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Research Paper: In Vitro Comparison of Microleaage of Two Nanohybrid Flowable Composites and RMGI in Class V Restorations in Primary Molars

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ABSTRACT

Introduction: Composite resins undergo microleakage due to polymerization shrinkage particularly when located in enamel free margins. The purpose of this study was to assess and compare the microleakage of two nanohybrid flowable composites and resin modified glass ionomer in class V restorations of primary mandibular second molars.

Materials and Methods: This in vitro, experimental study was conducted on 30 primary mandibular second molars which were randomly divided into three groups. Standard class V cavities were prepared and restored with Grandio flow in Group A, G-aenial universal flow in Group B and RMGI in Group C. The restored teeth underwent 3000 thermal cycles between 5–55°C and then immersed in1M silver nitrate solution for 24 hours. The samples were sectioned buccolingually and degree of dye penetration was evaluated by stereomicroscope at ×10 magnification. Mann-Whitney U test and Paired T-test were used to analyze the data.

Results: In occlusal margin, there was no significant difference between three groups but at gingival margin, Grandio flow demonstrated significantly lower microleakage than G-aenial universal flow (P=0.002). There was not significant difference between Grandio flow and RMGI and also between RMGI and G-aenial universal flow (P>0.05).

Conclusion: Grandio flow is effective for decreasing the microleakage on enamel free margins.

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Introduction

Resin composites are widely used because of improved aesthetic, lack of mercury, being thermally nonconductive , more conservation of tooth structure, easier reparability and bonding of restorative material to the tooth.(1) Cervical lesions are also common in primary dentition and usually have little or no enamel margin at the cervical margin.(2) One of the factors reducing life span of the restorations is microleakage at the interface of tooth and material. This problem is due to composite shrinkage during polymerization,(3) furthermore lack of enamel in gingival margins, exacerbate this situation.(3-4) Microleakage can cause marginal discoloration, recurrent caries, post-operative sensitivity and development of pulpal pathology.(5) To overcome this problem , nanofilled composites with high percentage of fillers (60% by volume) and improved clinical results have been introduced.(3)

Grandio flow is a light-cured flowable 80% filled nano hybrid composite with 4.3 mm depth of cure. Nano-particle is commonly identified as a particle with a diameter of 10-100 nm.(6)

Gænial Universal Flow is a light-cured radiopaque injectable nanohybrid composite resin with a combination of 2 types of prepolymerized resin fillers which was recently introduced and which claimed to have low modulus of elasticity and low volumetric shrinkage.(7) Gaenial universal flow contains 200nm strontium glass and also a revolutionary new silane treatment method is used on the surface of nano-sized glass in order to strengthen the adhesion between glass particle and resin matrix. This composite has filler loading of 69% by weight.

Glass ionomer cement (GIC) has been recommended for restoring cervical lesions because of its chemical bonding to both enamel and dentine. However, low mechanical strength, poor aesthetics and technique sensitivity to moisture contamination has limited the clinical acceptance of GICs. .(8) To overcome these problems, RMGI with improved mechanical, esthetic and handling properties, reduced moisture or dehydration sensitivity, decreased setting time and increased working time, while retaining the advantages of GI was introduced. .(9) The purpose of this study is to evaluate microleakage of highfilled nanofilled composites and comparing them with RMGI.

Materials and methods

This in vitro experimental study was conducted on 30 sound primary mandibular second molars extracted within the past six months. Carious or fractured teeth and previously restored teeth were excluded from the study. The study protocol was approved in the ethics committee of the School of Dentistry, Qazvin University of Medical Sciences. The teeth were randomly divided into 3 groups (n=10). After immersing in %0/5 chloramine, the teeth were stored in saline. All cavities were prepared and restored by one operator (pedodontist). Class V cavities (4 mm length × 2 mm height × 2mm deep) were prepared using #008 fissure bur (Teezkavan,Iran) in a high-speed air motor handpiece with water coolant. After preparing 5 cavities, the bur was changed. Occlusal margin of the cavity was located in enamel and cervical margin was considered at cementoenamel junction. The teeth were randomly divided into three groups of 10 teeth ,Group A (Grandio flow), Group B (G-aenial universal flow), and Group C (RMGI). In group A and B, cavities were etched by %37 acid phosphoric (Total Etch,Ivoclar Vivadent AG, Schaan, Liechtenstein) for 30 s (enamel) or 15 s (dentin), thoroughly soaked in water for 30 s, and lightly dried with compressed air. Subsequently Adper Single Bond 2 (3M,ESPE,USA) was applied and cured (woodpecker LED.D light cure,china) for 20 seconds. In the group A Grandio flow(voco corporation, Germany) and in the group B, G-aenial universal flow (GC corporation ,Tokyo ,Japan) were used for restoration and cured for 30 seconds. In the group C, dentin conditioner (GC corporation,Tokyo, Japan) was applied on the cavity surface for 20 seconds and after washing, dried with stream of air in a way to avoid dessication. RMGI (GC Fuji II LC, GC Corporation, Tokyo, Japan) was prepared according to the manufacturers' instruction, placed in the cavity and

