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Comparative evaluation of the fracture resistance of three different recent composite systems in large class II MOD cavities: An in vitro study

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***Abstract*---**Background: For severely mutilated teeth, this research evaluated the most contemporary restorative material. Aim: Repair of Class II MOD cavities in premolars with Ever X posterior in the recent past, Beautifil restorative, and the Universal TetricEevoCream composite systems will be evaluated and compared in this research.

"Materials and Methods:" Sixty human maxillary premolars were chosen for the study. As a check, we utilised a group of fifteen healthy teeth (Group 1). The remaining 45 teeth were fitted with MOD cavities of standardised dimensions and randomly assigned to one of three groups (Groups 2, 3, and 4) (n = 15). They used Beautifil restoratives for teeth in Group 2, GC Ever X posterior for teeth in Group 3, Universal Tetric EvoCream for teeth in Group 4. Newtons were used to measure the strength of a material (N). Results: Group 4 exhibited the greatest mean fracture resistance of the four groups, followed by Groups 3, 1, and 2 and finally Group 4. Conclusion: It was found that the Universal Tetric EvoCream composite had the greatest fracture resistance among the test groups. There was a substantial statistical difference between all of the groups.

***Keywords*---**comparative evaluation, fracture resistance, class II MOD.

Introduction

Tooth restoration for severely decayed teeth is one of the most difficult tasks in dentistry. Polymerization shrinkage, microleakage, water sorption, and method sensitivity are just a few of the challenges that researchers are working to solve at the molecular level in their quest to create composites that have better physical and functional qualities. "Improved handling qualities and lower polymerization shrinkage are among the benefits of new materials like fiber-reinforced composites (FRC), bulk-fill composites (BF), and higher filler content composites (HFC)."

Composites that cure in a single step and can be applied in a bulk of 4–5 mm have recently been offered as a time-saving technology. In order to provide a self-leveling effect, bulk fills have a rheological property that makes it easier for them to conform to the cavity walls. In millimetre terms, Eglass fibres and barium glass filler make up the fiber-reinforced Ever X composite in the rear. Dentine-like fibres inside a durable polymer matrix aid to halt the advancement of cracks, making it an ideal material for filling large-sized voids. (MOD). Traditional composite imitating enamel coverage is needed to cover the dentine replacement composite proximally and occlusally.

As a multifunctional giomer composite, In order to reduce shrinkage and stress during the polymerization process, a magnificent bulk-fill restorative (Shofu, Japan) is manufactured by blending different types of fillers with distinct monomers. Because the glass fillers in Beautifil bulk-fill restorative are treated with a higher surface treatment, these materials are both more wettable and more integrated into the matrix. "It is the goal of this research to examine the fracture toughness of current composite materials in severely damaged maxillary premolars with MOD cavities. When doing this research the objective was to establish which restorative material was the most resistant to fracture. No difference in the fracture resistance of undamaged teeth and those that have been repaired with various composite materials will be examined as the null hypothesis in this study"

Materials and Method

Sixty human maxillary premolars were removed for orthodontic purposes from the department of oral and maxillofacial surgery and utilised in the research. IBM® SPSS® 21 SOFTWARE was used to determine the study's power and sample size (IBM, Hong Kong). Removed soft tissue and calculus from all specimens before storing in physiological saline. A complete set of teeth was considered to be one with fully developed apices, unharmed enamel, and healthy dentine. Resorption, prior restorations, and any other anatomical variation were ruled out of the experiment. A set of fifteen healthy teeth was employed as a benchmark for the study (Group 1). For each of the 10 cavities that were produced, replaced by a straight fissure bur (KERR Haw, Canada) in a high-speed water cooled handpiece for the procedure. A periodontal probe was used to confirm the measurements of the pulpal width, gingival width, and buccolingual width, all of which were within 0.2 mm of each other. A 90-degree cavosurface angle was used for the occlusal section. Etching was done for 10 seconds, then the cavities were rinsed and air-dried for 30 seconds using COLTENE Swiss Tec etchant. 3M ESPE Single Bond, Bonding agent was applied with the use of a Dentsply Spectrum curing light, and it was allowed to harden for 20 seconds before being removed. Another composite restoration was done using the Tofflemire matrix band. Finally, teeth (n = 15) were randomised into three groups.

Group 1:
Fifteen intact teeth were used as positive controls.
Group 2:
The Beautifil restorative (Shofu, Japan) was applied in bulk and cured for 30 s without any gradual procedure.
Group 3:
Composite-reinforced GC Ever X is used to repair posterior teeth. Before inserting Ever X posterior into the MOD cavities, a microhybrid Coltene Swiss Tec composite was used to build the walls. This was the situation here. In order to finish the restoration, a microhybrid composite was applied to the occlusal surface.
Group 4:
“Incremental placement and 10 s curing time were used to apply the universal Tetric EvoCeram composite (Ivoclar Vivadent and Liechtenstein) on teeth that had been previously repaired. The composites were placed and cured in accordance with the manufacturer's specifications.”

