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RESEARCH ARTICLE

COMPARISON OF FRACTURE RESISTANCE OF CLASS II MOD CAVITIES RESTORED WITH COMPOSITE RESIN WITH OR WITHOUT FIBER INSERTS: AN IN VITRO STUDY

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ABSTRACT

Background: Fiber reinforcement of conventional dental composites is introduced with the aim of enhancing their physical and mechanical properties and increasing their resistance to fracture. **Aim:** To compare the fracture resistance of class II MOD cavities restored with Filtek z350 composite with and without dentapreg fibre inserts on premolars. **Materials and method:** Forty non-carious permanent human maxillary premolar teeth were taken. Class II MOD cavities were prepared and divided into two groups 1) Group 1: teeth with class II MOD cavities restored with Filtek z350 composite using horizontal incremental technique. 2) Group 2: teeth with class II MOD cavities restored with Filtek z350 composite and dentapregfiber inserts using horizontal incremental technique. Then fracture resistance test was done using universal testing machine. Data analysis was done by applying Independent Sample t test. **Results:** Mean Fracture Resistance of teeth in Group II was higher than Mean Fracture Resistance of teeth in Group I ($P < 0.05$). **Conclusion:** Insertion of Dentapregfibers under composite restoration significantly increased the fracture resistance of the restored teeth.

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INTRODUCTION

The loss of tooth structure can occur due to decay or trauma and which is the main reason for the need for restorations (Farahanny *et al.,* 2019) Among different restorative materials, Composite have revolutionized restorative dentistry due to their conservative technique, adhesive bond to natural tissues and their adequacy for aesthetic refurbishment (Călburean *et al.,* 2014) Composite Resin have become a routine procedure for Class I, Class II lesions and widely used in posterior teeth since the 1960s (Taha, 2011). The fracture resistance of posterior teeth has been greatly improved after the introduction of resin composites because it has the ability to strengthen the remaining dental tissue as a result of bonding to the tooth structure (Siso, 2007). So, it has been shown that composite materials are preferred in the situation of MOD cavities restorations also (Hamouda, 2011). MOD class II cavity is a cavity affecting mesial, occlusal, and distal surfaces of a tooth.[1] In these cavity preparations, the fracture resistance decreases both by reducing the dental tissue as much as by the loss of the enamel margins (Bhardwaj, 2002). Class II MOD cavity particularly in maxillary premolar creates a specific challenge for the restorative material in terms of longevity and fracture resistance (Valian, 2015). Dental composites have also shown some disadvantages like relatively increased brittleness and decreased fracture strength in stress-bearing posterior restorations like in class II MOD cavities (Garoushi, 2012).

Therefore, a restorative material having capability to resist great occlusal load and prevent fracture is needed for posterior teeth (Farahanny *et al.,* 2019). The introduction of fibers in composite resin has brought about a distinctive class of materials in the armamentarium of restorative dentistry (Khan, 2018). These fibers were incorporated into the composite resin material for their reinforcing effect (AlJehani *et al*., 2016). The various attributes of the fiber reinforced composite (FRC) include increase in flexural modulus and fracture resistance (Vallittu, 1998), stress relievers (Belli *et al*., 2006) and resistance to crack propagation (Meiers and Freilich, 2001). The insertion of a fiber sub-structure under composite resin have demonstrated superior characteristics when placed (Khan, 2013). Currently, various types of fiber having different architecture and composition are commercially available. The mechanical properties of these FRC are dependent upon fibertype, ratio of fiber to matrix resin, fiber architecture and quality of impregnation of fiber and resin (Soares *et al*., 2008). Dentapreg® UFM is a recently introduced braided glass fibres pre-impregnated with light curing resin. It is available as sticky strip of fibers packed in a light safe black protective blister covered with thin aluminium foil. It is manufactured using modified aerospace technology to produce thin pliable light curing prefabricated strips of different cross-section in which strong and rigid specially treated aerospace grade fibers are inserted in a dental resin used in many filling composites.[16] However, there are no studies which evaluated the effectiveness of these glass fibers substructure under composite resin. So, aim of the study is to Compare the Fracture Resistance of Maxillary Premolars with Class II MOD Cavities Restored with Filtek Z350 Composite Resin with And Without Dentapreg Fibers.

MATERIAL AND METHODOLOGY

Sample Criteria: This study was a laboratory experiment using only control group design. Study samples consisted of 40 upper first and second premolars. The selection criteria were fresh intact individual human upper premolars that were extracted for orthodontic purpose or because of mobility. The exclusion criteria were premolars with caries, restoration, and crack.

