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Original article

Fracture resistance of endodontically treated teeth restored with short fiber composite used as a core material—An in vitro study

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ABSTRACT

Purpose: This in-vitro study tested the fracture resistance of endodontically treated molars with Mesial-Occluso-Distal (MOD) cavities restored with fibre reinforced composite material everX posterior in comparision with hybrid composite and ribbond fiber composite.

Materials and methods: Fifty intact freshly extracted human mandibular first molars were collected and were randomly divided into five groups (n=10). Group 1: positive control (PC) intact teeth without any endodontic preparation. In groups 2 through 6 after endodontic procedure standard MOD cavities were prepared and restored with their respective core materials as follows: group 2, negative control (NC) left unrestored or temporary flling was applied. Group 3, Hybrid composite (HC) as a core material (Te-Econom Plus Ivoclar Vivadent Asia) group 4, Ribbond (Ribbond; Seattle, WA, USA)+conventional composite resin (RCR) group 5, everX posterior (everX Posterior GC EUROPE)+conventional composite resin (EXP) after thermocycling fracture resistance for the samples were tested using universal testing machine. The results were analysed using ANOVA and Tukey's HSD post hoc tests.

Results: Mean fracture resistance (in Newton, N) was group 1: 1568.4±221.71N, group 2: 891.0 ±50.107N, group 3: 1418.3±168.71N, group 4:1716.7±199.51N and group 5: 1994.8 ±254.195N.

Conclusion: Among the materials tested, endodontically treated teeth restored with everX posterior fiber reinforced composite showed superior fracture resistance.

1. Introduction

Endodontically treated teeth are structurally weakened due to loss of physical characteristics like loss of tooth structure, cusps, ridges and the arched roof of the pulp chamber [1]. This structural loss is often a result of caries, trauma, access cavity preparation and radicular preparation [2]. Certain iatrogenic factors like effect of chemicals and intracanal medicaments,

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Table 1 – Composition of the materials testes in the study.

S. no	Materials tested	Specification of the material
1.	Hybrid composite (Te-Econom Plus ivoclar Vivadent Asia) LOT: U33179	bis-GMA, bis-EMA, UDMA, silica 78.5 wt%
2.	everX posterior (everX posterior GC EUROPE) LOT:1407081	Short E-glass fiber with barium galss fillers, bi-GMA, TEGDMA and PMMA
3.	Ribbond (Ribbond; Seattle, WA, USA) LOT: 9560	Leno Weave Ultra High Modulus polyethylene fiber ribbon.

bis-GMA: bisphenol-A-glycidyldimethacrylate; TEGDMA: triethylene glycol dimethacrylate; PMMA:polymethylmethacrylate; bis-EMA: Ethoxylatedbisphenol-A-dimethacrylate; wt%: weight percentage.

non-iatrogenic factors like history of recurrent pathology, anatomical position of the teeth and effect of ageing on the dentinal tissues can also result in fracture of endodontically treated teeth [2]. Studies have shown that endodontically treated teeth have reduced level of proprioception [3,4] and hence impaired normal protective reflex. Long term survivability of root canal treated teeth not only depends on the success of the endodontic treatment but also on the amount of remaining dentine thickness and post endodontic restoration [5].

Restoring endodontically treated teeth with appropriate material, capable to resist fracture is an important factor to be considered during post endodontic restoration. With the development and advancements of dentin bonding systems and increased strength of the newer fibre reinforced composite materials, these structurally and chemically weakened teeth could be reinforced. Eskitascioglu et al., reported that endodontically treated teeth are susceptible to fracture and this can be prevented by using fiber reinforced composite materials [6]. Belli et al., placed polyethylene fiber ribbon in the bed of flowable resin to reinforce tooth structure and concluded that placement of fiber under composite restoration significantly increased the fracture strength of enodontically treated teeth [7].

When fibres like polyethylene and glass are used, they act not only as a stress reliever in composite resins [8] but also show increased resistance to fracture and flexural modulus [9,10].

Recently e-glass fibre with barium glass filler fiber reinforced composite material everX posterior has been introduced. Manufacturers claims that this short-fiber composite reinforces the restoration by preventing crack formation which is the main cause for failure of the post endo restoration.

Mechanical properties of polyethylene fiber [10,7,11] and everX posterior [12–16] have been reported in literature, but the evidence on fracture resistance of everX posterior, when used as a core material in an appropriate tooth model has not yet been studied. Hence the aim of this study is to compare fracture resistance of an endodontically treated molars with MOD cavities restored with fibre reinforced composite material everX posterior in comparision with Hybrid composite and polyethylene ribbond Fiber composite in a tooth model replicating the clinical scenario.

2. Materials and methods

Fifty intact freshly extracted human mandibular first molars of similar dimensions with complete root formation were collected from the department of Oral and Maxillo-facial surgery of our institution. All the teeth were extracted due to periodontal reasons and were caries free and without any previous restorations, pre-existing fractures or cracks when observed under maginification & transillumination. Any calculus and soft tissues deposits were removed from the teeth using a hand scaler, rinsed in water and stored in physiological saline. To avoid size discrepency of the tooth, small and large teeth were excluded and then randomly divided. All the teeth were used within one month from the time of extraction.

2.1. *Preparation of base*

To mimic or reproduce the alveolar bone and periodontal ligament, root surfaces of all the teeth were dipped in molten wax to 1 mm apical to the cement-enamel junction (CEJ) which resulted in formation of about 0.2–0.3 mm thick wax layer. Custom made molds of standard size of 5.1 × 5.1 cm were prepared for mounting the samples. Self-curing polymethylmethacrylate resin mixed in porcelain jar and poured in to the mold. All the samples were embedded vertically into the mold to a level 1 mm apical to the CEJ. The teeth samples were removed from the resin block after the resin had set and wax was eliminated from the samples and the base. Elastomeric impression material was loaded in the mold cavity and the sample was re-seated in position. The extruded flash paste was trimmed with a no.15 scalpel blade.

The samples were randomly divided into 5 groups (n = 10) (Table 1):

Group 1: positive control (PC) intact teeth without any endodontic preparation.

Groups 2–5 after Endodontic procedure MOD cavities were prepared and divided accordingly.

Group 2: negative control (NC) left unrestored or temporary filling was applied.

Group 3: Hybrid composite (HC) as a core material (Te-Econom Plus ivoclar Vivadent Asia).

Group 4: Ribbond (Ribbond; Seattle, WA, USA) + conventional composite resin (RCR).

Group 5: everX posterior (everX Posterior GC EUROPE) + conventional composite resin (EXP).

2.2. *Endodontic procedure (Groups 2–5)*

Standard endodontic access cavities were prepared in 40 teeth using high speed airotor hand piece (NSK Nakanishi Inc Japan) with coolant, No: 2 Endodontic aceess bur (Dentsply DeTrey; Konstanz, Germany) later access cavity was refined using

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