substance and smaller pulp chambers to retain a core buildup after endodontic treatment than do molars, and posts are required more often in premolars. In addition to root taper and curvature, many premolar roots are thin mesiodistally, and some have proximal root invaginations. Furthermore, the clinical crown of the mandibular first premolar often is inclined lingually in relation to its root. These anatomical characteristics must be considered carefully during post space preparation to avoid perforating the root.  

A few studies have concluded that a post is not necessary in an endodontically treated anterior tooth with minimal loss of tooth structure. These teeth may be restored conservatively with a bonded restoration in the access cavity.  

Classification of post

Posts can be classified into following categories:

I). According to Robbins  
Posts can be classified as metallic or non-metallic posts.

1. Metallic Posts
   a. Custom-cast Posts
   b. Prefabricated Posts - Passive Tapered Posts Passive Parallel Posts Active Posts

2. Non-metallic Posts
   a. Carbon Fiber Posts
   b. Tooth Colored Posts

II) According to Schwartz  

1. Active versus Passive Posts
2. Parallel versus Tapered Posts
3. Prefabricated Post and Cores: consists of
   - prefabricated posts and
   - custom cast post and core.

4. According to material composition:
   i. Metal posts
   ii. Ceramic and Zirconium Posts
   iii. Fiber Posts
      - Carbon fiber posts
      - Quartz fiber
      - Glass fiber
      - Silicon fiber posts

III) According to Rosenstein  

Classification of prefabricated posts

1. Tapered, smooth-sided posts
2. Tapered, serrated posts
3. Tapered, threaded posts
4. Parallel, smooth-sided posts
5. Parallel, serrated posts
6. Parallel, threaded posts.

Custom Cast Dowel Core

The traditional customs cast dowel core can be made by relieving a plastic sprue...
with acrylic or a metal pin with wax to form the post. The same material can be used for core formation.

**Indications**

1. When the remaining coronal tooth structure supporting an artificial crown is minimal so that it can resist torsional forces.
2. When multiple cores are being placed in the same arch and small teeth such as mandibular incisors,
3. When there is minimal coronal tooth structure available for antirotation features or bonding.

It offers the advantages of easy retrievability of post, greater strength and excellent core retention. Various materials can be used like cast gold and base metal alloys. Cast gold alloy (type III or IV) is an inert material with modulus of elasticity (stiffness of 14.5 ×106 psi) and coefficient of thermal expansion (15 [C-1] ×106) similar to those of enamel, and yet it has good compressive strength that can withstand normal occlusal forces. Other base metal alloys have been used, but their hardness might be a major disadvantage in adjustment and may predispose the tooth to root fracture. Many practitioners prefer to use a cast gold post and core for endodontically treated anterior teeth. Its major disadvantage, however, is esthetics, as the metal shows through the newer all-ceramic restorations. Other disadvantages are increased susceptibility to root fracture and two visit procedure and its additional lab fee. An alternative is a prefabricated post that can be adjusted and inserted in a single visit.

**Prefabricated Dowel**

Many types of prefabricated posts (in terms of shape, design, material) are available.

**Post design:**

The available post designs can be classified according to their shapes and surface characteristics. They may be **parallel, tapered, or parallel-and-tapered** combination. According to their surface characteristics, the posts are **active or passive**.

The **active post** mechanically engages the dentin with threads, whereas the **passive post** depends on the cement and its close adaptation to the canal wall for its retention. Active posts are more retentive than passive posts, but introduce more stress into the root than passive posts. Active posts can be used safely, only in substantial roots with maximum remaining dentin. Their use should be limited to short roots in which maximum retention is needed.

A photoelastic stress analysis of post design led to the conclusion that cement-retained posts and parallel posts were the least stressful to the root, but they also were the least retentive.