Sample Preparation: A total of 40 freshly extracted upper premolars were cleaned with a scaler and stored in saline solution until use. Samples were mounted on gypsum blocks for preparation and restoration procedures.

Cavity preparation: Class II MOD cavities were prepared using round diamond and straight fissure bur. The occlusal preparation was 2-mm deep, with a width of one-third the intercuspal distance. The facial and lingual walls were prepared parallel to each other, with a 90-degree cavosurface angle. The proximal boxes were one-third the buccolingual distance and 1.5 mm deep axially. The cervical wall was 1 mm coronal to the CEJ. Cavity dimensions were measured with a digital caliper (Taha *et al.,* 2011). Samples were randomly divided into following 2 groups of 20 teeth each according to the type of restoration material used. Group I: class II MOD cavities restored using Filtek z350 composite without fibre. Group II: class II MOD cavities restored using Filtek z350 composite with dentapregfiber.

Restoration: After the application of tofflemire matrix system, the prepared cavities were acid etched using 37% phosphoric acid for 15 seconds and then rinsed with water and air dried. Afterward, the prepared cavity surfaces were saturated with a GC Premio bonding agent for 10 seconds using a microbrush and gently air-dried. An LED light curing unit was used for the polymerization process for 20 seconds. In group 1, teeth were restored with Filtek z350 composite using horizontal incremental technique. In group 2, The cavity surfaces were then coated with a layer of flowable resin composite. Dentapreg fibre was removed from the package using cotton pliers. A piece of the fiber was cut. The fiber was subsequently coated with adhesive resin. Excess material was blotted off with lintfree gauze. Then the fiber was embedded inside the flowable composite on the floor of the cavities. After light curing for 20 seconds, these cavities were restored with Flitek z350 composite using horizontal incremental technique (Chandrasekhar, 2017).

Finishing and Polishing: Specimens were finished using fine finishing diamond bur to remove excess composites and then polished with a silicone bur.

Water Storage and Thermocycling: All the restored specimens were freed from the gypsum blocks and then stored in a container filled with saline solution for 24 hours and thermocycled for 500 cycles at 5°C and 55°C with a dwell time of 20 seconds and a transfer time of 5 seconds.[1]

Sample Fixation and Fracture resistance Test: Self-cured acrylic resin in a cylinder mold was used to fix each tooth up to 2.0 mm below the cemento-enamel junction. Afterward, the samples were subjected to compressive load with a 5 mm diameter stainless steel bar centered on the tooth at a cross-head speed of 1 mm/minute using Universal Testing Machine. The test machine's software recorded the peak-loaded fracture in newtons (N) for each sample and tabulated.

STATISTICAL ANALYSIS

The obtained data was compiled systematically and presented as individual tables on a Microsoft USA Excel Worksheet 2016. Statistical analysis was performed at 95% confidence interval with Statistical Package for Social Sciences (IBM SPSS Statistic for window, version 21.0. Armonk, NY: IBM Corp.). Shapiro-Wilk test for Normality was applied to check for normal distribution of the data. Data comparison was done by applying Independent Sample t test to find out the statistical significance of the results.

RESULTS

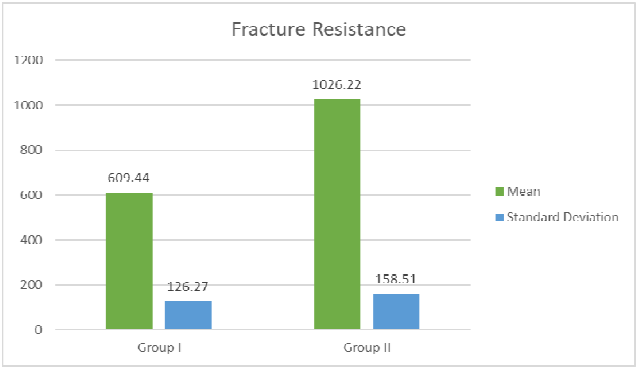
The Fracture Resistance values of Mean ± Std deviation in both Groups were represented in Table no.1 and Graph no. 1. Mean Fracture Resistance of teeth in Group II was higher (table 1) than Mean Fracture Resistance of teeth in Group I (table 1). Results showed statistically significant difference between Group I and Group II (Table 1).

