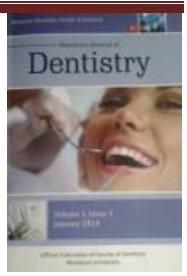
Effect of Teeth Contamination on The Retention and Microleakage of Stainless Steel Crowns in Primary Molars.



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Abstract:
Aim: determine the effect of teeth contamination on the retention and microleakage of stainless steel crowns in primary molars cemented either with; resin modified glass ionomer cement or self-adhesive resin luting cement. **Methodology:** One hundred and twenty extracted primary maxillary and mandibular molars were collected and stored in tap water at 37°C till its use for the study. The roots of each tooth were embedded in self-cure acrylic blocks. Standard SSC preparations were performed for all molars. After fitting SSCs, the sample was divided into non-contaminated group (n=40): group A; 40 teeth, and contaminated groups (n=80): group B saliva contamination and group C saliva and blood contamination (40 teeth each). Then each group was subdivided into two sub-groups; 20 teeth each according to the type of the luting cement, which then subdivided into 10 teeth for retention test and 10 teeth for microleakage test. For groups B&C, teeth enamel was contaminated immediately before cementation process. Luting cements used in this study were resin modified glass ionomer (FujiCEMR 2) or self-adhesive lutting cement (MulitilinkR Speed). After crowns cementation retention test was measured for the allocated groups using instron universal testing machine, while microleakage test was evaluated with the digital method for the other groups. **Results:** Compared to the experimental groups, the control group (non-contaminated; group A) showed the highest retention value and the least microleakage. Self adhesive resin luting cement significantly had higher retention and less microleakage degree than resin modified glass ionomer cement with a significant difference ($p<0.001$). Under saliva (group B) and saliva and blood (group c) contaminations, the mean retention value of self adhesive resin was higher when compared to retention of RMGIC with a significant difference in saliva group ($p<0.023$), and in saliva and blood group ($p<0.18$). Also less microleakage was recorded with both types of cement in saliva contamination when compared with saliva and blood contamination with a significant difference ($p<0.001$). The highest degree of microleakage (3473.00±486.21) was observed with RMGIC in group C. **Conclusion:** The self adhesive luting cement had a significantly higher retention, and lesser microleakage than RMGIC in all conditions of this study. Both materials showed a significant increase in the retention value and lesser degree of microleakage when contaminated with only saliva than with saliva and blood contamination.

Introduction

Stainless steel crowns (SSCs) are frequently used to reestablish essential teeth with broad carious injuries when there are inadequate retention or resistance form for coordinate amalgam or composite restorations.[1] The stainless steel crown (SSC), first presented in 1950 by Engel[2] and created by Humphrey,[3] is an extremely durable, moderately cheap treatment, in addition to the advantages of the ease, less seat time, counteractive action of repetitive caries, absence of mercury and safeguarding of normal vertical dimensions.[1]

One of causes for the clinical failure of SSCs is retention failure as a result of loss of cementation.[4]The main role of cements is improving retention by increasing the adherence between the restoration and the prepared tooth andmechanically lock the restoration in place to prevent its dislodgement during mastication.[5] Exposing these luting cements to different moist conditions such as saliva and blood leading to decrease the bond strength between the restoration and tooth structure due to the loss of retention and microleakage at the interface.[6]

Saliva control in the operation field is difficult especially in cementation process with, partially erupted molars, gingival extending contamination on the retention and microleakage of cemented stainless steel crowns with two different luting cements cavity margins, or when patients have a limited mouth opening.[5]Therefore, isolation and salivary control play an important role in success of cementation procedure.[7]

As a result, the present study was undertaken to evaluate the effect of teeth contamination on the retention and microleakage of cemented stainless steel crowns using two different cements in primary molars.

