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Use of Polyethylene Fibre Ribbon Reinforced Composite Resin as Post-Core Build-Up: A Technical Report

SUMMARY

Restoration of an endodontically treated tooth is a subject that has been evaluated and discussed widely in the dental literature. Use of polyethylene fibre ribbon reinforced composite resin as post in restoring extensively damaged teeth is something new. This article describes the use of polyethylene fibre ribbon reinforced composite resin as post-core build-up.

Keywords: Polyethylene Fibre Ribbon; Reinforced Composite Resin; Post-Core Build-Up

Hasan N. Alkumru, Sebnem Begum Turker, Buket Evren

Marmara University, Dept. of Prosthodontics
Faculty of Dentistry, Istanbul, Turkey

TECHNICAL REPORT (TR)

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Introduction

Teeth that have been endodontically treated often have little coronal tooth tissue remaining and, as such, require a post to retain the core and restoration, and need to be restored by crowns[1,5,9]. Metal posts are most commonly used due to their favourable physical properties and excellent biocompatibility[4,8]. With recent advances in ceramic technology, the all-ceramic crown has become more popular. However, restoring a pulpless tooth with a metal post and core in combination with an all-ceramic is a challenge. The underlying metal from the post and core can alter the optical effects of a translucent all-ceramic crown and compromise the aesthetics[7]. There has been a significant amount of interest in the development of non-metallic post systems in recent years. Several tooth-coloured posts have been developed, such as zirconia coated CFP, all-zirconium posts and fibre-reinforced posts[2,10,12].

A leno-woven polyethylene ribbon (Ribbond Bondable Reinforcement Ribbon) has been used successfully for a variety of clinical techniques, including tooth splinting, replacement of missing teeth, treatment of dental emergencies and reinforcement of resin provisional fixed prosthodontic restorations, orthodontic retention and other clinical applications[11]. In recent year, there has been a great deal of interest in the use of resin cement to bond a post into a prepared canal[2,10]. Some laboratory studies have shown a significant increase in post retention with resin cement[3,6,13].

This paper describes a treatment alternative for extensively damaged tooth using polyethylene fibre ribbon reinforced composite resin as post-core build-up.

Technical Report

Clinical and radiographic examinations of a 21-year-old male patient revealed a root canal treatment due to the fracture of the maxillary right central incisor, which was restored with composite resin filling materials 4 years ago. The discolouration and secondary caries of the related tooth was not satisfactory for the patient (Fig. 1). Polyethylene fibre ribbon reinforced composite resin as post-core build-up and Empress II crown were planned as treatment options to the patient for replacement of the extensively damaged tooth. The construction of polyethylene fibre ribbon reinforced post-core restoration is not time consuming and provides tooth coloured aesthetic substructure for a complete porcelain crown, which will satisfy aesthetic requirements of the patient.

Figure 1. Initial view of teeth

Polyethylene Fibre Ribbon as Post Material

The root canal filling was removed to the apical third by using gates glidden and washed with 5% sodium hypochlorite (Fig. 2A and B). After drying procedure with paper points, 37% phosphoric acid was used to etch the root canal wall and remaining tooth surface for 15 seconds, and washed thoroughly for 30 seconds (Fig. 3). Retraction cord (Stay-put; Roeko, Germany) was used to isolate sub-gingival finish line after anaesthesia. Resin cement (Variolink; Ivoclar Vivadent, Liechtenstein) was used for luting polyethylene fibre ribbon. Syntac primer (Ivoclar Vivadent), Syntac Adhesive (Ivoclar Vivadent) and Heliobond (Ivoclar Vivadent) were applied to dentine separately in accordance with the manufacturer's directions. A piece of fibre ribbon (Kerr Connect Reinforcement Ribbon; Kerr Corp, Orange, CA), 3 mm width and 5-6 mm longer than the prepared root canal length (Fig.4), was cut off and embedded in mixed Variolink resin cement (Variolink; Ivoclar Vivadent).

Figure 2A. Remaining tooth structure, after removal of composite resin restoration and caries

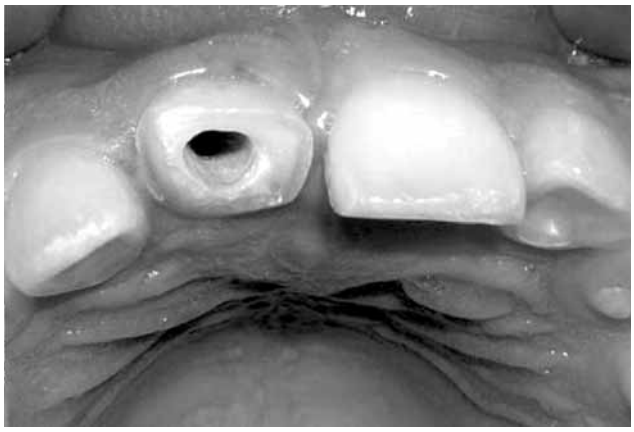

Figure 2 B. Root canal ready for polyethylene fibre ribbon reinforced composite resin post-core restoration

