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RESEARCH ARTICLE

AN IN-VITRO STUDY TO COMPARE AND EVALUATE THE COMPRESSIVE STRENGTH AND MICROLEAKAGE OF THREE HYBRID COMPOSITE RESIN RESTORATIONS

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ABSTRACT

Background: In an effort to combine the favorable physical and mechanical properties of conventional composites with the smooth surface typical of the microfilled composites, the hybrid composites were developed. Marginal adaptation of a restoration can be assessed by measuring the amount of microleakage at the interface area, after it has undergone contraction during polymerization. **Objective:** The aim of the present in-vitro study was to compare and evaluate the compressive strength and microleakage in class I cavity restored with hybrid composite. **Method:** Thirty freshly extracted human premolars were used. Standardized Class I cavity was prepared and randomly divided into 3 groups with 10 teeth in each group. The teeth in Group A was restored using Spectrum (Dentsply), Group B-Charisma (Kulzer) and Group C- Hybrid, LOT-FDH07U (Unicom Den Mart) and then subjected to thermo cycling; immersion in 1% methylene blue dye for 24 hours; sectioning longitudinally; evaluation of micro leakage under a stereomicroscope and scoring on an ordinal scale (0-4). Compressive strength was measured after loading the specimen in resin blocks and subjecting them to compressive tests using universal testing machine. The results were tabulated and subjected to Kruskal- Wallis and Mann- Whitney test for statistical analysis.

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INTRODUCTION

Adhesively bonded composites have the advantage of conserving the sound tooth structure while at the same time providing a cosmetically acceptable restoration. Mitra S, Dong W, Brian N. Holmes. An application of nanotechnology in advanced dental materials. *J Am Dent Assoc.* 2003;134:1382-90. Since the very first dental composites were developed, many efforts to improve their clinical performance have been undertaken. Xu HH, Sun L, Weir MD, Antonucci JM, Takagi S, Chow LC. Nano DCPA whisker composites with high strength and Ca and PO₄ release. *J Dent Res.* 2006;85:722-7. In an effort to combine the favorable physical and mechanical properties characteristics of conventional composites with the smooth surface typical of the microfill composites, the hybrid composites were developed. The presence of sub-micrometersized micro-filler particles interspersed among the larger particles provide a smooth "patina-like" surface texture in the finished restoration.

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Composite resins have better mechanical properties, such as compressive strength, than other restorations such as conventional or resin-modified glass ionomers, suggesting a longer clinical life in regions submitted to occlusal loads.

Della Bona A, Benetti P, Borba M, Cecchetti D. Flexural and diametral strength of composite resins. *Braz Oral Res.* 2008;22:84-9. Compressive strength of composite resin material can be assessed using Universal Testing Machine. Marginal integrity is another important property of the tooth-restoration interface. Marginal leakage is clinically undetectable passage of bacteria, fluids, chemical substances between the tooth and the restoration. Marginal leakage is used as a measure by which clinicians and researchers can predict the performance of a restorative material. Alani AH, Toh CG. Detection of microleakage around dental restorations: A review. *Oper Dent.* 1997; 22:173-85. Microleakage can be studied by dye penetration method. Hence this study was conducted to evaluate the best hybrid composite resin material currently used in clinical practice for better clinical results and longevity. The hybrid composites that are compared are Spectrum (Dentsply), Charisma (Kulzer) and Hybrid, LOT-FDH07U (Unicom DenMart).

Aim: To compare the compressive strength by Universal Testing Machine and micro-leakage using dye penetration method, of three different hybrid composite resin materials.

OBJECTIVES:

- To evaluate compressive strength of three hybrid composite resin materials.
- To evaluate the micro-leakage of three hybrid composite resin materials.

Armamentarium

- Air rotor handpiece (NSK)
- Burs
- Periodontal probe with gradings
- Ethchant (Charisma)
- Bonding agent
- Prime & Bond NT [Dentsply]
- Gluma SelfEtch [Kulzer]
- Adper Single Bond 3M ESPE
- Applicator tip
- Curing light (Woodpecker)
- Composite materials
- Charisma [Kulzer]
- Spectrum [Dentsply]
- Hybrid, LOT-FDH07U (Unicorn DenMart).
- Finishing and polishing kit
- Nail varnish
- Methylene blue dye
- Diamond disk
- Cold cure resin material
- Stereomicroscope
- Universal Testing Machine

Inclusion Criterion: 30 freshly extracted intact, non-carious human premolars were included. **Exclusion Criteria:** Teeth having developmental defects and having visible cracks or fracture were excluded from the study. 30 freshly extracted non-carious human premolars. Extracted teeth were scaled to remove debris, calculus, and rinsed with sodium hypochlorite. Standardized class 1 preparation (acc. to Sir G.V. Black) was carried out on all teeth with an air-rotor handpiece under air/water spray. Standard preparation was carried out according to the following specification. Occlusal isthmus-width of 1/3 of distance between cusp tips. Depth of the cavity was kept at 2-2.5mm. Teeth were then etched for 20s using 37% phosphoric acid and then rinsed with water for 20s. Bonding agent was applied (according to manufacturer's instruction) and cured for 15s. Teeth were randomly divided into three different groups

- Group A
(Spectrum)
- Group B
(Charisma)
- Group C
(DenMart)

Horizontal layering technique for composite was followed, with the incremental curing of each layer using the conventional curing light for 40s.



