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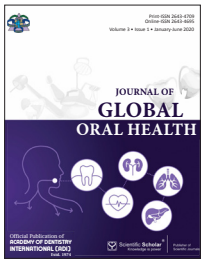

Opinion Piece Articles

Evolution of posts-from rigid to flexible

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ABSTRACT

Once endodontic treatment is completed, the tooth must be provided with adequate protection. The endodontically treated teeth are considerably more brittle due to structural changes in the tooth structure, which is more prone to fracture if they are not properly crowned. Not every root treated needs a post space. Predominantly when the roof of the pulp chamber is removed, it weakens the tooth thus resulting in the need for strong interior and exterior support like a post system. It is critical that the implications (remaining tooth structure, number of teeth, periodontal support, active caries, and good oral hygiene as well as tooth biomechanics) largely influence the restorative approach. Several alterations of the natural shape of the canal become necessary to accommodate a circular post inside the root. Non-rigid post systems such as glass, quartz, and silicon fiber posts have become hugely popular since their introduction in the 1990s. Requirements include an optimal combination of resilience, stiffness, flexibility, and strength. These posts have modulus similar to dentin and provide a more uniform distribution of stress on the remaining tooth structure. Sometimes an anatomic post becomes necessary where fiber posts are contraindicated. Here, it requires more than one visit. Thus, we need to have a thorough knowledge of what type of post to be used.

Keywords: Dental post, Metal post,biological post, Ceramic dowels, Glass fiber-reinforced epoxy resin dowels

INTRODUCTION

Once endodontic treatment is completed, the tooth must be provided with adequate protection. The endodontically treated teeth are considered more brittle due to structural changes in the tooth structure, which is more prone to fracture if they are not properly crowned. There are some exceptions, where tooth structure is lost during the process of access opening, or in cases of anterior teeth where it does not have to bear much masticator load, but there are teeth where post endodontic treatment is a must as they have a high risk rate of fracture (e.g., upper premolar).

The access cavity preparation is one of the main steps toward the preservation and to determine the time spam it will last after the endodontic procedure has been done, as it results in loss of structural integrity. It leads to increased cuspal deflection during function, which leads to a higher occurrence of fractures. Manipulation of the pulp chamber leads to the greatest weakness of tooth structure. The roof of the pulp chamber has the configuration of an arch, which is a shape that is resistant to pressure and stress. Preservation of root structure is the guiding principle in the decision to use a post, selection of post, and preparation of post space. Not every root treated needs a post space. Predominantly, when the roof of the pulp chamber is removed, it weakens the tooth. Thus, resulting in the need for strong interior and exterior support like a post system.[1] It is critical that the implications (remaining tooth structure, number of teeth, periodontal support, active caries, good oral hygiene as well as tooth biomechanics) largely influence the restorative

approach. Several alterations of the natural shape of the canal become necessary to accommodate a circular post inside the root. Non-rigid post systems such as glass, quartz, and silicon fiber posts have become hugely popular since their introduction in the 1990s. Requirements include an optimal combination of resilience, stiffness, flexibility, and strength. These posts have modulus similar to dentin and provide a more uniform distribution of stress on the remaining tooth structure. Sometimes, an anatomic post becomes necessary where fiber posts are contraindicated. Here, it requires more than one visit. Thus, we need to have a thorough knowledge of what type of post to be used.

HISTORY

Attempts to restore pulpless teeth using posts and crowns have been made for more than 200 years. The teeth were often intentionally made nonvital so that the dentist could use retention provided by the dowel placed during the root canal procedures. As early as in 1747, Pierre Fauchard, proposed a technique of placing posts fabricated in gold and silver and held in place with a help of heat softened adhesive called as "mastic." It was noted that the life of the crowns restored by this technique was increased quite a bit. Teeth and artificial dentures, placed with posts and gold wire, stick on and have a better life compared to other techniques which were present at that time. There have been cases that have been recorded in the literature where the tooth with the post has lasted for more than 15–20 years without displacement. Common thread and silk, used ordinarily to attach all kinds of teeth or artificial pieces, do not last long.[2]

During the next 100 years following Fauchard, hippopotamus, sea horse, and ox teeth were used in place of the missing tooth structure. Gradually, the use of such naturally acquired substitutes was reduced, and slowly replaced by porcelain substrate. In the year 1839, Chaplin Harris came up with the suggestion that by providing artificial crowns to natural roots were a much better method of inserting artificial teeth.

