Fibre reinforced composite post systems: a review

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Abstract

Numerous ways have been described in literature for restoration with procedure to retain the tooth. In case of badly broken teeth application of post and core helps in restoration of the tooth. Earlier post systems required lot of preparation and caused greater loss of tooth structure. With improvement in minimal invasive dentistry and demand in esthetics, there was development of newer post materials which required less tooth preparation and improvised esthetics. This article sums up newer post systems in place.

Keywords: Aesthetics, Minimal Invasive Procedure, Spirapost, Everstick, Ribbond.

Introduction

Long term success of endodontically treated teeth depends upon the skilled integration of endodontic and restorative procedures. Endodontically treated teeth are considered more brittle, when compared to their non-treated counterparts, due to moisture loss.[1] and loss of collagen cross-linking in the dentin after endodontic treatment[2] and loss of structural integrity associated with the access preparation.[3] Post endodontic restoration is necessary to prevent fracture of the remaining tooth structure, reinfection of the root canal and replace the missing tooth structure. In 1728, Pierre Fauchard described the use of 'tenons' that were fabricated in metal and screwed into tooth[4]. The traditional custom cast post has thorough adaptation to the canal walls, because it is fabricated of metal alloy, it has modulus elasticity greater than dentin which may cause catastrophic failure of the post and the tooth. Alternative to that is prefabricated post system, which are classified according to their shape, mode of retention and post material.

Ideally, the post should have the same shape as the endodontic preparation, and should be readily adjusted, non-corrosive and able to be removed without difficulty. Radiopaque, adquate removal of tooth structure, and a modulus of elasticity synonymous to dentin are other important features, as are adaptability in the canal and

to the core. The post must give all of the mechanical requirements needed to restore the tooth.

The function of post is to engage the post and core unit within the radicular portion of the remaining tooth. The post does not reinforce the root nor does it extend any strength to the remaining fragile dentin. Earlier, cast post and core were used and later metal pre-fabricated posts were in use. These can be active or passive. Active post engages itself in the dentin and passive posts are cemented within the canal.

Different types of posts have been evolved since past, which include custom made and pre-fabricated posts. Pre-fabricated posts may be either metal or non-metal posts. Conversely metal posts showed several short-comings such as corrosion, inflammatory reaction, high incidence of catastrophic root fractures, discoloration.

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Fibre-reinforced composite (FRC) posts were developed to overcome the disadvantages of metallic posts. The preference and popularity of FRC posts can be attributed to its elastic modulus which is similar to that of dentin so that the occlusal stresses are distributed evenly resulting in favourable root fractures that are easy to repair. They can be easily removed from the root canals in the cases of retreatment[5].

The other advantages are the adhesion and micromechanical bonding characteristics of these fiber posts to the resin luting agent, dentin, and composite core which gives life like appearance.

Spirapost

Spirapost is the polyfibre post madeup of polyfibre strands and surgical steel wire. This gets integrated in resin cement to form homogenous unit. It can be angled to the vertical axis of the tooth in order to maintain its complete structure upto preparation. Due to its unique, flexible design, Spirapost is able to adapt to the curvature and irregularities of the canal, permitting an ultra-conservative post space preparation, preserving more tooth structure, leading to a stronger tooth – a critical factor in the long-term success of the restoration.[6]

Spirapost is available in two shapes:

Tapered (yellow)

Recommended for both for smaller canals and more curved canals. Diameter of fibres 1.5 mm at the coronal portion 2.5 mm at the apex

Parallel (green)

Recommended for larger, straighter canals Diameter of fibres 3.5mm

Mastoras et al conducted an ex-vivo study and found out that spirapost has significantly higher push out bond strength compared to

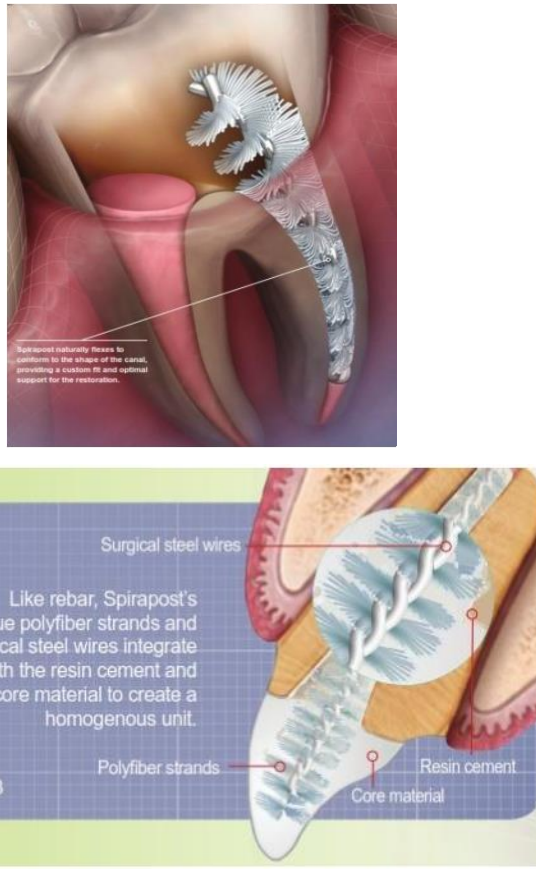

Fig 1: Spirapost

DT light post concluding that it had greater adhesion compared to routine post systems.[7] Also, spirapost has been found to recover complete fracture resistance in premolars regardless of type of composite resin used as core material.[8]