Figure 1. Armamentarium



Figure 2. Samples for the study





Figure 3. Cavity preparation and standardization



Figure 4. Composites used in study



Figure 5. Microleakage method



Figure 6. Resin mounting and placement of specimen in Universal testing machine

The final layer was contoured and polished using the composite polishing kit. All specimen were stored at room temperature in distilled water for 24h. Teeth were then subjected to thermocycling between 5°C and 55°C for 500 cycles. The dwell time in each bath and the time intervals at room temperature between baths were 20s. For measuring the compressive strength, 5 specimens of each material were mounted on (6mm X 4mm) resin blocks. The specimens were stored in distilled water for 24 hours and then were subjected to compressive test using the Universal Testing Machine. Load was applied until visible or audible evidence of failure was observed.

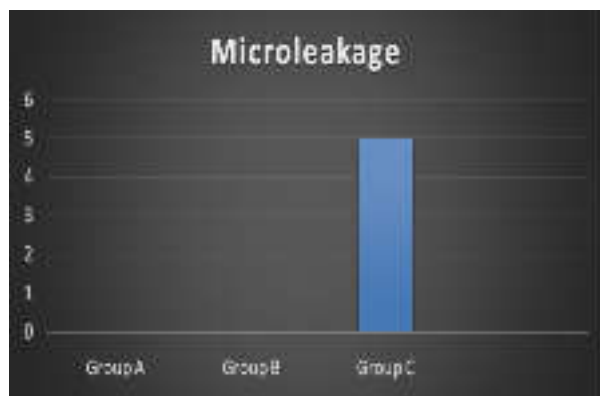
RESULTS:

Micro leakage

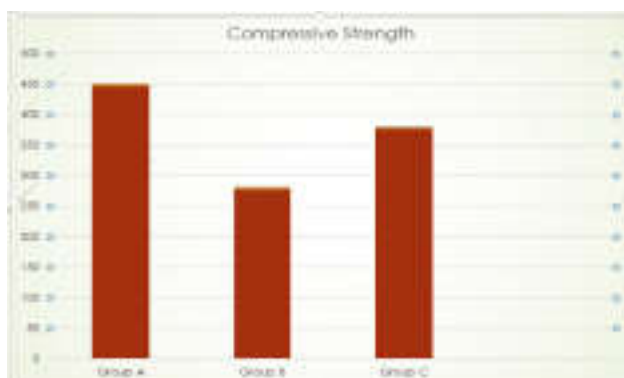
Sample A: Score 0

Sample B: Score 0

Sample C: Score 1



Compressive Strength



Sample A: 422.3 - 479.6 MPa

Sample B: 264.04 – 288.2 MPa

Sample C: 358.6 – 394.7 MPa

DISCUSSION

The present in vitro study was done to compare and evaluate the compressive strength and micro leakage of three hybrid composite material. Marginal leakage is used as a measure by which clinicians and researchers can predict the performance of a restorative material. Group A and B showed no micro leakage with zero score, which was statistically significant and better than Group C. This can be explained by the fact that both Group A and B has hybrid composites which contain silanes as one of the resin components. These silane molecules react with fillers and the methacrylate group simultaneously during polymerization and act as a re-inforcement. Where as Group C lack such phenomenon. For the compressive strength, Group A showed higher Compressive strength of 447.24 MPa; which was statistically non-significant in comparison to group C, which showed a mean value of 376.16 MPa.

This can be explained as Group A has higher filler content of 82% w/w where as Group C has higher content of macro-filled particles in the hybrid form. Where as group B shows least compressive strength even though the filler content is 78% w/w because of the presence of micro and nano hybrid particles.

MSDS Data Sheet: It can be concluded from the present in-vitro study that Spectrum will be more suited in the clinical practice to restore a tooth to its strength with low post-operative sensitivity than the other materials compared in the study. Further clinical trials are required to support the result of this study.

Conclusion

Within the limitations of the present in-vitro study, it can be concluded that Spectrum (Dentsply) has superior mechanical and esthetic properties as a restorative material than the other materials used in the study.

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