IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 24, Issue 9 Ser. 2 (September. 2025), PP 28-30
www.iosrjournals.org

Clinical Evaluation Of Fibre-Reinforced Composite Restorations

Ruchi Gupta, Asit Vats, Th Sujata Devi

Professor, Dept Of Conservative Dentistry And Endodontics, Divya Jyoti College Of Dental Sciences And Research, Modinagar, Ghaziabad
Professor And Head, Dept Of Conservative Dentistry And Endodontics, Divya Jyoti College Of Dental Sciences And Research, Modinagar, Ghaziabad
PG Student, Dept Of Conservative Dentistry And Endodontics, Divya Jyoti College Of Dental Sciences And Research, Modinagar, Ghaziabad

Abstract
Leno weaved ultra-high-molecular-weight polyethylene continuous fiber ribbon systems are developed to enhance the toughness of composite resins, increasing their durability and damage tolerance. No additional preparation is required and these continuous fibers can be adapted in close approximation to the sound tooth substance. Multiple directional yarns and mesh-like nodal intersections in these continuous fibers lead to multiple load paths that redistribute the masticatory forces over a larger bed of composite restoration.This article compared clinical outcome of fiber reinforced composite restorations.After the reinforcing material was inserted, the resin composites was deposited on the cavity's bottom. Large composite restorations were strengthened by the fiber inserts. Inserting polyethylene fiber inserts in Class II composite restorations significantly increases clinical outcome. Furthermore, the horizontal orientation of fiber on both pulpal and gingival floor of wide class II MOD cavities gives the best performance.
Keywords: *Composite, Restoration, Fiber, Orientation, Esthetics*

Date of Submission: 02-09-2025 Date of Acceptance: 12-09-2025

I. Introduction

An ideal restoration in a tooth should be able to maintain the esthetics, function and preserve the remaining tooth structure and prevent microleakage. Besides many significant material improvements restorative composite still suffers lack of mechanical properties and problems related to polymerization shrinkage. Clinical studies have shown that direct fillings fail predominantly because of occlusal wear or secondary caries. However, fracture of restorative composite is reported also as a common reason for replacement.[1] Due to the failures of this kind, it is still controversial, whether restorative composites should be used in large high-stress bearing applications such as in direct posterior restorations. In class II cavity, there is loss of the proximal and marginal ridge. This causes the tooth stiffness to reduce significantly by 2.5-fold, resulting in an overall 46% reduction of tooth stiffness. Therefore, restoration material with high fracture resistance is highly recommended in cases where it is subjected to heavy load as in cases of class II.[2-4]

Dental fiber-reinforced composites (FRCs) have been studied and developed since the 1960, although breakthroughs in the research happened in the early 1990s. Manmade high aspect ratio fillers of fibers have been used since ancient times to reinforce bricks and buildings. Modern FRCs have diverse applications such as the airspace industry, sport industry, and car industry, where high static and dynamic strength and fracture toughness, especially in relation to weight, are desired properties. [5-7] Dental and medical devices are typically subjected to repeated loading cycles by the masticatory system or by the weight of the body during physical exercise. Of the many types of fibers available (various glass, carbon/graphite [G/F], polyethylene, and aramid) clinically, the most durable and suitable have proved to be E-glass fibers which can be silanized and adhered to the resin matrix of the FRC. [8-10] The other mentioned fibers cannot be silanized due to their chemical inertness. Glass fibers vary according to their composition and most commonly used fibers are E-glass and S-glass, which are chemically stable and durable in the pH environment. The basis of glass fillers and glass fibers is silica (silicon dioxide), SiO_2, which in its pure form, is an inorganic polymer (SiO_2). Interestingly, silica has no true melting point but softens at 2000°C, where it also starts to degrade. E-glass composition is alumina-borosilicate with <1 wt% alkali oxide.[11]Attempts to use ultrahigh molecular weight polyethylene fibers (UHMWP) have also been made, but there are problems in bonding the fibers to the resin matrix because these fibers are chemically too inert. In addition, bacterial accumulation to the reinforced composite limits the use of fibers clinically. The strength and rigidity of the dental construction made from FRC are dependent on the polymer matrix of the FRC and the type of fiber reinforcement. FRCs are typically designed to have the highest possible reinforcing efficiency against the direction of stress, and with this in mind, they represent anisotropic material in terms of their mechanical properties.[12-14] Additionally, some other clinically important properties such as optical, surface, chemical, and physical, thermal, and polymerization contraction are related to the direction and alignment of fibers in the FRC. The structural designs of elements in natural materials are to a large extent based on fibrous materials. Fibrous materials provide high tensile strength to the structure, typically in the direction of the fibers. The engineering sciences have successfully used reinforcing fiber systems, which have their structural origins in tissues like bone and dentine or wood.[15] Engineers weave the synthetic reinforcing fibers into fabrics in order to reinforce construction in multiple directions. The dental treatment approach, which beneficially utilizes the versatile properties of FRCs, is called the "dynamic treatment approach," where the restorative and prosthetic treatment starts with minimal intervention. This article compared clinical outcome of fiber reinforced composite restorations.