**Caputo and Standlee** categorize these different design features into three basic combinations:

- tapered, serrated or smooth sided, cemented into a post space prepared with a matched-size post drill;
- parallel-sided, serrated or smooth-sided, cemented into matched cylindrical channels prepared by a post drill;
- parallel-sided, threaded and inserted into pre-tapped channels

In regard to conservation of tooth structure, the use of **tapered posts** requires removing less dentin because root canal spaces are cleaned and shaped in a tapered fashion.
Although parallel posts and screw posts are more retentive in the root canal, more dentin removal is required in their post space preparation. This can be undesirable, especially in post space preparation for parallel posts, as more dentin is removed from the thinner apical and middle aspects of the root canal walls.

**Post Material**

Prefabricated posts can be made up of:

- Stainless steel
- Titanium and titanium alloys
- Gold plated brass
- Ceramic
- Fiber reinforced polymers

The ideal post and core material should have physical properties such as modulus of elasticity, compressive strength and coefficient of thermal expansion that are similar to those of dentin. In addition, prefabricated posts should not be corrosive and should bond easily and strongly to dentin inside the root using suitable cement so that the entire assembly of a post and core resembles the original tooth.

**Stainless steel** has been used for a long time in prefabricated posts. However, it contains nickel, and nickel sensitivity is a concern, especially among female patients. Stainless steel and brass have problems with corrosion.\(^3\)

**Pure titanium** has slightly lower physical properties such as in compressive and flexural strength than alloys, but it is the least corrosive and most biocompatible material. Titanium posts, however, have low fracture strength and tend to break more easily compared with stainless steel posts during removal in retreatment cases. Furthermore, most titanium alloys used in posts have a density similar to that of gutta-percha when seen on radiographs, which makes them more difficult to detect.\(^5\)

Strong, tooth colored **zirconia posts** are highly radiopaque and rigid. However, they are difficult to use, are expensive and, unless they are rough on the surface, do not offer optimal retention. When a tooth-colored post of maximum strength is desired, these posts should be considered, but their extreme rigidity may contribute to vertical tooth fracture when stressed.

Since there are many drawbacks in metallic prefabricated posts, another newer type of post, the **fiber reinforced polymer post** is introduced. It is made of carbon or silica fibers surrounded by a matrix of polymer resin, which usually is an epoxy resin. The fibers are 7 to 10 micrometers in diameter and are available in a number of different configurations, including braided, woven and longitudinal. They are superior to metal prefabricated posts in aspects that they are tooth colored and do not impart a gray color to the remaining tooth\(^5\). Additionally, they are easy to place, are relatively inexpensive, can be bonded to resin cement and are easy to remove if the tooth needs to be retreated endodontically\(^4\). Since fiber-reinforced posts are metal-free, they do not cause metal allergies or corrode. They offer good esthetics in easily visible areas of the mouth, especially under the all-ceramic crowns and bridges. Finally, fiber-reinforced posts can be removed easily in case of an endodontic failure requiring re-treatment.
According to two in vitro studies,\textsuperscript{11,12} the physical strength of fiber-reinforced post is significantly weaker than that of cast metal posts and cores.

The highly rigid metal would transfer lateral forces without distortion to the less rigid dentin and lead to a higher chance of root fracture. The lower flexural modulus of fiber-reinforced posts (between $1$ and $4 \times 10^6$ psi), on the other hand, measures closer to that of dentin ($2 \times 10^6$ psi) and can decrease the incidence of root fracture. In the event of failure when restored with fiber reinforced posts, teeth are more likely to be restorable.

**Conclusion**

Use of post-and core restorations has changed markedly in the past several decades. Current use and research supports techniques using tooth-colored, fiber-reinforced resin-based composite posts or titanium alloy posts cemented with resin cement, followed by resin-based composite build-ups. Although fiber reinforced resin-based composite posts appear to be very promising, long-term clinical observation is needed.\textsuperscript{3,5}

**References**

9. Rosensteil SF, Land MF, Fujimoto J. Contemporary Fixed prosthodontics, 4\textsuperscript{th} ed, 2006, USA, Elsevier, 336-374

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