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REVIEW ARTICLE

RECENT ADVANCEMENTS IN POST SYSTEMS: A REVIEW

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ABSTRACT
Restoration of an endodontically treated tooth presents a challenge to the restorative dentist. The tooth to be restore has been followed out as part of the endodontic treatment. Depending on the degree of instrumentation, that tooth has lost a significant amount of structural support due to the endodontic access to treat the pulp chamber and root canals.The primary function of an endodontic post is to provide retention for the core and enable full sealing of the coronal portion of the root canal. Traditionally used metal posts do not meet the requirements of modern dental medicine due to some fairly significant drawbacks such as color, corrosion potential, non-adhesive bonding and high modulus of elasticity which can lead to root fracture. Recently, esthetic ceramic and fiber reinforced posts have been manufactured in order to avoid such imperfections. This is due to the fact that, apart from being an esthetically pleasing material, they are also biocompatible, have good physical properties and the capacity of adhesive bonding to tooth tissue and core buildup. Nonetheless, a good clinician should know how to spot the difference between them in order to select and use the appropriate post system in each specific situation.
Keywords: Endodontic, ceramic, fiber, core buildup, non-adhesive.

INTRODUCTION
Post design and shape has been based on both anatomic considerations and features that improve the retention of the post within the root canal, and the retention of the core material built in the coronal portion of the tooth. Post shapes include parallel-wall design, tapered design, hourglass, and hybrid parallel-tapered. Posts can have a variety of textures, such as smooth, serrated, or threaded to improve retention within the canal when cemented.The heads of some posts have retention features designed to offer additional retention of the coronal restorative material. In several research studies, the retention of posts within the root canal was improved with the addition of serrations and threads.[1,2] Also, parallel-metal posts are more retentive than tapered posts when pull tests are done to evaluate retention.[3,4] Traditionally used metal posts do not meet the requirements of modern dental medicine, due to disadvantages such as color, corrosion potential, non-adhesive bonding and high modulus of elasticity which can lead to root fracture. In order to enhance the esthetic aspects, physical properties and biocompatibility, a wide range of esthetic posts have been developed and become commercially available. In addition to esthetic and health benefits, they hold the capacity of adhesive bonding to tooth tissue and core buildup and that

potentiates the creating of the monoblock, a gap-free single unit in which the loading stresses are evenly distributed and borne by all the monoblock components.[5]

CERAMIC ZIRCONIA POSTS

Zirconia posts are indicated in grossly destructed tooth, areas with heavy forces and in high lip line and thin gingival tissue for achieving better esthetics[6]. To improve the bond strength of zirconia post to core and root dentin, it is recommended to use resin cements[7] and do surface pretreatment of which the most effective is airborne particle abrasion using silicated Al_2O_3 particles in a combination with silanization[8]. However, the high elastic modulus of zirconia posts at 200 Gpa causes stress to be transferred to the less rigid dentin, thereby resulting in root fractures [9]. Furthermore, zirconia posts are stiff, but at the same time very brittle, without any ductility [10]. Therefore, it is necessary to make a deep post preparation which, on the other hand, prevents the use of a minimally invasive approach when it comes to removing the dentin tissue. Furthermore, if a failure occurs and there is a need for endodontic retreatment, the reported strength becomes a significant disadvantage because it is nearly impossible to remove a zirconia post from the root canal[11]

EVERSTICK POST SYSTEM

In this system, glass fibers are impregnated with a semi-interpenetrating polymer network (IPN). An IPN polymer may be defined as a polymer comprising two or more networks that are not covalently bonded to each other, while a semi-IPN comprises only one network and a linear polymer. In the everstick dowel, the matrix is a multiphase of bisphenol A diglycidylether methacrylate (Bis-GMA) monomer resin partially diffused into a linear phase of polymethyl methacrylate (PMMA).[12,28] Further, the fiber bundle is surrounded by a PMMA outer layer to improve the adhesive properties of the dowel. According to the manufacturer, when a light-curing bonding resin is applied for 5 min onto the surface of the fiber bundle pre-impregnated with PMMA, the latter will be partially dissolved. Consequently, grooves and undercuts are created on the surface to provide micromechanical bonding in addition to the chemical adhesion – surface reactivation. On polymerization, the monomers form a cross-linked semi-IPN polymer together with phases of linear polymer. The flexible dowel system is not based on a matching reamer and dowel approach. Instead, the most appropriate dowel size for the available canal space is advocated by the manufacturer. One advantage of this dowel system is that it facilitates conservation of root tissue, which is an important contribution to the durability of the dowel and core restoration.[13,27]

