Original Article

WATER FLOSSER'S EFFECT ON MICROLEAKAGE AMONG SELF-ADHESIVE RESIN CEMENT AND RESIN-MODIFIED GLASS IONOMER CEMENT

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ABSTRACT

Dental caries and periodontal disease are mostly caused by plaque buildup, a complex biofilm that builds up on the oral cavity's hard tissues, or teeth. Oral illnesses including periodontal disease and dental caries can be brought on by plaque biofilms. Hence, to maintain a healthy oral cavity, there are many ways to prevent plaque accumulation through mechanical plaque control aids. This study aims to consider the effect of water floss on marginal microleakage (RMGI). This study consists of 4 main stages, which are as follows: Collection, preparation, scanning, and cementation of the samples. Flossing – thermocycling data collection. Twenty teeth were cemented with rely-X and RMGIC cement and exposed to water floss to investigate the effect on marginal microleakage. The dye penetration was then measured and analyzed. The data shows a mild change in the margin of the crown cemented with rely-x and RMGIC. However, rely-x cement shows less effect on marginal microleakage.

Key words: Water floss, Margins, Resin cement, Zirconia, GIC cement, Rely-X.

Introduction

Dental caries and periodontal disease are mostly caused by plaque buildup, a complex biofilm that builds up on the oral cavity's hard tissues, or teeth. Oral illnesses including periodontal disease and dental caries can be brought on by plaque biofilms [1]. Hence, to maintain a healthy oral cavity, there are many ways to prevent plaque accumulation through mechanical plaque control aids [2]. Traditionally, toothbrushes and dental flossers were used to clean the supragingival plaque and the marginal and interproximal areas. Water floss is a new way to remove plaque accumulation in marginal areas. The first commercial water flosser available was invented in 1962 [3]. Several studies have confirmed the effect of removing the plaque biofilm using water floss. A study that was done in 2009 indicated that the water floss effectively removed 99.99% of the salivary biofilms [4]. Additionally, another research recommends using water floss for patients with different needs and concerns like dental braces and patients with crowns and bridges to improve the cleaning of dental biofilms under challenging areas and improve overall oral health [5].

The combination of pulsation and pressure are the key elements to the efficiency of the water flow. They produce a compression and decompression phase that ejects the debris and plaque biofilm from subgingival and interdental areas [6]. A recent study concluded the safe use of water flossers on many types of resin composite, where no significant change in surface roughness and no color change was observed [7].

In this study, we consider the impact of water flossers on microleakage at crown edges sealed with resin-modified glass ionomers (RMGI) and self-adhesive resin cement. Thus, the null hypothesis is a slight difference in marginal microleakage of crowns cemented with RMGIC and rely-X cement.

Materials and Methods

This study consists of 4 main stages, which are as follows: Collection, preparation, scanning, and cementation of the samples. Flossing – thermocycling data collection.

The collection of samples was based on the board's approval for non-human research. Human premolar teeth were collected from Riyadh Elm University's Oral and Maxillofacial Surgery department. As **Figure 1** shows every tooth was inspected using a dental explorer for caries and a 50x lens (VHX 600, Keyence, Osaka, Japan) under a digital microscope to check for fractures and fracture lines. This study eliminated any teeth that showed signs of decay, fracture lines, or cracks. Hence, the total number of samples selected was 20.

In the second stage, tooth samples were prepared by hand with standardized crown preparation with all walls' depth of 1.5mm and occlusal reduction of 2mm. The walls were tapered between 4° and 8°. Moreover, the finish line was circumference chamfer with a reduction of 0.5mm at the gingival margin **(Figure 3)**. Then, teeth were scanned with an intraoral scanner (TRIOS3, 3Shape TRIOS A\S, Holmens Kanal, Copenhagen, Denmark) **(Figure 4)**. The digital impression was sent to a denttech laboratory (Custom Milling Center, Riyadh, KSA) to fabricate zirconia crowns with a 0.6 mm wall thickness and a 100 µm cement space (Rodenbacher Chaussee 4 63457 Hanau-Wolfgang Germany). Samples were embedded into acrylic resin base blocks to stabilize the teeth **(Figure 1)**.