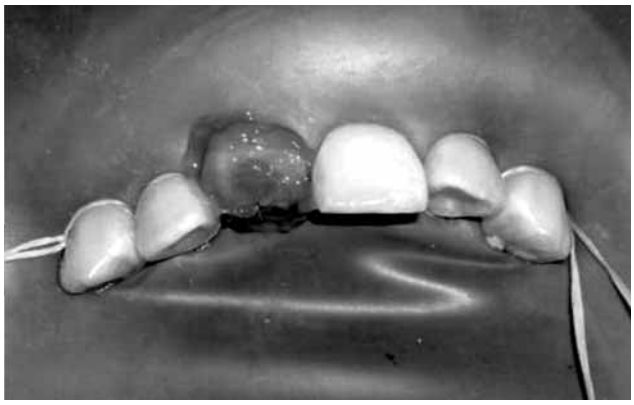

Figure 3. Total etch of the root canal

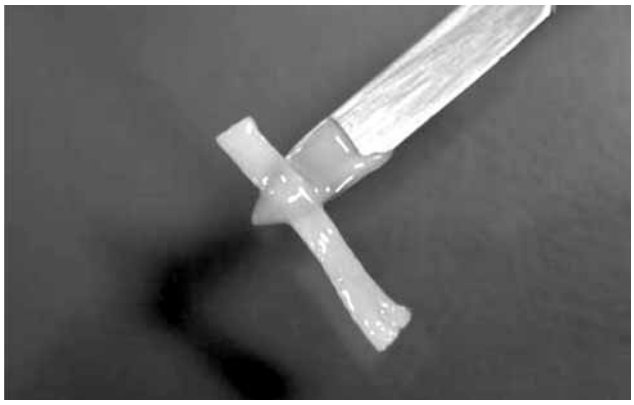

Figure 4. Polyethylene fibre ribbon embedded in resin cement (Variolink II)

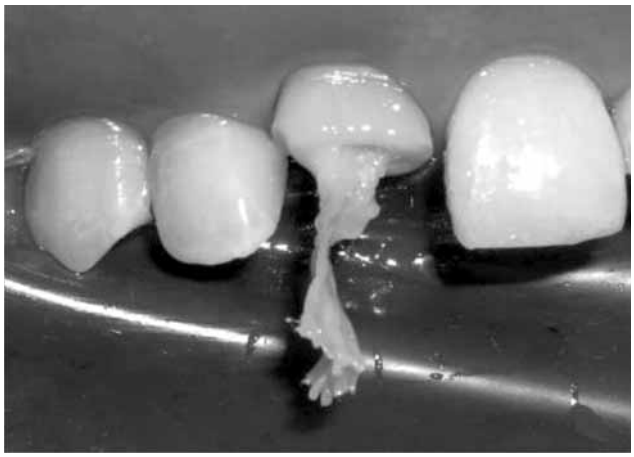

Figure 5A. Insertion of polyethylene fibre ribbon into the resin cement filled tooth canal

Figure 5B. Forming loop by insertion of free end of fibre ribbon into root canal

Figure 6. Construction of composite resin (Tetric-Ceram) core

The root canal was filled with resin cement. Fibre-resin combination was carefully placed into the canal by use of titanium nitride coated instruments (Brilliant Esthetic Line Composite Instrument, Coltène AG, Switzerland), leaving a loop formed 2-3 mm ribbon above the occlusal surface of the root (Fig. 5A and B). The combined fibre ribbon and luting resin was light cured for 40 sec (Optilux; Demetron Inc, Danbury, Conn). Exposed ribbon loop was then filled and covered with composite resin (Tetric Ceram, Ivoclar Vivadent) incrementally for fabricating core, and light cured for 40 sec from one surface, total of 160 seconds (Fig. 6) .

Core Preparation

The core preparation was completed with circumferential deep chamfer finish line (Fig. 7). Medium and coarse diamond burs (Accurata, G+K Mahnhardt Dental, Germany) were used for tooth preparations. The width of the shoulder was kept 1 ~ 1.2 mm. Cervical margin was placed 0.5 mm sub-gingivally to increase the length of preparation as well as aesthetic improvement of the final restoration. Sharp edges or irregularities were corrected to minimize stress concentration. Complete arch impression was made with a silicon impression material (Speedex; Coltene AG, Switzerland) and chair side provisional crown (Dentalon Plus; Heraeus Kulzer, Germany) was constructed. Empress II full ceramic crown (Empress II; Ivoclar, Vivadent) was fabricated. The complete seating, marginal adaptation, aesthetic appearance of crown and occlusion was checked at the first try-in. Any premature contacts of centric occlusion position and /or the lateral and anterior movements were eliminated.