Table 1. Comparison of Mean Fracture Resistance (Newtons) of teeth with class II MOD cavities in Group I and Group II

Groups	N	Minimum	Maximum	Mean ± Std. Deviation	t value	p value
Group I	20	399.84	812.5	609.44 ± 126.27	-9.197	0.001
Group II	20	838.88	1308.3	1026.22 ± 158.51		

DISCUSSION

In the present study, we have selected maxillary premolars with class II MOD cavities because maxillary premolars, have an anatomic shape that makes them more susceptible to cuspal fractures under occlusal load in the mastication process and also MOD cavities are highly susceptible to fracture as the missing mesial and distal walls puts severe strain on the remaining tooth structure.



Graph 1. Mean Fracture Resistance and Std deviation of teeth with class II MOD cavities in Group I and Group II

FRC is essentially a fiber embedded polymer matrix system which was introduced to overcome the shortcomings of conventional composite resin like brittleness and ease of crack propagation and polymerization shrinkage.[9] Many fiber types and architectures are available for clinical use to reinforce dental composites. Among them, ultrahigh molecular weight polyethylene fibers (UHMWPE) and glass fibers have a wide application in dentistry (Strassler, 2008). Foek *et al*. (2009) found that resin adhesion to polyethylene reinforced composites was less favorable because of the difficulty in plasma coating, silanization and impregnation of the polyethylene fibers (Foek, 2013). Vallittu *et al*. (1997) using scanning electron microscopy demonstrated good adhesion between glass fiber and matrix but relatively poor adhesion between UHMWPE and matrix resins (Vallittu, 1997). Glass fibers are used in different forms to strengthen dental composites; most common being the E glass and S glass. The composition of E glass system is calcium–aluminium–borosilicate fiber. There are different types of polymer networks among the fiber reinforced composites such as semi–Interpenetrating Polymer Network and cross-linked polymer systems. These fibers can have different orientation – unidirectional, bidirectional or multidirectional fibers (Khan, 2018). Dentapregfibers are based on the E glass system embedded in Bis-GMA and TEGDMA in a cross-linked polymer matrix. Dentapreg® UFM contain 10,500 ultra-thin flat multidirectional fibers. These dense glass fibre content with minimal matrix layer present in dentapreg fibres improves the strength. This study is in agreement with the study by sumitabhagwat which stated that increase in filler content by the use of fibre inserts which occupy approximately 50% of the prepared cavity might be the reason for increased strength (Bhagwat, 1999). A study by Rocca *et al* in 2013 stated that multidirectional or woven fibers seems more appropriate than unidirectional ones, as in the mouth the restoration is submitted to multidirectional chewing loads (Rocca, 2013). This study is in disagreement with a study by khan *et al* (2018) which stated that FRC structure with continuous unidirectional fiber can express better results compared to reinforcement with other type of fibe. Dentapreg displays a plasma-enhanced chemical vapor deposition (pecv) coating due to which direct bond is formed between monomers and glass fibers. In this study, thermocycling process was done for 500 cycles, which was assumed to be equal to 20–25 days usage in the oral cavity (Vahid, 2016). In this study, the age of the subjects where the samples were acquired was not controlled. This might be due to the difference in enamel rods alignment, which was perpendicular in young age, while in elderly, it was tilted. This difference might influence the result of fracture resistance (de Noronha, 2012). Therefore, taking all above factors into consideration further in vivo investigation is recommended.

CONCLUSION

Within the limits of the laboratory investigation, the results have shown that insertion of Dentapregfibers significantly increased the fracture resistance of the restored teeth.

REFERENCES

Farahanny W, Dennis D, *et al*., 2019. Fracture Resistance of Various Bulk-fill Composite Resins in Class II MOD Cavity on Premolars: An In Vitro Study. *World Journal of Dentistry.,*10(3):166–169.

Călburean F, Gălbinașu BM, Cara-Ilici R, Pătrașcu I., 2014. Fracture Resistance in Fiber Reinforced Composite Restorations–An in Vitro Study. *JMED Research.,* 2014.

Taha DG, Abdel-Samad AA, Mahmoud SH. 2011. Fracture resistance of maxillary premolars with Class II MOD cavities restored with ormocer, nanofilled, and nanoceramic composite restorative systems. Quintessence international. Jul 1;42(7).

Siso Ş, Hürmüzlü F, Turgut M, Altundaşar E, Serper A, Er K. 2007. Fracture resistance of the buccal cusps of root filled maxillary premolar teeth restored with various techniques. *International Endodontic Journal*., 40(3):161-8.

Hamouda IM, Shehata SH. 2011. Fracture resistance of posterior teeth restored with modern restorative materials. *Journal of biomedical research*. Nov 1;25(6):418-24.