Everstick Post

It is individually formed glass fibre reinforced composite post that can be adapted to the shape of the root canal to form customized fibre reinforced post and core. It is a soft, flexible and adaptable unpolymerized glass fiber post. It is made from a mixture of oxides of silica, calcium, boron, aluminum, and some other oxides of alkali metals.[9] The preparation required for this post allows root dentin tissue to be preserved as its fibers adapt to the shape of the root canal, and the risk of dentin perforation can be prevented. The micromechanical bonding between composite and core ensures a strong bond to the composite core and the root canal.[10] It has unidirectional fiber bundle with diameter ranging from 0.9 to 1.2 or 1.5 mm. The fibers are impregnated with polymethyl methacrylate (PMMA) and 2,2 - bis - (4 - [2 - hydroxy - 3 - methacryloyloxypropoxy] phenyl) - propane (bis-GMA) with an interpenetrating polymer network (IPN).

Fig 2: Everstick Post

It can be cemented either by:

- Direct technique
- Indirect technique

Indirect technique

The fibre post is cut to a premeasured length and inserted into the root canal to adapt to the shape of the root canal. Then it is initially light cured inside canal for 20 seconds and after removing the post from the canal, it is further light polymerized for total of 40 seconds. The surface of post is coated with thin layer of low viscosity dual cure or self cure polymerised resin cement and then reinserted into the root canal. The post is then light polymerized and the core build up is completed on exposed portion of the post.

Direct Technique

The uncured individually formed FRC post is inserted directly into the root canal with luting cement and light polymerized together.

An in-vitro study found out that everstick post had significantly higher push out bond strength compared to glass fibre post which can be due to presence of both linear and cross linking phases present also dual cure resin cements also improve bonding strength because of the fact that monomers of dual cure cement penetrated into the linear phase of polymer structure of everstick post.[10]. A study by Doshi et al concluded that everstick post had greater fracture resistance compared to glass fibre or carbon fibre posts.[11]

Ribbond

Ribbond is made of bondable, reinforced ultra-high-strength polyethylene fiber[12] with a high coefficient of elasticity (117 GPa) that makes it resistant to stretch and distortion and a high resistance to traction (3 GPa) that allows them to easily adapt to tooth morphology and dental-arch contours. Ribbond fibers conveniently absorb water because of the “gas-plasma” treatment to which they are exposed to. This treatment reduces the fibers’ superficial tension, ensuring a good chemical bond to composite materials.[13] Ribbond is esthetic, translucent, biocompatible practically trasperant and disappears within the composite or acrylic without show-through.

Ribbond can be used in stabilizing traumatized teeth, restoring fractured teeth and creating a fixed partial denture and for direct-bonded endodontic posts and cores, orthodontic fixed lingual retainers and space maintainers.

Fig 3: Ribbond

This method uses :

1. A bondable reinforcement fibre
2. A fourth generation bonding agent
3. A dual cure hybrid composite as luting agent
4. A dual cure hybrid composite as core build up

polyethylene FRC (Ribbond) specimens had the highest surface roughness value, which is calculated around 2.33 μm, while that of glass FRC (everStick) is almost half the value of polyethylene FRC .[14]

Fig 4: Ribbond Kit

The rough surface of a restoration increases plaque accumulation, which may result in discoloration and increased the risk of secondary caries.

Cementation Technique

- After post space preparation, The fibre is selected depending on width of the root canal.
- The length of the post space is measured using a periodontal probe or endodontic file. This measurement is doubled, estimated core length added and the necessary length of fibre is decided.
- Two pieces of fibre should be cut with special scissors, then coated with a dual cure adhesive resin and set aside in a light protected container.
- The internal surface of the root canal is treated with a dual cure adhesive resin system to control polymerization in the deepest part of root canal.
- Excess adhesive on the ribbond pieces is gently removed with a hand instrument moving in the direction of fibres.
- A piece of reinforcement fibre coated with adhesive is then wrapped and condensed tightly into the canal with an endodontic plugger.
- A second piece is then condensed into the canal space at right angles to the first piece.

- The excess resin is removed and the free ends of the fibres are twisted and condensed in the canal. The entire fibre resin post is cured for 20 seconds.
- The core is completed using a hybrid composite resin following the technique of small progressive increments. All increments are fully light cured.

Belli et al. evaluated the effect of different FRCs (polyethylene and glass) on microleakage of class II composite restorations. Their results indicated that there was no significant difference in microleakage among the groups when the cavities were lined with glass FRC (everStick net) or polyethylene FRC (Ribbond). Authors stated in conclusion that both polyethylene and glass FRCs in combination with flowable composite helps to reduce occlusal leakage in Class II adhesive cavities with enamel margins.[15]

Conclusion

Fiber-reinforcing materials need to be part of the armamentarium of a restorative dentist. When treatment is planned appropriately, fiber-reinforced composite resin restorations can be highly successful. Preservation of coronal dental tissue, the use of post with elastic properties similar to dentine, and effective post adhesion are the most critical factors for the successful clinical performance of restored endodontically treated teeth.

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CONFLICT OF INTEREST
No conflict of interest

FINANCE/ SPONSORSHIP
No finance sponsorship

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