Microleakage of Silver Modified Atraumatic Restorative Technique (SMART) Restorations Using Two High Viscosity Glass Ionomer Materials

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PURPOSE

To determine if less microleakage occurred with SMART fillings compared to traditional glass ionomer restorations and if glass ionomer brands had different amounts of microleakage observed after thermocycling.

METHODS

Extracted carious permanent molars with at least two walls intact were collected and stored in 0.5% Chloramine T solution (IRB Exempt: 20-07513-NHSR UM). Teeth with large carious lesions, pulpal involvement, and teeth with previous restorations were excluded from this study. Teeth were randomly divided into four groups, two control groups (n=15 per group) and two experimental groups (n=15 per group). In this study, two glass ionomer restorative materials were investigated with and without the use of 38% SDF: Fuji IX© Glass Ionomer (GC America Inc, Alsip, IL USA) and SMART Advantage™ Glass ionomer (Elevate Oral Care, West Palm Beach, FL USA). The experimental groups were treated with Advantage Arrest™ 38% SDF (Elevate Oral Care, West Palm Beach, FL USA) prior to GI placement and were restored with either SAGI or Fuji IX© GI©. The control group received SAGI without SDF or Fuji IX© GI© without SDF. All teeth were mounted in acrylic for ease of handling. All samples were placed in Dulbecco's Phosphate Buffered Saline (DPBS 8662) in a water bath at 37 degrees Celsius for 24 hours prior to tooth preparation. Selective caries removal was achieved on each tooth with a Brasseler slow speed #6 round bur until hard dentin was reached on the margins and leathery dentin was left above the pulpal floor. Burs were used for five teeth preparations and discarded.

After caries removal, all groups were contaminated with human saliva to represent clinical situations. For the experimental groups, one drop of SDF was applied with a microbrush to remaining leathery dentin and allowed to dry for one minute. Excess SDF was removed with a cotton pellet. For teeth restored with SAGI, SMART Advantage™ Tooth conditioner (Elevate Oral Care, West Palm Beach, FL USA) was used and per manufacturer instructions was rinsed after 15 seconds. GC tooth conditioner (GC America Inc, Alsip, IL USA) was applied for teeth restored with Fuji IX© and was rinsed after 10 seconds per manufacturer instructions. Both conditioners were applied to margins of restoration only. After rinsing, the teeth were lightly air dried with a gentle flow of air. Teeth were then restored with either Fuji IX© or SAGI, adapted to margins with wet cotton tip applicator, and allowed to set for 2 minutes and 30 seconds per manufacturer instructions. The control group was restored with either SAGI or Fuji IX© in the manner described above without the SDF step. After restorations were placed, teeth were placed in DPBS solution at 37 degrees Celsius for 24 hours and then placed into a thermocycler (SABRI, Downers Grove, Il, USA) for 1,000 cycles, alternating between 5 and 55 degrees Celsius. After thermocycling, the teeth were painted with acrylic varnish to within one millimeter of the restoration margin. Next, they were placed in two percent basic fuchsin dye solution. After 24 hours, the teeth were embedded in acrylic and sectioned buccolingually three times to generate six faces for microleakage evaluation per tooth. Sections were examined with a digital microscope (Keyence, Osaka, Japan) at 30x magnification and scored from zero to three based on the amount of staining toward the pulp (Table 1). Each face was independently scored and the worst score for any face of a given tooth was used for the whole tooth score. For each group, the mean score and standard deviation for each microleakage category was calculated. Data were statistically analyzed with SigmaPlot 14 software (Systat Software Inc. San Jose, CA, USA) using Kruskal-Wallis One Way Analysis of Variance on Ranks, Dunn's Method (P<0.05). Fifteen samples per group were calculated to be adequate to yield a power of 0.93 with an alpha of 0.05.

Category	Description	Example
0	No microleakage visible	
1	Penetration short of dentin-enamel junction	
2	Penetration along axial wall and into outer dentin	
3	Microleakage throughout inner dentin and pulpal tissue	

Table 1. Grading criteria to score microleakage

RESULTS

The mean score and standard deviation for each group is recorded in Figure 2. Smart Advantage Glass Ionomer with SDF had a mean score of 1.53±0.74 while Fuji IX© Glass Ionomer with SDF had a mean score of 1.53±0.99 which were not significantly different (p=1). Smart Advantage Glass ionomer had a mean score of 2.40 ±0.63 when restored without the use of SDF. Fuji IX© without SDF had a mean score of 1.53 ±0.52. The difference in means between Smart Advantage Glass Ionomer without SDF compared to Fuji IX©, Smart Advantage Glass Ionomer with SDF, and Fuji IX© without SDF were all 0.87. Fuji IX© without SDF did not show a statistically significant difference in microleakage when compared to SAGI with SDF or Fuji IX© with SDF (P=1.0 for both). There was also no significant difference between the two test groups with SDF (p=1.0). However, SAGI without SDF did show a significant difference in microleakage when compared to Fuji IX© with SDF, Fuji IX© without SDF, and SAGI with SDF (P=0.045, P=0.039, and P=0.027, respectfully).

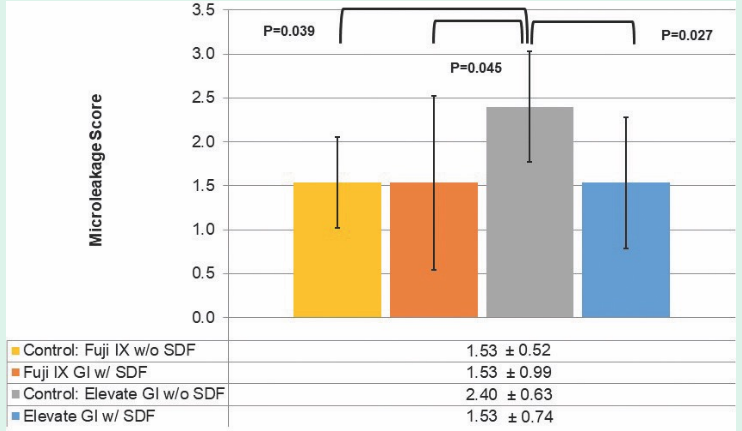

Figure 1. Means and standard deviation values for microleakage

CONCLUSIONS

1. Restorations treated with 38% SDF prior to placement of glass ionomer resulted in significantly less microleakage compared to SAGI alone. However, there was no significant difference when compared to Fuji IX alone.
2. Microleakage between SMART Advantage glass ionomer and GC America Fuji IX glass ionomer after SDF treatment is similar.