Empress II Crown Cementation Procedure

The internal surface of the crown was etched with 5% hydrofluoric acid gel (IPS ceramic etching gel; Ivoclar, Vivadent) for 20 sec. A silane coupling agent (Monobond-S; Ivoclar, Vivadent) was applied for 60 sec. The preparation was cleaned with pumice slurry and retraction cord was applied. The core surfaces and remaining tooth surfaces were etched with 37% phosphoric acid (Total Etch; Ivoclar, Vivadent) for 60 seconds. Tooth was rinsed with water and dried. Following the manufacturer's guidelines, Syntac Primer and Syntac Adhesive were applied. The bonding agent was brushed on both preparation surfaces and internal surface of the restoration, thinned with air, and cementation was performed immediately by using Variolink II high viscosity resin cement. Excess cement was removed with brush and dental floss. The restoration was photo-polymerized for 40 sec. from all surfaces, total of 200 seconds. The occlusion was controlled to preclude premature contacts (Fig. 8).

Figure 7. Final preparation for full ceramic restoration

Figure 8. Full porcelain in-situ

After cementation of Empress II crown, routine recall visits were performed 4 times over a 1-year period. The evaluation of the polyethylene fibre ribbon reinforced composite resin as post-core build-up at these visits was made with radiographic examination. In each recall, radiograph was taken from the restored tooth with the standardized long-cone technique. No differences were observed between the initial and recall radiographs. The outcome was successful. Additionally, no functional or aesthetic problems were reported by the patient.

Discussion

The purpose of a post and core is to reinforce the remaining coronal tooth structure and to replace missing

coronal tooth structure[9]. Due to the shearing forces that act on anterior tooth, anterior endodontically treated teeth are restored with posts more often than posterior teeth[8]. The metallic colour of metal posts leads to a greyish discoloration of the root and consequently of the gingiva. This may be an enormous aesthetic disadvantage in the anterior teeth[5] and cosmetic concern has led to development of aesthetic posts[7]. The use of polyethylene fibre ribbon reinforced composite resin as a post-core restoration material satisfied the aesthetic demands beneath all ceramic restorations and also provided a level of strength to composite core material replacing the lost tooth structure.

Dental cement lute the post to radicular dentin and some properties of cements, such as compressive strength, tensile strength and adhesion, are commonly described as predictors for success of a cemented post[8]. Cement provides important retention to the post and core; however, no cement can compensate for a poorly designed post[7]. Mendoza et al[6] showed that resin cements give additional resistance to fracture compared to brittle, nonbonding zinc phosphate cement, and reported that resin luting agents are technique-sensitive and difficult to manipulate. In the presented study, before the cementation procedure, the canal was washed off and dried after the etching procedure, ensuring that the post space was free of any residue[4]. The root canal was filled with resin cement by using lentulospiral[10] and polyethylene fibre ribbon embedded to the resin cement was placed to the prepared root canal.

Silver amalgam, composite and glass-ionomer are 3 basic direct core materials[8]. Kovarik[5] evaluated different core materials under simulated chewing conditions and concluded that amalgam core build-ups with metal posts had a significantly higher resistance to chewing forces when compared to metal post-composite resin build-ups. In the present study, since exposed ribbon loop was filled and covered with composite resin incrementally, fibre-resin combination with 2-3 mm loop provided adequate retention and resistance for the core material clinically.

The technique presented in this paper is a chair-side procedure, and allows direct core build-up. Therein with one visit for the patient, the dentist can fabricate post-core, complete the crown preparation and make a final impression for the restoration. Since the endodontic enlargement is enough and since there is no need for extra preparation in the canal for the polyethylene ribbon, the preservation of residual dentin is possible with this technique. Therefore, the risk of root perforation can be eliminated and the remaining root dentin to resist fracture is optimized. However, a significant challenge with this technique is the handling of the polyethylene fibre ribbon during embedment of the resin cement. Titanium nitride coated instruments can be used for better handling of ribbon and resin cement combination.

Sirimai et al[12] reported that the polyethylene fibre ribbon was effective in reducing the incidence of vertical root fractures and the failure thresholds were significantly lower than that of conventional cast posts. In this clinical application, the aesthetic goal was achieved and there was functional success over 1 year period. Long-term clinical performance of polyethylene fibre ribbon reinforced composite resin as post-core build-up needs to be evaluated.

In summary, the polyethylene fibre ribbon can be used safely with composite resin for post-core build-up restorations for endodontically treated teeth. The translucent quality of fibre ribbon and composite resin enables complete porcelain crowns to be fabricated without compromising aesthetics.

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Correspondence and request for offprints to:

Dr. Hasan N. Alkumru
Marmara University
Faculty of Denistry
Buyukcftlik Sok. No:6
34365 Nisantasi, Istanbul
Turkey
E-mail: halkumru@superonline.com