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light cured for 20 seconds with light curing unit at a light intensity of 1500 mw/cm2(woodpecker LED.D light cure,china). The restorations were then finished and polished and finally one coat of finishing gloss (GC Corporation, Tokyo, Japan) was applied on the restoration surfaces and light cured for 10s. Then, the root apices were sealed with acrylic resin, and the teeth were covered with two layers of nail varnish, except in the area of the restoration and at a 1-mm border of tooth surrounding each cavity. The teeth were then subjected to 3000 thermal cycles between 5–55°C with a dwell time of 60 seconds and transfer time of 15 seconds. Next, the teeth were immersed in water at 37°C for 24 hours and were then immersed in 1M silver nitrate solution (Sigma-Aldrich Chemie GmbH, Germany) for six hours in a dark room and then stored in a photochemical developer (Jahan Chemical Inc., Iran) for 12 h followed by an exposure to a 150-W fluorescent lamp for 6 h. The specimens were then embedded in a transparent self-cure acrylic resin (Rapid Repair, Meliodent, Heraeus Kulzer GmbH, Germany). Specimens were cut in a bucco-lingual direction through the center of restorations using a slow speed diamond saw (Isomet, Buehler,Lake Bluff, IL, USA) with water cooling. The degree of microleakage, indicated by dye penetration (silver nitrate) at the tooth–restoration interface, was evaluated with a stereomicroscope (Olympus, SZX 16, Tokyo, Japan). All measurements were taken from the junction of the tooth–restoration interface to the point of termination of the dye, and measurements were recorded in micron. Both sections of each restoration were measured at the occlusal and gingival margins (7,9). Analysis of data for comparison of mean scores for microleakage between three groups in occlusal and gingival margins was performed using Mann-Whitney U test. Paired T-test was used to compare the mean score of microleakage in occlusal and gingival margin of each group.

Results

The mean scores for microleakage in occlusal margin (Table1) and gingival margin (Table2) are shown. No significant difference was seen between the three groups in occlusal margin (P=0.08). There was significant difference in gingival margin of three groups (P=0.003). Gingival microleakage of Grandio flow was significantly lower than G-aenial universal flow(P=0.002) but there was not significant difference between gingival microleakage of Grandio flow and RMGI (P=0.07). There was not significant difference between gingival microleakage of RMGI and G-aenial universal flow (P>0.05). Paired T-test showed no significant difference between the gingival and occlusal microleakage in any of the groups (P>0.05).

Table1: Comparison of Mean Scores for Microleakage Between three Groups in Occlusal Margin

Group	N	Mean	Std. Deviation	P-value
Grandio flow	10	766.66	665.53	0.08
G-aenial universal flow	10	1677.77	1067.60	
RMGI	10	1433.33	913.92	
Total	30	1292.59	950.67	

Table2: Comparison of Mean Scores for Microleakage Between three Groups in Gingival Margin

Group	N	Mean	Std. Deviation	P-value
Grandio flow	10	533.33	605.86	0.003
G-aenial universal flow	10	1900	1044.22	
RMGI	10	1355.55	680.51	
Total	30	1262.96	960.47	

Discussion

This in vitro research was conducted in order to study the microleakage in class V cavities of primary teeth restored with G-aenial universal flow, Grandio flow and RMGI. G-aenial universal flow and Grandio flow were selected for this study because of nanofiller technology of both composites which increase the filler content of the composites. One of the factors that contributes to marginal microleakage in composite restorations is contraction of material during polymerization.(10)Restorations in the oral cavity are subjected to occlusal forces, moisture and temperature variations. Thermal cycling may also

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contribute to the dislodgement of the restoration from the cavity walls, so we used thermocycling in our study to resemble oral environment.(8)

We used AgNo3 for measuring microleakage. Because of high penetration capacity of the silver nitrate solution and small diameter of the silver ion (0.059 nm) compared to the mean size of a bacteria (0.5-1.0 µm), its use is considered a very severe test.(11)

In this study there was statistically significant difference in gingival microleakage between G-aenial universal flow and Grandio flow in which Grandio flow showed the least amount of micoleakage. According to manufacturers explanation, filler content of Grandio flow is 80% by weight compared to the G-aenial universal flow which is 69%. High percentage of filler content in Grandio flow can reduce polymerization shrinkage and thus the microleakage. Although the ginigival microleakage of RMGI was more than Grandioflow but the difference was not significant. RMGI bond to enamel and dentin through both chemical and micromechanical bonding mechanism which could explain the low degree of microleakage in ginigival margin of this restorative material in spite of lacking enamel.(12)

In the study by Sooraparaju S G et al.(7) nanohybridcomposite (Tetric N-ceram) alone and with flowable composite (Tetric N) showed high levels of dye penetration in gingival margins compared to G-aenial universal flow. Results of this study can show advantages of G-aenial universal flow. High flexibility, prepolymerised fillers, and low volumetric shrinkage of Gænial Flow may be the possible reason for less microleakage. Contrary to our study, all the composites showed more microleakage at gingival margins compared to occlusal margins. The differences between the results could be attributed to anatomical and histological differences between primary and permanent teeth, because the mineralization of the enamel in primary teeth are low and irregular compared to permanent teeth which lead to weaker bond of composite to primary teeth.(13)

In the study by Ahmadi R et al.(3) difference in microleakage of flowable and nanofilled composites at the cervical margin of primary molars was not statistically significant, however nanofilled composite in occlusal margin exhibited significantly less microleakage than flowable composite. Nanocomposites with higher filler contents undergo less shrinkage and create stronger bonds, although they have lower adaptability to dental tissues due to their higher elastic modulus. Contrary to our study, microleakage of nanofilled composite in gingival margin was greater than occlusal margin. This difference can be explained by using flowable nanocomposite with greater flexibility and adaptability in our study and using universal composite in this study.

In the study by El-Ashiry E A et al.(14) microleakage of RMGI was higher than nanocomposite in class V cavities in primary molars. There was not significant difference between the occlusal and gingival margins for nanocomposite but there was significant differences between the occlusal and gingival margins for RMGI. Due to the lack of an additional conditioning step, RMGI might show more gingival leakage because of the superficial mechanical interlocking.

Conclusion

1.Nanocomposites with high percentage of fillers can reduce microleakage in enamel free region similar to margins in enamel.

2.Grandio flow can have important role in restoring class V cavities in primary dentition by reducing microleakage.

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