Methodology

Specimen preparation:

Extracted one hundred caries free maxillary and mandibular primary molars were selected for this study and stored in tap water at 37°C till its use. Collected teeth should be free from any developmental defects or previous restorations. The roots of each tooth were embedded in self-cure acrylic blocks (green block for RMGIC & red block for self adhesive resin cement) up to 1 mm below the cemento-enamel junction. Standard preparations were performed for SSC restoration by a single operator in which reduction of occlusal surface was prepared in depth of 1-1.5 mm with a straight fissure bur. This was established by placing depth

orientation grooves at the cuspal height. Proximal reduction was accomplished with maintaining vertical walls by a tapered fissure bur until a satisfactory fit of a suitable size crown was achieved.

Teeth grouping:

After fitting SSCs, the sample was divided into non-contaminated group (n=40): group A; 40 teeth, and contaminated groups (n=80): group B saliva contamination and group C saliva and blood contamination (40 teeth each). Then each group was subdivided into two sub-groups; 20 teeth each according to the type of the luting cement, which then subdivided into 10 teeth for retention test and 10 teeth for microleakage test. For groups B&C, teeth enamel was contaminated immediately before cementation process.

Contamination process:

Contamination process was done as follow:

1) In group A: Uncontaminated, the enamel surfaces were kept dry.

2) Saliva collection and application for group B:

To collect saliva sample for the study, I brushed my teeth, refrain from eating for one hour and chewed paraffin wax to help for saliva stimulation. Saliva collected in a clean plastic test tube for convenient use. Immediately before cementation the enamel surface was contaminated for 10 seconds using a cotton pads saturated with saliva. Then, enamel surface was blown off with an air syringe for five seconds.

3) Saliva and blood collection and application for group C:

Fresh capillary blood was collected from my fingertip. The index finger was cleaned with alcohol and then punctured with a hypodermic needle and blood sample collected in a clean plastic test tube . One drop of both blood and saliva was applied directly to the enamel surface of each sample, and was left undisturbed for 15 seconds and then blown off with an oil-free air syringe for five seconds. The enamel surfaces were contaminated with saliva and blood immediately before cementation process.

All crowns in green blocks were cemented using resin modified glass ionomer cement (FujiCEMR 2) and crowns in red blocks were cemented with self-adhesive resin luting cement (MulitilinkR Speed). The cements were used according to manufacture's instructions at room temperature, then they were loaded into the crown and each crown was seated and sustained with finger pressure. After initial set, excess cement was removed from the crown tooth interface using an explorer.

Evaluation of retention:

Retentive force was tested using instron universal testing machine

Evaluation of Microleakage:

Microleakage degree was obtained by using OmniMet^{TM}Image software analysis for detection the value of microleakage in microns by obtaining the parallel length of dye penetration through luting cements.

Result:

Table 1 Shows the effect of different contaminations on retention of each luting cement. For both luting cements it was revealed that the highest retention was noted in case of no contamination, while the lowest was noted with saliva and blood contamination. The difference was highly significant ($p<0.001$).

Table (1): The effect of different contaminations on retention of each luting cement.

Retention	No contamination	Saliva group	Saliva+Blood group	ANOVA test	p-value
Self adhesive luting cement					
Mean ± SD	451.25±66.5 ab	348.99±73.77 ac	289.93±58.65 bc	15.02	<0.001*
Min-Max	346.53-586.23	234.38-480.7	212.73-366.1		
RMGIC					
Mean ± SD	362.24±66.65 ab	280.77±45.43 ac	219.53±62.75 bc	14.72	<0.001*
Min-Max	225.70-430.39	222.71-344.9	131.92-291.2		

Table 2 shows the effect of different contaminations on microleakageof each luting cement. For both luting cements, it was revealed that the least microleakage was noted in case of no contamination, while the maximum was noted with saliva and blood contamination. The difference was highly significant ($p<0.001$).

Table (2): The effect of different contaminations on microleakage of each luting cement.