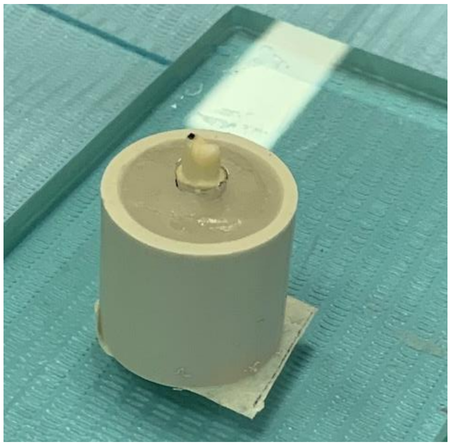
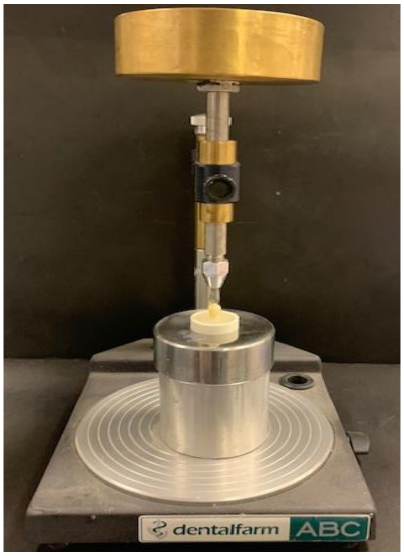


Figure 1. Teeth imbedded in acrylic

Subsequently, crowns were received and tried on the teeth samples, then divided into two test groups. The first group contained 10 samples cemented with self-adhesive resin cement (RelyX Unicem Aplicap, 3M). The second group contains 10 samples cemented with resin-modified glass ionomer (RMGI) cement (Ketac Cem Aplicap, 3M). Each group was categorized into 5 samples as control cases and 5 as study cases **(Figure 2)**.

Figure 2. Teeth samples

During the cementation, The crowns were pressed on the surveyor by Costumize weight apparatus, 2 kg lead, to mimic the rule of the thumb pressure. After that, the light cure was done for 20 seconds on each side for one minute at room temperature **(Figure 3)**. Samples were stored in distilled water at 37°C for 24 hours.



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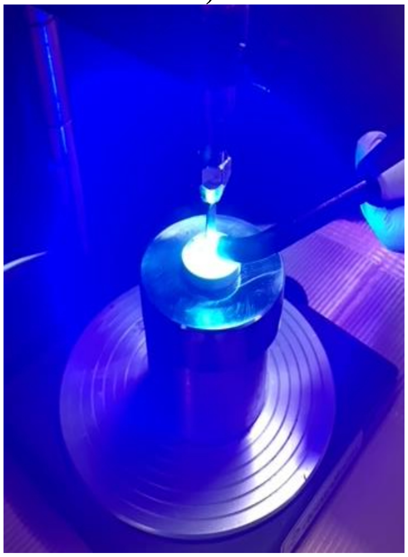

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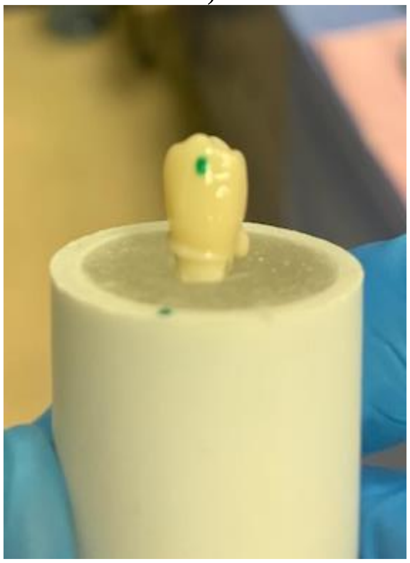


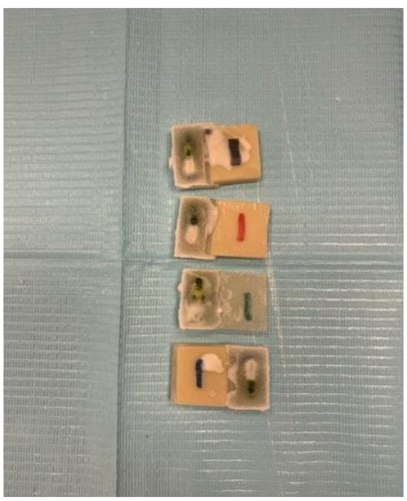
c)

Figure 3. samples after cementation.

Water floss was used at full power 100 psi, on all study cases in which The water pressure was perpendicular to the tooth for 30 minutes (Aquarius Water Flosser, WATER PIK, FT. COLLINS, CO, USA).

