Fracture Resistance of Bulk fill and Indirect Resin Composites

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Purpose

The study aimed to evaluate the fracture resistance of mesio-occlusal-distal (MOD) cavities restored with bulk-fill and indirect resin composite

Materials & methods

Freshly extracted sound premolar teeth (n=20) were used and embedded in acrylic resin 2 mm below the cementoenamel junction (CEJ) then devided into 2 grpoups of 10

Group 1; the teeth were restored with flowable bulk-fill composite resin (Estelite Bulk-Fill Flow (EBF), Tokuyama, Japan) .
Group 2; light-curing micro hybrid indirect composite resin (Ceramage, Shofu, Japan).

Material	Company	Chemical composition	Application instruction
Estelite Bulk-Fill Flow	Tokuyama, Japan	Bis-GMA, TEGDMA, Bis-MPEPP, silicone oxide, zirconium oxide ,Butylated hydroxytoluene	Application and polymerization in 4 mm layers
Ceramage (İndirekt composite)	Shofu, Japan	UDMA, zirconium cilicate	300 s polymerization with Labolihgt LV-III
Syntac Primer (Primer)	Ivoclar Vivadent , Liechtenstein	TEGDMA, PEGDMA, maleic acid and acetone	15 s application and drying
Syntac Adhesive (Adhesive)	Ivoclar Vivadent, Liechtenstein	PEGDMA, glutaraldehyde	10 s application, drying
Monobond N (Silane)	Ivoclar Vivadent, Liechtenstein	Alcohol solution of silane methacrylate, phosphoric acid methacrylate and sulfide methacrylate	60 s application, drying
Variolink-N (Resin cement)	Ivoclar Vivadent, Liechtenstein	Bis-GMA, UDMA, TEGDMA, barium glass, ytterbium trifluoride , Ba-Al-fluorosilicate glass, mixed oxide, initiator, stabilizer and pigments	10 s mixing of catalyst and base in 1:1 ratio, 10 s LED light cure per millimeter of restoration (>800 mW/cm2)

Preparation

Standard sized MOD cavities with a bucco-lingual width of 3 mm and a cavity depth (measured from the tip of the palatal tubercle) of 3.5 mm were prepared in each premolar. Cavities were prepared without proximal boxes to minimize preparation variation (1). The buccal and lingual walls of each cavity were parallel to each other (2)

Restoring the Cavities

Group 1; the teeth were restored with flowable bulk-fill composite resin (Estelite Bulk-Fill Flow (EBF), Tokuyama, Japan) and Group 2; light-curing micro hybrid indirect composite resin (Ceramage, Shofu, Japan). In Group1; The cavity was cleaned, and then a three-step adhesive system (Syntac Primer/Adhesive/Heliobond System, Ivoclar Vivadent) was applied according to manufacturer instructions and restored with EBF.

In Group 2; The indirect restorations were fabricated by a dental technician and photopolymerized for 300 s using a light curing unit (Labolight LV-III, GC Corp., Tokyo, Japan). A dual-cure resin cement (Variolink-N, Ivoclar Vivadent, Liechtenstein) was used for the cementation of indirect composite restorations.

Fracture Test

Prepared specimens were placed in the universal testing device (Autograph AGS-X, Shimadzu, Tokyo, Japan) parallel to the long axis of the tooth.
A round tip with a diameter of 4 mm was inserted into the fissures of the restoration and a fracture test was performed under vertical loading at a speed of 1 mm/min.
Fracture areas were examined with a stereo-microscope with x20 magnification and digital photographs were taken

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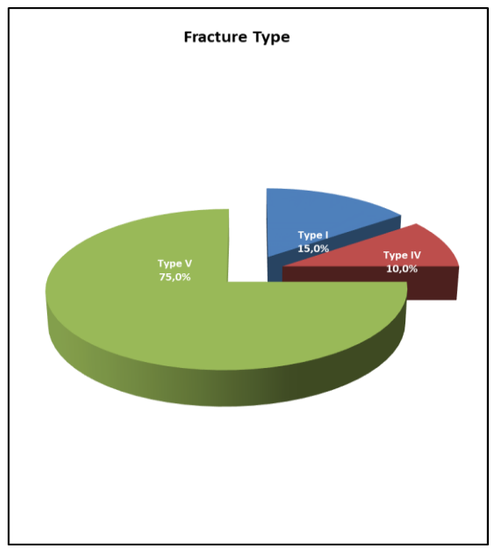
Fracture Types

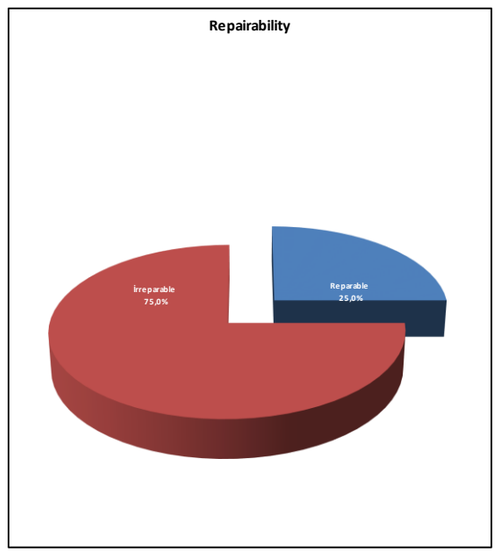
- Fractures were evaluated according to the following classification (El Ghoul et al., 2019).
- Type I (Repairable): Cohesive failure, fracture in restoration.
- Type II (Repairable): Adhesive failure, separation from the bond surface of the restoration.
- Type III (Repairable): Cohesive-adhesive failure, separation at the adhesive joint surface with fracture in restoration.
- Type IV (Repairable): Tooth fracture over the cemento-enamel junction with a restoration fracture.
- Type V (Irreparable): A tooth fracture that occurs below the enamel-cementum boundary with a restoration fracture.

Results

Statistical analysis revealed no statistically significant difference between the groups' load-bearing capacity and fracture types (p>0.05).



The maximum fracture force measurement values ofthe cases participating in the study ranged from 513.01 to 1458.2 mm2; the mean value is 1088.67±238.71 mm2.
When the fracture types of the restorations were examined; It was observed that 15% (n=3) were type I, 10% (n=2) were type IV, and 75% (n=15) were type V.



It was observed that the fractures of 25% (n=5) of the fractures were repairable, and 75% (n=15) of them were non-repairable.

Statistical analysis

NCSS (Number Cruncher Statistical System) 2020 Statistical Software (Utah, USA) program was used for the statistical analysis.
Shapiro Wilks test and Box Plot graphics were used to evaluate the conformity of the data to the normal distribution.
The Mann-Whitney U test was used to evaluate the non-normally distributed parameters in two groups.
Fisher's Exact test and Fisher Freeman Halton test were used to compare qualitative data.
The results were evaluated at the 95% confidence interval and the significance level of p<0.05.

References

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Key Words: Flowable Bulk-fill composite resin, micro-hybrid indirect composite resin, fracture resistance, MOD cavity

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