II. Methodology

Patients irrespective of age & sex with proximal restoration were included. With a 245 carbide bur, a high-speed airotor was used for tooth preparation. Caries lesions or the dimension of the restorations that has to be replaced defined the cavity's shape; no bevel preparations was done. Dental caries excavation was being carried out manually using hand tools or with slow-moving round burs. A suction apparatus, cotton rolls, and rubber dam was used to isolate the working field. Cavity etching was performed using a 35% phosphoric acid gel for 20 seconds on the enamel and then 10 seconds on the dentin. The cavity walls was brushed with an adhesive bonding technique after being thoroughly cleaned with water and dried with air. After the reinforcing material is inserted, the resin composites was deposited on the cavity's bottom. Large composite restorations were strengthened by the fiber inserts in the following positions.

GROUP 1- Three everstik fiber pieces was cut almost 1 mm less than the bucco-lingual dimension, impregnated with resin and placed directly on gingival and pulpal floor against tooth substrate secured with composite and light-cured for 40 s.

GROUP 2-Restoration was done similar to Group 1 except that the everstick fiber was placed horizontally only on the pulpal floor.

GROUP3-Restoration was done similar to Group 1 except that the everstick fiber was placed vertically.

GROUP 4-Restoration was done similar to Group 1 except that the everstick fiber was cut into small chips.

The manufacturer's guidelines were followed for light curing. In the isolated operating environment, resin has to be allowed to dry for a minimum of one minute. Articulating paper was used to precisely adjust occlusion. Following occlusal adjustment, finishing and polishing operations was performed during the same appointment. Following completion, polishing took place. Discs and burs made of fine grid diamond were used to complete restorations. Clinical evaluation of restorations was done.

III. Results

Fiber placement significantly improved the restoration. Horizontal orientation of polyethylene fiber on both pulpal and gingival floor of MOD cavities gives the best results. The clinical performance was best with fiber placement placed in different orientation in horizontal on pulpal and gingival floor followed by horizontally only on pulpal floor, vertically on both gingival and pulpal floor, small chips.

IV. Discussions

Everstick glass fiber reinforcements have been developed to provide solutions for modern, patient-friendly dentistry. EverStick fiber reinforcements are made of silanated glass fibers in thermoplastic polymer and light curing resin matrix. This products address the advantages of minimally invasive dentistry where the patient´s own healthy tooth tissue is saved for as long as clinically possible. Great bond strength is the best future of Everstick GC fuse reinforcement maretial.

Leno weaved ultra-high-molecular-weight polyethylene continuous fiber ribbon systems are developed to enhance the toughness of composite resins, increasing their durability and damage tolerance. No additional preparation is required and these continuous fibers can be adapted in close approximation to the sound tooth substance. Multiple directional yarns and mesh-like nodal intersections in these continuous fibers lead to multiple load paths that redistribute the masticatory forces over a larger bed of composite restoration.These polyethylene fibers alter interfacial stresses due to higher elastic modulous and lower flexural modulus. A fail-safe mechanism was reported by Sengun *et al.* for fiber-reinforced restorations, whereby catastrophic failures are avoided as fractures occur upwards of cementoenamel junction (CEJ), ensuring the restorability of the remaining tooth structure. Placement of the fiber against the cavity walls strategically can lead to proper stress distribution and energy absorption, leading to avoidance of failure in large class II cavities.

Clinically, placement of fibers might be cumbersome, technique sensitive, and time-consuming procedure. This led to the development of preincorporated fiber-reinforced composite Ever X. Ever X posterior composite consists of short E-glass fibers and filler in form of barium glass, whereby the length of preincorporated glass fiber is 1–2 mm. These short-fiber helps in stopping the crack progression same as the function of dentine. Ever X is used as a dentine replacement composite and has to be covered proximally and occlusally with conventional composite as enamel coverage to avoid the roughness of fibers on the external surface and better finishing and polishing.