Harris in his text on "The Principles and Practice of Dentistry" described the preparation of a natural root for an artificial crown. He was the one who had recommended removing the remaining part of the anatomic crown with excising forceps and the extirpation of the nerve by rapid rotation with the help of silver wire into the canal. Its main function was to provide access to the canal space so the pivot (dowel) that would serve as an anchor for an artificial crown can be placed with ease. The dowels consisted of well-seasoned hickory, which gained retention by absorbing moisture and then swelling. "Pivot crowns" failed frequently and were placed into poorly treated or totally untreated canals. The problem was tried to be rectified by Dr. F.H. Clark in 1849, who proposed to use retentive devices, which he developed and consisted of a metal tube in the canal and a split metal dowel, which was inserted into it. This "spring loaded" dowel was so designed to allow for the easy drainage of suppuration from within the canal or apical areas.[3]

Later, fine gold and platinum were used. There was decreased corrosion with these posts, compared with brass, copper, silver, and even inferior gold.

Sir John Tomes in 1894 presented one of the best representations of a pivoted tooth. Tomes post length and diameter conformed closely to today's principle in fabricating posts to retain both cores and copings.

In 1869, Dr. G. V. Black suggested a method of filling the root canal with a gold foil, containing a threaded gold bolt, which retained a denture tooth.

A design whose use persisted for a number of years was the Richmond crown. He introduced them in the year 1880; this design consists of a threaded tube in the canal, which held a screw placed through the crown. This design was later modified for eliminating its complexity.

Although many of the restorative techniques used today had their inception years ago, proper endodontic treatment was severely neglected until years later. If canals had been properly cleansed and obturated, these early attempts at restoring pulpless teeth would certainly have advanced more rapidly toward today's clinical success.

Claude R. Baker in 1960 introduced a dowel crown that could be used as a dental crown. Their retention was achieved by means of a fixed adaptation to a metal post inserted into a prepared root canal for a pre-determined portion of its length. The metal post crowns are time tested and they have proven themselves time and again to be a more useful unit for tooth substitution or against fixed partial denture retainer. With the recent advances in achieving successful endodontic therapy, there is increased professional use of the dowel crown.

James L. Gutmann insisted on certain guidelines that needed to be followed in the preparation of root of endodontically treated teeth which often require the material that has not been disturbed by the dowel space. Trabert *et al*. (1978) investigated the resistance of untreated, endodontically treated, and dowel restored maxillary central incisors to simulate trauma and also endodontically treated central incisors to simulate trauma. Endodontically treated central incisors with posts evidenced the greatest resistance to fracture during impact in comparison with root canal obturated teeth.[4]

The dentition injunction is subject to intermittent forces loaded in multiple directions. The ramifications of this loading must be considered when selecting materials to reconstruct after endodontic therapy.

MATERIALS USED FOR DOWELS

Posts can be classified based on,

a. Metallic and non-metallic post (Robbins)
b. Active and passive
c. Parallel and tapered
d. Prefabricated and custom made (Schwartz).

PEEK POSTS

Polyetheretherketone (PEEK) that has been recently introduced in dentistry is a high-performance polymer. It has been used for the fabrication of implant fixtures, fixed, and removable dental prosthesis frameworks, and for implant frameworks and restorative implant parts. 20Modified PEEK material containing 20% ceramic fillers (BioHPP; Bredent GmbH) has good mechanical properties and excellent biocompatibility. It can also be used for the fabrication of prosthesis.

Biological posts "Biological Post" serves as a homologous recipe for intraradicular rehabilitation of a fractured endodontically treated tooth by virtue of its biomimetic property. They are manufactured from the extracted natural teeth which are readily available from tooth banks. These posts aid in the strengthening of intraradicular dentin.[5]

CUSTOM CAST DOWELS

Custom cast posts are fabricated from gold alloys (primarily Type III and Type IV casting alloys) and other conventional fixed prosthodontic metals.