To provide a suitable oral cavity environment for the samples, they underwent a thermocycling bath, 10,000 cycles, with water temperatures of 5C°and 55C°, baseline and following the completion of the 30-minute therapy, which is comparable to five years of once-daily, one-minute water flossing simulation [8]. Each cycle lasted for 1.35 minutes, in each bath the dripping time was 30 seconds. Lastly, samples were immersed in 2% Methylene blue dye for 48 hours.

The dental sectional disc device was used to segment the samples buccolingually from the center of the crown in order to assess their impact (Figure; Abrasive Discs, Zermatt, Buehler, Lake Bluff, IL, USA). Then, all the samples were examined under a light microscopy device with 50xlens. (KH-7700, hirox, Suginami-Ku, Tokyo, Japan). Finally, the integrated image analysis program with a 50× magnification was used to evaluate the dye penetration from the exterior crown surface to the most exact area of samples **(Figure 4)**.



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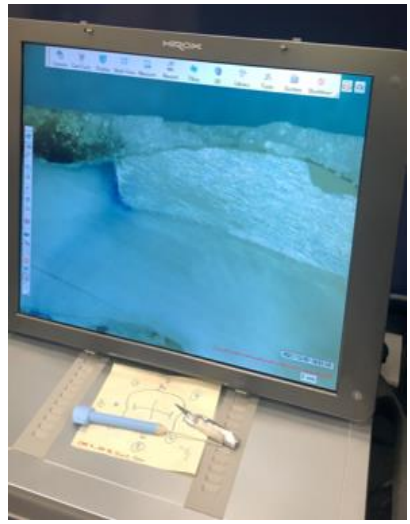

b)

Figure 4. Samples after sectioning and measuring the dye penetration

Results and Discussion

A total of 20 teeth were studied for the effect of water floss on microleakage around crown margins with two different types of cement. The null hypothesis was accepted based on the statistical analysis (SPSS) of the dye penetration. Thus, the result reveals a mild change in the marginal area when water floss is used on GIC and rely-X cement based on the measurement of dye penetration.

The table below **(Table 1)** summarizes the statistical analysis of the data. The mean microleakage in the GIC group was 2881.6+_ 7.87%, while the control GIC was 1940+_4.31%. Conversely, the mean for Rely_X and Rely _X_ control are 1352.2+_5.03% and 911.8+_2.43%, respectively.

Table 1. Statistical analysis of the data

Paired Samples Statistics					
Paired Samples	**Cement type**	**Mean**	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	RMGIC	2881.6000	5	787.41273	352.14168
	RMGIC_Control	1940.4000	5	431.61012	193.02192
Pair 2	Rely_X	1352.2000	5	503.40759	225.13072
	Rely_X_Control	911.8000	5	243.47834	108.88682

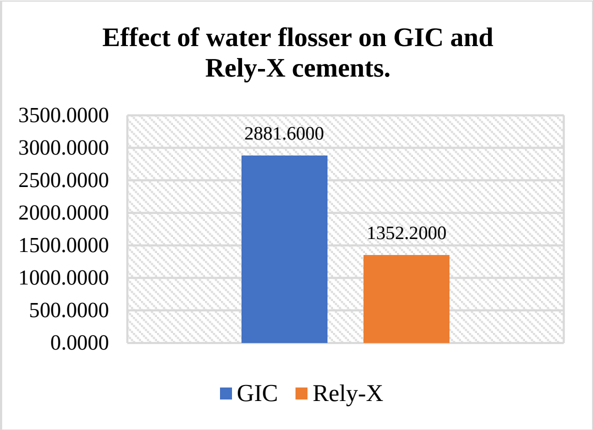

Figure 5. Comparison of the effect of water floss on GIC and Rely-X cement

Both cements show a slight change in the marginal crown. However, the RMGIC cement groups show higher microleakage than Rely_X group cement since the bond strength between the GIC cement and dentine is less than that of rely-X cement **(Figure 5)**. [9] the microleakage in different types of cement, including rely-x and GIC, was studied by Piwowarczyk, which concluded that the Rely-x cement shows the slightest degree of microleakage in typical oral cavity environment and without the use of external instruments [10].

Future research may investigate the effect of water flossers on the microleakage of different types of cements and crowns. In addition, increasing the number of teeth studied may provide a solid conclusion of the degree of the gap created. Another area of interest might compare the effect of water flosser and regular dental floss on crown cement, providing the safest way to clean the interproximal area.