One thousand and five hundred cycles of thermal cycling were completed using an SD Mechatronik thermocycler in Germany. Each cycle took 30 seconds, and the transfer time was 5 seconds. Incubators (Bioline technology, India) were used to keep the specimens at 37°C and 100% humidity for 24 hours. Up to one millimetre apical to the cement–enamel junction, blocks of 2-inch by 2-inch square cold-cure acrylic resin were employed. Root surfaces were imprinted using elastomeric imprint material, which resembles the periodontal ligament. An Instron India universal testing equipment was used to assess the teeth's fracture resistance. (model 1011). Using a stainless steel ball with a diameter of 5 mm and a strain rate of 2 mm/min, each specimen was compressed loaded. It's important

that the ball touches the inclined planes of the cusps beyond the edges, mimicking the masticatory forces that bend the cusps under stress. IBM SPSS Statistics software was used to compile and analyse the data collected, including the amount of force required to fracture the specimen in Newtons (N).

Results

"This is followed by Group 3's Ever X posterior, Group 1's Intact teeth, and Group 2's Beautifil restorative, which have all had higher mean fracture resistance than the group 4 universal Tetric EvoCeram (Ivoclar Vivadent and Liechtenstein). The one-way ANOVA test showed that there was a statistically significant difference between the groups."

Table 1: Mean fracture resistance in Newton (N) in all four groups

	n	Mean	Standard deviation	Standard error	Lower Bond	Upper bond	Minimum	Maximum
Control	15	1290.4322	237.68575	60.10942	1158.4453	1420.2000	887.00	1677.00
Beautifil restorative	15	950.7767	180.73630	47.43333	850.0776	1047.2568	685.00	1420.00
Ever X Posterior	15	1333.3000	117.78843	120.77843	1076.6648	1577.6649	966.00	2874.00
Universal Tetric EvoCream	15	1440.600	504.26432	128.94229	1154.9015	1722.2985	873.00	2799.00

Table 2: Fracture resistance analysis of variance test

	Sum of squares	Degree of freedom	Mean square	*F*	Sig
Between groups	1989545.932	3	663185.645	4.860	0.005
Within groups	7646654.069	56	136548.379		
Total	9636197.000	59			

Discussion

"The universal Tetric EvoCeram has the greatest mean fracture resistance for large cavities, followed by Ever X Posterior, positive controls, and the Bulk-fill group. Thus, our null hypothesis has been discarded." Excessive force results in a full or partial break in a material, which is referred to as a fracture. Resistance to crack propagation is a key factor in fracture resistance. To reduce the cusp deformation that occurs under masticatory pressure in a dental appliance, composites are used. A composite's varying strength may be attributed to a variety of factors, including variances in matrix chemical composition, filler quantity, filler size, and filler distribution. Compressive strength and surface hardness increase in direct proportion to filler amount and size reduction.

“Physical and handling qualities are improved by increasing filler loading, In addition, new adhesive materials help to seal the margin and increase the repair tooth's retention and robustness. Strong filler loading from nanometric fillers impregnated in nanoclusters leads to high compressive and flexural strength in modern nanofiller technology.” Using a composite to fill all of the tooth preparation at once offers obvious benefits for both the patient and the dentist. Six millimetres is the depth of cure claimed by the bulk-fill manufacturers. Using bulk-fill technology would not only produce less gaps in the mass of the material, but it would also be quicker than adding several increments of material.

The mechanical properties of a composite material are considerably improved when fibres are added into it. There are fibres present that assist limit fracture growth when stress is delivered to the fibres by means of a stress transfer mechanism. It is possible to employ 4 mm posterior implants with E glass fibres of 1–2 mm length impregnated in the nanohybrid composite. For bulk fill composites, 76.5 percent by weight of inorganic filler is used; for Ever X posterior, 53.6 percent by weight; and for Universal Tetric EvoCream, 82% by weight. In the universal Tetric EvoCeram, the maximum filler loading delivers exceptional sturdiness as well as longevity.

It is possible that the mechanical characteristics of the materials and their efficacy might be affected by factors such as inserting or handling them differently in clinical settings than what was done in this study. These premolars were selected because their anatomical form with high cuspal inclines, which causes cuspal separation during mastication, makes them more prone to fractures. MOD cavities were drilled in the teeth because they are regarded to be the most vulnerable to breakage. There was no comparable research that compared bulk-fill composite (Beautiful restorative), Ever X posterior, and universal Tetric EvoCeram, thus the study's findings cannot be corroborated with those of any other studies of the same subject.

Conclusion

Despite the constraints of this investigation, the Universal Tetric EvoCeram is the most resistant to breakage.

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Conflicts of interest - There are no conflicts of interest

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