Bhardwaj T, Solmon P, Parameswaran A. 2002. Tooth restored with composite resin-a comparative analysis. *Trends in Biomaterials and Artificial Organs.,* 15(2):57-60.

Valian A, Moravej S, *et al*., 2015. Effect of extension and type of composite restored class II cavities on biomehanical properties of teeth: a three-dimensional finite element analysis. *Journal of Dentistry*., 12(2):140–149.

Garoushi S, Tanner J, Vallittu P, Lassila L. 2012. Preliminary clinical evaluation of short fiber-reinforced composite resin in posterior teeth: 12-months report. *The open dentistry journal*. 6:41.

Khan SI, Ramachandran A, Alfadley A, Baskaradoss JK. 2018. Ex vivo fracture resistance of teeth restored with glass and fiber reinforced composite resin. *Journal of the Mechanical Behavior of Biomedical Materials*. Jun 1;82:235-8.

Al Jehani YA, Baskaradoss JK, Geevarghese A, AlShehry MA, Vallittu PK. 2016. Shear bond strength between fiber-reinforced composite and veneering resin composites with various adhesive resin systems. *Journal of Prosthodontics*. Jul;25(5):392-401.

Vallittu PK. 1998. The effect of glass fiber reinforcement on the fracture resistance of a provisional fixed partial denture. *The Journal of prosthetic dentistry*. Feb 1;79(2):125-30.

Belli S, Cobankara FK, Eraslan O, Eskitascioglu G, Karbhari V., 2006. The effect of fiber insertion on fracture resistance of endodontically treated molars with MOD cavity and reattached fractured lingual cusps. Journal of Biomedical Materials Research Part B: Applied Biomaterials: An Official Journal of The Society for Biomaterials, The Japanese Society for Biomaterials, and The Australian Society for *Biomaterials and the Korean Society for Biomaterials.* Oct;79(1):35-41.

Meiers JC, Freilich MA. 2001. Chairside prefabricated fiber-reinforced resin composite fixed partial dentures. *Quintessence International*. Feb 1;32(2).

Khan SI, Anupama R, Deepalakshmi M, Kumar KS. 2013. Effect of two different types of fibers on the fracture resistance of endodontically treated molars restored with composite resin. *The Journal of Adhesive Dentistry*. Apr 1;15(2):167-71.

Soares CJ, Santana FR, Pereira JC, Araujo TS, Menezes MS. 2008. Influence of airborne-particle abrasion on mechanical properties and bond strength of carbon/epoxy and glass/bis-GMA fiber-reinforced resin posts. The Journal of prosthetic dentistry. Jun 1;99(6):444-54.

https://issuu.com/ozonecreative/docs/sua4039_bracon_branded_dentapreg_eb_ddf4a537418aa5

Chandrasekhar V, Rudrapati L, Badami V, Tummala M.. 2017. Incremental techniques in direct composite restoration. Journal of Conservative Dentistry20:386-91.

Strassler HE. 2008. Fiber-reinforcing materials for dental resins. *Inside Dent*., 4(5):2-6.

Foek DL, Yetkiner E, Özcan M. 2013. Fatigue resistance, debonding force, and failure type of fiber-reinforced composite, polyethylene ribbon-reinforced, and braided stainless steel wire lingual retainers in vitro. *The Korean Journal of Orthodontics*. Aug 1;43(4):186-92.

Vallittu PK. 1997. Ultra-high-modulus polyethylene ribbon as reinforcement for denture polymethyl methacrylate: a short communication. *Dental Materials*. Sep 1;13(5-6):381-2.

Bhagwat SA, Bhagwat SV. 1999. An In Vitro Comparison Of The Fracture Resistance Of Class-I Composite Resin Restorations With And Without Glass Ceramic *Inserts. Journal of Conservative Dentistry*. Jul 1;2(3):140.

Rocca GT, Rizcalla N, Krejci I. Fiber-reinforced resin coating for endocrown preparations: a technical report. *Operative dentistry*. 2013;38(3):242-8.

Vahid NA, Mahjunath MK. 2016. Comparation of fracture resistance of maxillary first premolars with class II mesio-occluso-distal (MOD) cavities restored with newer resin based composites-an ex vivo study. *International Journal of Current Research* 2016;8(4):29814–29820.

de Noronha F, Scelza MF, da Silva LE, de Carvalho WR. 2012. Evaluation of compressive strength in the first premolars between young and elderly people: ex vivo study. *Gerodontology*. Jun;29(2):e898-901.

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