FIBER REINFORCED POST

Fiber-reinforced posts are not as rigid as metal or ceramic posts. Some of the focus on fiber-reinforced posts has been on their ability to flex like the tooth. While it has been demonstrated that there is flexion in the function of teeth, the definitive restoration of any tooth should create an integrally sealed element that does not yield, bend, or flex. A number of studies have focused on functional stresses to the tooth crown when it is restored with a post and bonded composite resin versus restoring it with an integral cast-metal post and core. The results of these studies demonstrated that failure occurs at the interface between the restorative material and the tooth.[14,15] The thinner the root, the greater the flexion, and the greater the failure. In fact, Reeh and coworkers[16,29] evaluated reduction in tooth stiffness as a result of endodontic and restorative procedures, and found that the tooth was inherently stiff and resistant to flexion. Once a tooth was prepared, the rigidity was reduced. An occlusal cavity preparation reduced tooth stiffness by 20%, and loss of marginal ridge integrity with a mesial-occlusal-distal preparation reduced cuspal stiffness by 63%. In comparison, an

endodontic access preparation reduced relative tooth stiffness by a mere 5%. Flexion of the post should not be the issue; instead, the focus should be on the ability of a post to dissipate the energy of function and trauma.When a fiber-reinforced post is bonded within the root canal it dissipates functional and parafunctional forces, reducing the stress on the root. When catastrophic force is placed on the crown of the tooth, the post or crown will fracture instead of the post transmitting the energy of force down the root, creating a vertical root fracture.[17-20,30]

INDIVIDUAL GLASS FIBER POSTS

In the early 2000s, individually formed glass fiber reinforced posts were introduced [21,31] to eliminate the shortcomings and improve the advantages of the prefabricated glass reinforced posts. They are made of unidirectional, silanated E-glass fibers impregnated with a combination of two non-polymerized polymers, PMMA as a linear phase and poly Bis-GMA as the cross-linked phase that form semi-interpenetrating polymer network (semi-IPN). PMMA chains, with molecular weight of 220 KD, plasticize the cross-linked Bis-GMA based matrix and thus reduce the stress formation in the fiber-matrix interface during deflection[22,32]. Because of the non-polymerized semi-IPN, the monomers of adhesive resins and cements can diffuse into the linear polymer phase and by polymerization, form interdiffusion bonding and so-called secondary semi-IPN structure [23,33] that contributes to the better load transfer from the core to the root. Resin substrates suitable for dissolving the IPN matrix, i.e. linear polymer, are the ones containing monomers such as Bis-GMA, TEGDMA or HEMA and belong to those that are most commonly used in restorative dentistry.Since they are not polymerized, the IPN posts can be easily adapted to the shape of the root canal, thereby possibly reducing the number of voids and potentially reducing the number of post decementations[24,34]

WUERZBURG POST

The Wuerzburg Post, introduced in 2008, is a new post-and-core restoration system designed to eliminate the weak parts of post-and-core restorations and the associated problems, respectively. In contrast to conventional posts, the Wuerzburg Post is a short and thick post, which no longer relies on cementation or luting for retention in the root, but on stress-free positive locking, which it achieves by means of a post which can be spread into a predefined and form-congruent undercut cavity. The second key feature is an annular groove which runs in the dentin ensuring regular force transmission and stress dissipation, as opposed to the classic ferrule design. There are two versions: One with a machined core which can be prepared like a classic build-up to support crowns and bridges, and another one with a 2.25 mm ball end to connect to common dies which can be integrated into removable prostheses. As the system utilizes prefabricated parts made from Titanium, a precise fit is ensured, enabling the user to restore teeth quickly and easily. It is also important to note that if necessary, it is possible to remove the Wuerzburg Post in a reasonable time without extensive risk of destroying the remaining tooth.[25]It is also important to note that if necessary, it is possible to remove the Wuerzburg Post in a reasonable time without extensive risk of destroying the remaining tooth. This involves destructive separation of the build-up or ball end with a diamond bur which separates the core from the spreadable lamella which remains in the cavity and can be removed individually. In particular, this feature is helpful when endodontic retreatment become necessary.

PARAPOSTFIBER WHITE SYSTEM

The estheticParaPost has longitudinally arranged glass fibers. The post is essentially parallel and has white translucent color that minimizes shadowing. Parapost system is made metal

free for esthetic purposes and is also indicated for patients with metal allergies. Flexural modulus measures closer to dentin than other post materials. Filled resin/unidirectional fiber matrix strengthens the structure of the post without compromising flexibility. It is passive, parallel-sided design mirrors the qualities of metal ParaPost®. This post system is specially fabricated to bond with resin cements and core materials. If endodontic treatment becomes necessary, this para post can be removed readily. The posts are color coded for use with existing ParaPost® drills[26,35,36]

CONCLUSION

The primary function of endodontic post is to provide retention for the core and enable full sealing of coronal portion of the root canal. Therefore, it should bond firmly to the root dentin and buildup core. Additionally, an endodontic post should have sufficient fracture strength to withstand the loads, but elastic modulus similar to that of dentin to enable more uniform stress distribution and prevent root fractures.

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