The results showing best performance for (fiber placed horizontally both on the pulpal and gingival floor), may be due to the following reasons: Coverage of larger surface area (pulpal + gingival) by fiber placed horizontal, so increase capacity to bear the forces and dissipation of forces equally over the large surface area, As they are not cut (Chopped) as in other groups so leno– weave continuous structure of everstick fiber is maintained, which might have increased fracture resistance, Increase quantity of fibers and adequate adaptation to the gingival floor, reduce shrinkage stress occurring during polymerization of composite resin, Fibers increase the strength of restoration if the longitudinal axis of fibers is perpendicular to the compressive forces but, if the longitudinal axis of fibers is parallel, it leads to matrix failure and no enhancement in strength.

Within the limitations of the study, it can be advocated that inserting polyethylene fiber inserts in Class II composite restorations significantly increases clinical outcome. Furthermore, the horizontal orientation of fiber on both pulpal and gingival floor of wide class II MOD cavities gives the best performance.

Bibliography

[1]. Wilson MA, Cowan AJ, Randall RC, Crisp RJ, Wilson NHF. A Practice-Based, Randomized, Controlled Clinical Trial Of A New Resin Composite Restorative: One-Year Results. Oper Dent 2002; 27: 423–429.

[2]. Opdam NJ, Loomans BA, Roeters FJ, Bronkhorst EM. Five-Year Clinical Performance Of Posterior Resin Composite Restorations Placed By Dental Students. J Dent 2004; 32(5): 379-383.

[3]. Rodolpho P, Cenci M, Donassollo T, Loguercio A, Demarco F. A Clinical Evaluation Of Posterior Composite Restorations: 17-Year Findings. J Dent 2005; 34: 427–435.

[4]. Garoushi S, Shinya A, Vallittu P. Fiber-Reinforced Onlay Composite Resin Restoration: A Case Report. J Contemp Dent Pract 2009; (10)4: 104-110.

[5]. Garoushi S, Tanner J, Vallittu PK, Lassila L. Preliminary Clinical Evaluation Of Short Fiber-Reinforced Composite Resin In Posterior Teeth: 12-Months Report. Oper Dent J 2012; 6: 41-45.

[6]. Pallesen A, Dijken V,Halken J, Hallonsten A, Hoigaard R. Longevity Of Posterior Resin Composite Restorations In Permanent Teeth In Public Dental Health Service: A Prospective 8 Years Follow Up. J Dent 2012; 41: 297-306.

[7]. Kalburge V, Yakub SS, Kalburge J, Hiremath H, Chandurkar A. A Comparative Evaluation Of Fracture Resistance Of Endodontically Treated Teeth, With Variable Marginal Ridge Thicknesses, Restored With Composite Resin And Composite Resin Reinforced With Ribbond: An In Vitro Study. Ind J Dent Res 2013; 24(2): 193-198.

[8]. Garoushi S, Säilynojac E, Vallittua PK, Lassila L. Physical Properties And Depth Of Cure Of A New Short Fiber Reinforced Composite. Dent Mater 2013; 835-841.

[9]. Maryeapen A, Amirtharaj V, Sanjeev K. Fracture Resistance Of Endodontically Treated Teeth Restored With 2 Different Fiber-Reinforced Composite And 2 Conventional Composite Resin Core Buildup Materials: An *In Vitro Study*. J Endod 2017; 43: 1499-1504.

[10]. Tanner J, Tolvanen M, Garoushi S, Säilynoja E. Clinical Evaluation Of Fiber-Reinforced Composite Restorations In Posterior Teeth - Results Of 2.5 Year Follow-Up. Oper Dent 2018; 12: 476-485.

[11]. Hatanto C, Farahanny W, Dennis D. Comparative Evaluation Of Short Fiber-Reinforced Composite Resin Thickness On Fracture Resistance Of Class II Composite Restoration: An In Vitro Study. J Contemp Dent Pract 2020; 21(11): 1201–1204.

[12]. Janani K, Khandelwal A, Ajitha P. Fiber-Reinforced Composite In Dentistry – A Review. Drug Inv Today 2020; 13(6): 1231-1235.

[13]. Shah E, Shetty P, Aggarwal S, Sawant S, Shinde R, Bho R. Effect Of Fibre-Reinforced Composite As A Post-Obturation Restorative Material On Fracture Resistance Of Endodontically Treated Teeth: A Systematic Review. S Dent J 2021; 33: 363-369.

[14]. Misar P, Hiremath H, Harinkhere C, Sonawane S, Sharma V, Rana KS. Reinforcing An Immature Tooth Model Using Three Different Restorative Materials. Dent Res J 2022; 21:19-28.

[15]. Ranka S, Rao AS, Shah U, Solanki, D, Pawar AM, Reda R, Zanza A, Testarelli L. Comparative Evaluation Of Two Different Fiber-Reinforced Composite Materials In Class 1 Post-Endodontic Restorations In Molars—A Randomized Clinical Study. Mater 2022; 15: 1-11.