The impact of water flossing on microleakage around crown edges using two distinct kinds of cement was examined in twenty teeth. The dye penetration statistical analysis (SPSS) approved the null hypothesis. Based on the assessment of dye penetration, the result indicates a minor alteration in the marginal region when water floss is used on GIC and rely-X cement.

Table 1 in this research provides an overview of the data's statistical analysis. In the GIC group, the mean microleakage was 2881.6+_ 7.87%, while in the control group, it was 1940+_ 4.31%. Conversely, Rely_X and Rely _X_control averages are 1352.2+_5.03% and 911.8+_2.43%, respectively. The degree of marginal microleakage effects between GIC and rely-X cements is shown in **Figure 5**.

The primary influence of composite type was not statistically significant in the change in surface roughness score (F (4,30) = 2.390, p = 0.073, partial η2 = 0.242). However, water-jet flossing had a significant main effect (p = 0.073). F (2,30) = 25.981, partial η2 = 0.634, p < 0.001. Regarding a decrease in surface roughness score, there was a substantial relationship between the water-jet flossing and the composite: F (8,30) = 2.454, p = 0.036, partial η2 = 0.396.

The marginal crown of both cements exhibits a modest variation in the current investigation. Nonetheless, compared to Rely_X cement, the RMGIC cement groups exhibit more microleakage because the GIC cement's connection with dentine is weaker than Rely-X cement's. Piwowarczyk examined the microleakage in many types of cement, such as Rely-x and GIC, and concluded that, in a typical oral cavity setting and without the need for external tools, Rely-x cement exhibits the least amount of microleakage [10].

Despite using a standardized polishing procedure, the initial surface roughness of different composites varied in the earlier study. These changes might be caused by inherent composite composition properties related to the filler (type, shape, size, hardness, and spatial arrangement of the particles), the type of resin matrix, the rate of polymerization, and the binding effectiveness at the filler/matrix interface. The study's initial surface roughness levels are consistent with previous research, where roughness values varied between 0.3 and 1.2 μm [8, 11].

In past research, when compared to Z350 specimens, the Ceram x and Estelite Sigma specimens in the 100 Psi treatment group both had a significantly greater increase in surface roughness, according to a pairwise comparison: F (2,30) = 13.467, p < 0.001, partial η2 = 0.473; F (2,30) = 17.623, p < 0.001, partial η2 = 0.540, respectively. The simple main effects for the composite type indicated a statistically significant difference in the change in surface roughness score across the water-jet flossing groups for only Ceram. x and Estelite Sigma. Nevertheless, this difference was not statistically significant for the other composite kinds [12, 13].

Water flossing had no effect on the color longevity of the materials used, irrespective of the form of composite being used or water pressure. Additionally, no specimen showed any discernible color alteration ($\Delta E \leq 2$). This conclusion is in line with other research findings that water sorption and storage alone did not significantly change the colors of the composites [14, 15]. Furthermore, theoretically, since surface roughness modifies the quantity, direction, and quality of reflected light, it often influences color coordinates. Nonetheless, in this investigation, the variance in the surface roughness of every specimen was lower than the visible light wavelength, or around 0.5 μm. Consequently, minute variations in surface roughness did not affect the spectrophotometer's result [16, 17].

A previous study discovered that after abrasion polishing, smaller filler sizes led to decreased surface roughness values [18]. As a result, the nano-filled composite had lower roughness values than the Submicron and micro-hybrid composites. Given the variances in these kinds of investigations, it is usual that the roughness levels noted in this research were more significant than others. This result might result from technique-related issues, that are naturally susceptible to errors involving manufacturing, polishing, measuring, or using instruments for taking the specimens' measurements [19].

After five simulated years of water-jet flossing, no appreciable color change was seen. None of the composites showed any discernible increases in surface roughness, with the exception of the two that contained spherical filler specimens in the 100 Psi group [20, 21]. The surfaces of these composites were rougher than those of the nano-filled composite. The variations were nonetheless clinically acceptable [22, 23].

Future research may investigate the effect of water flossers on the microleakage of different types of cements and crowns. In addition, increasing the number of teeth studied may provide a solid conclusion of the degree of the gap created. Another area of interest might compare the effect of water flosser and regular dental floss on crown cement, providing the safest way to clean the interproximal area.

Conclusion

In conclusion, using a water flosser on the crown cemented with Rely-X and GIC caused marginal microleakage, which resulted in caries and periodontal disease. Thus, using a water flosser with caution is recommended to protect the crowns.

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Conflict of interest: None

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Ethics statement: This study received ethical approval from the REU ethical committee (FRP/2021/345/431/451).

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