The custom cast post has the advantage of imitating the configuration of the prepared canal. This is especially significant when the canal is severely flared. They also reduce the thickness of the cement layer which may be beneficial.

They are less retentive than parallel-sided posts and little or no stress is associated with installation. They act as wedges during occlusal load and transfer resulting in vertical fracture of roots.

PREFABRICATED DOWELS

In recent times, in response to a large growing demand for tooth-colored posts, several non-metallic posts such as carbon-fiber epoxy resin, zirconia, glass fiber-reinforced epoxy resin, and ultra-high polyethelene fiber-reinforced posts have entered the market.

CARBON FIBER-REINFORCED EPOXY RESIN DOWELS

In France in the year 1988, Duret and Renaud developed a new system which was a carbon fiber-reinforced epoxy resin dowel system (CF) by Duret *et al*.[6-8] first introduced in Europe in the early 1990s. The carbon fiber-reinforced dowel has been reported to exhibit high fatigue strength, high tensile strength, and a modulus of elasticity similar to dentin.[9,10]

The most common type of failures in this system are dowel loosening, periapical pathology, root fracture, crown debonding, secondary caries, periodontitis, dowel fracture, tooth extraction for unspecified reasons, and unknown reasons for failures.

GLASS FIBER-REINFORCED EPOXY RESIN DOWELS

The glass fiber-reinforced epoxy resin dowel (GF) consists mainly of glass or silica fibers; they are mainly white or translucent in shade. For example, Mirafit white, FRC Postec, FiberKor, and light post.

Newman *et al*. compared the fracture resistance of two GF dowels containing different weight percentages of glass fibers. It was concluded that the higher content of glass fibers in the dowel had contributed to the greater strength displayed by the tested dowel.

POLYETHYLENE FIBER-REINFORCED DOWELS

Polyethylene fiber-reinforced dowels (PF) are made of ultrahigh molecular weight polyethylene-woven fiber ribbon (Ribbond, Ribbond Inc, Seattle, WA). It is not a dowel in the traditional sense; it is a polyethylene-woven fiber ribbon coated with a dentin bonding agent and packed into the canal, where it is then light polymerized in position.[11]

The failure rate was reported to be 2.4% after a mean time of 2.9 years. In this system, the mode of failure which was registered was loosening of the PF dowel.

CERAMIC DOWELS

The trend toward the use of all-ceramic crowns has encouraged manufacturers to explore the development of all-ceramic dowels. A tooth-colored ceramic is the best material for the anterior tooth where esthetics are the main concern and produce optical properties comparable to all-ceramic crowns. One type of all-ceramic dowel is the zirconia dowel, composed of zirconium oxide, an inert material used for a range of applications.

Kern and Knode in 1991 first described the slip casting technique.

Dowel loosening failure was the most common failure seen in 16 of the 23 studies done on it, making it the most commonly reported failure. Other complications (periapical pathology, root fracture, crown debonding, periodontitis,

dowel fracture) were reported less frequently than dowel loosening.[12]

PEEK DOWELS

These dowels have higher biocompatibility and they have a lower elastic modulus in PEEK material in comparison to the ceramics with metal sub-structure. PEEK is lighter and does not corrode. Furthermore, as they have a lower reactivity when compared to the other materials, the sensitivity to metallic taste is eliminated. Therefore, PEEK is competitive with metal-supported ceramics as a crown material.[13]

BIOLOGICAL POST

Biological post is typically used in conditions where there is an extensively damaged tooth. Ambica *et al*., reported in their study, both carbon fiber and glass fiber posts had high resistance against fracture.[14,15]

CONCLUSION

The never ending quest for an ideal material to restore lost tooth structure continues to be the focus of dentistry, but there are many post materials and techniques that are available to the clinicians to use for different clinical cases and thus each case situation should be studied and handled on an individual basis.

Declaration of patient consent

Patient consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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