Micro leakage	No contamination	Saliva group	Saliva+Blood group	ANOVA test	p-value
Self adhesive luting cement					
Mean ± SD	327.49±104.77 ab	797.20±49.86 ac	1731.00±513.44 bc	55.26	<0.001*
Min-Max	209-441	718-867	941-2659		
RMGIC					
Mean ± SD	592.30±49.83 ab	2676.20±218.62 ac	3473.00±486.21 bc	231.54	<0.001*
Min-Max	512-673	2118-2831	3020-4512		

Discussion

Despite the high clinical success rate of SSCs, the main cause for it's failure is mainly due to the loss of the crown due to the cementation failure. occurred as a result of repeated loads subjected to SSC during mastication, parafunction, and temperature changes in the oral environment.[4,8]

In this study primary molars were selected because of the widely used of SSCs on it to prevent the early tooth loss and development of future malocclusion.[9] Although all restorations undergo different temperature variations in the oral cavity, the thermocycling process simulates that same as in laboratory procedures, that the specimens underwent thermocycling during this study. A live time of 30 seconds was acceptable because patients can not accept the long lasting touch of the essential tooth with cooling or hot materials. [10]

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The leakage was estimated during the study throughout the usage of OmniMet^{TM}Image software analysis for detection the value of microleakage in microns. Although this software analysis was simply operated, and allowed the analysis of microleakage in a very short measure, it took longer to induce pictures digitalized, compared to the visual assessment. This might be thought-about a limitation of the digital methodology.[11]

In the present study, under all contamination conditions the higher retention values and lower values of microleakage, were recorded for the self-adhesive resin cement, which in accordance with the results found by Yilmaz et al [12] who found that the retention was improved with resin cement and the microleakage was lower than RMGIC. Also results in this study are in agreement with the results obtained by Reddy [13] who found that SSCs that were cemented with self adhesive resin luting cement showed a less degree of microleakage and yielded a higher tensile bond strength than those cemented with the adhesive cements.

The higher retention values and the lower degree of microleakage in self-adhesive resin luting cement might be due to the composition of resin matrix of this cement.[109]It consists of multifunctional acid methacrylate that demineralize and infiltrate into the tooth structure by reacting with the hydroxyapatite of the tooth and the basic fillers within the luting material.[14]

On the other hand, and under all contamination conditions RMGIC showed less retention and higher microleakage values, as RMGIC has some problems that explain this result like initial slow setting, increased water sorption that will lead to increase the rate of microleakage as a result of the presence HEMA in it.[8]

The lower degree of microleakage reveled in self adhesive resin luting cement and higher degree showed in RMGIC in this study was also supported by the result of Albert and El-Mowafy[15] they obtained that both ceramic and metal ceramic crowns demonstrated lower microleakage degree when luted with self adhesive resin cement than RMGI cement.

When saliva was applied on the tooth before cementation procedure, there was a higher degree of microleakage than in the dry condition, as saliva consists mostly of water (99.4%), with 0.6% solids. The solid is composed of macromolecules like proteins, glycoprotein sugars and amylase, inorganic particles like urea, amino acids, fatty acids and free glucose.[16] It seems that within seconds, an organic smear layer is formed and act as a mechanical barrier and covering the etched porous surface,[17]these in accordance with Pashley[18] who reported that presence of saliva contamination promotes physical obstacles by deposition of macromolecules of these contaminants into the dentinal tubules. Also Benderliet al[19] stated that saliva contamination might be a risk factor to the bonding process.

Also in saliva and blood contamination group, the highest value of microleakage was observed for both cements. One explanation to our results could be that to

mimic the clinical situation as close as possible, fresh capillary blood obtained from me was used for the experiment. As blood plasma is also composed in a high percentage by water, in addition to the water in saliva this might explain why the results in saliva and blood group shows higher degree of microleakage than saliva group.[20]

The different degrees of interference in the bonding procedures caused by water, saliva and blood are the result of the different compositions of the substances. Saliva is more complex than water and the difference in the type and quantity of inorganic and organic substances in the blood makes it a mechanical barrier that is greater than saliva.[125]

Conclusion:

1- Contamination before cementation of SSCs had a great effect on decreasing retention and increasing microleakage of luting cements, so isolation is highly important.

Self adhesive resin luting cement had a significantly higher retention, and lesser microleakage than RMGIC in all conditions of this study.

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