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COMPARATIVE EVALUATION OF MICROLEAKAGE OF THREE DIFFERENT LUTING CEMENTS USED FOR CEMENTATION OF STAINLESS STEEL CROWNS IN PRIMARY MOLARS - IN VITRO STUDY

Dental Science

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ABSTRACT

Microleakage may be a major factor for failure of the crown. This may allow passage of microorganisms, by-products of food and salivary fluids into the tooth -cement interface which may lead to eventual loss of crown. To avoid microleakge and failure of crown, choice of luting agent is extremely important. So the aim of the study is to evaluate and compare the microleakage of glass ionomer luting cement (Fuji I), resin-modified glass ionomer cement (Fuji CEM) and resin cement (RelyX U200) when used for cementation of stainless steel crowns in primary molars.

MATERIALAND METHODS: 42 extracted teeth were divided randomly into 3 groups of 14 teeth ,with crowns cemented with different cements as follows: Group 1 – Glass ionomer luting cement (GC Fuji I), Group 2-Resin modified glass ionomer luting cement, (Fuji CEM); Group 3 – Resin luting cement. (RelyX U200). Using image analysis system, microleakage measurements was done two times successively, and the mean value of the two measurements were computed.

RESULTS: The data was statistically analyzed by the one way ANOVA test and Post hoc Tukey test. Mean and standard deviations (SD) were calculated. The result of a present study were tabulated as,Group 1: Crown cemented with Glass Ionomer Cement (GC Fuji I). (n=14).
Group 2: Crown cemented with Resin Modified Glass Ionomer Cement (GC FujiCEM) (n=14).Group 3: Crown cemented with Resin Cement (RelyX U200). (n=14).

DISCUSSION : RMGI has many superior properties when compare to conventional GIC like it is less erosive less dissolvable also has higher compressive and tensile strength. On other hand, with respect to conventional GIC, RMGIC has some disadvantages too, like dehydration shrinkage, volumetric expansion due to hydroplastic properties of resin, all these may happen after several months of insertion. Because of all these properties lone term dimensional stability and consistency of physical properties of RMGIC may turn into doubt

KEYWORDS

RMGIC, RelyXU200, Microleakge, Stainless Steel Crown, Dye Penetration

INTRODUCTION

Since their intro in 1950 stainless steel crowns (SSC) have been the 1st choice of restoration for primary molars and has been recommended for the restoration of teeth with multi-surface tooth decayed or developmental defects, following endodontic treatment.[1]

An achievement of SSC relies upon nature of tooth preparation, choice and modification of suitable crown and the luting cement used for cementation and most importantly on marginal seal.[2]

Microleakage may be a major factor for failure of the crown.[3] This may allow passage of microorganisms, by-products of food and salivary fluids into the tooth -cement interface which may lead to eventual loss of crown. To avoid microleakge and failure of crown, choice of luting agent is extremely important.[1]

According to Hill 2007,ideally luting cements should form bonding between tooth structure and crown so that it not get disintegrate into oral cavity.[4] Initially non adhesive luting cements e.g. zinc phosphate, polycarboxylate cements get bonded only mechanically to tooth which used to result in microleakeage. As a result, a new generation of luting cements accomplishes both mechanical and chemical bonding to the tooth. These materials include conventional Glass ionomer cement (GIC),Resin cements and resin modified glass ionomer cements (RMGIC).[5]

In our study we used RelyX U200 which is a new material introduced by RelyX in 2011. This study aims to investigate the microleakage associated with these 3 cements:

1. GIC (Fuji I)
2. Resin modified glass ionomer cements(Fuji CEM)
3. Resin cement(RelyX U200)

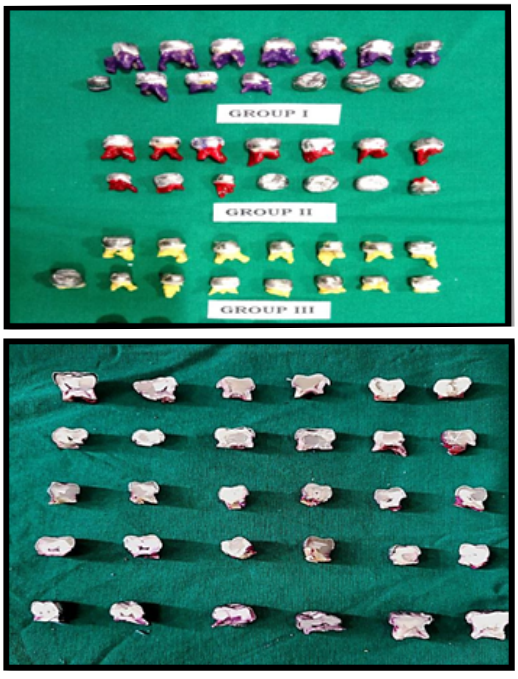
MATERIALAND METHODS

This in-vitro study was undertaken to evaluate and compare the the microleakage of glass ionomer luting cement (Fuji I), resin-modified glass ionomer cement (Fuji CEM) and resin cement (RelyX U200) when used for cementation of stainless steel crowns in primary molars. 42 Extracted and exfoliated primary molars were collected from Department of Pedodontic and Preventive Dentistry , Dr. D.Y. Patil Dental College and Hospital , Pimpri ,Pune – 411018, which were washed with water and soaked in 3% sodium hypochlorite for soft tissue debridement for 15 minute and stored in 0.1% thymol solution. Then teeth were mounted on wax sheet. Conventional tooth preparation for stainless steel crown was performed and the occlusal surface was reduced by approximately 1-1.5 mm with 169 L diamond bur. Mesial and distal undercuts removed. Stainless steel crown were selected and adapted onto the tooth. Then the specimens were divided randomly into 3 groups of 14 teeth with crowns cemented with different cements as follows:

Group 1 – Glass ionomer luting cement (GC Fuji I)
Group 2-Resin modified glass ionomer luting cement, (Fuji CEM);
Group 3 – Resin luting cement. (RelyX U200);

All SSCs were cemented using glass three types of cement. These luting cement was mixed according to manufacturer's recommendations and was filled on the inner surface of each crown. Then crowns were placed in their correct position on the prepared teeth with finger pressure and placed for 10 minutes. Excess cement was removed using a dental explorer. Except for a 1mm wide zone around the margins of each SSC, the root surfaces were sealed with 2 coats of nail varnish. All cemented SSCs were kept in distilled water at room temperature for 24 hours. Thermocycling was carried out 200 times in water at 5 ^{0} C and then in 55 ^{0}C water for 30 seconds respectively. All

teeth were then immersed in 0.5% basic fuchsin dye solution for 24 hours. The specimens were then sectioned in a mesiodistal direction along the long axis of the tooth along pre marked lines with slow speed diamond saw. Microleakage in mesial or distal parts of the crown were evaluated and photographed under a stereomicroscope at 10X magnification. Using image analysis system, microleakage measurements was done two times successively, and the mean value of the two measurements were computed. To determine measurement error, photographs of all samples were re-measured by the same investigator after a two-week interval. Microleakage measurements were recorded in milimeter.



RESULTS

The present study was carried out to evaluate and compare microleakage of glass ionomer luting cement (Fuji I), resin-modified glass ionomer cement (Fuji CEM) and resin cement (RelyX U200) when used for cementation of stainless steel crowns in primary molars. The obtained data was then analysed statistically.

The data was statistically analyzed by the one way ANOVA test and Post hoc Tukey test. Mean and standard deviations (SD) were calculated.

The result of a present study were tabulated as,
Group 1: Crown cemented with Glass Ionomer Cement (GC Fuji I). (n=14).

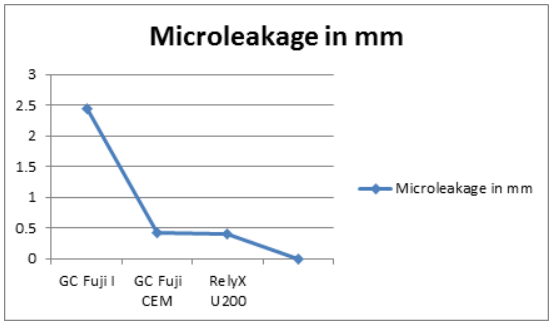
Group 2: Crown cemented with Resin Modified Glass Ionomer Cement (GC FujiCEM) (n=14).

Group 3: Crown cemented with Resin Cement (RelyX U200). (n=14).

The maximum and minimum values in group 1 were 0.70 mm and 5.56 mm respectively maximum and minimum values in group 2 were 0.00 mm and 1.24 mm respectively while the values in group 3 were 0.00 mm and 1.50 mm (Table 1).

The mean microleakage in group I was 2.4507 mm and the mean microleakage in group II was 0.4121 mm whereas the mean microleakage in group II 0.4029 (Table 2)

- The data on microleakage across the three study groups is presented as Mean ± Standard Deviation. The statistical significance of difference of average microleakage across the three study groups is tested using independent 'ANOVA' test after confirming the underlying normality assumption. All data was recorded and analyzed using the SPSS ver.11.5 (SPSS Inc. Chicago, IL, USA).
- Student t test was used to compare the significance of differences in microleakage between the three groups. P-values less than 0.05 are considered to be statistically significant



DISCUSSION

Luting cement is an agent which holds an indirect restoration in place for an uncertain timeframe, and fills the gap at the tooth and restoration surfaces.[5] ideal luting agent must not harm the tooth or tissues and should allow adequate working time to place the restoration. It must be fluid enough to permit complete seating of the restoration and should rapidly form a hard mass strong enough to resist functional forces.

Shiflett K *et al.* (1997)[2], Yilmaz Y *et al.* (2004)[10], Memarpour M *et al.* (2011)[1], Rossett P *et al.* (2008)[15] proposed that microleakage of adhesive cements like GIC, RMGIC and Resin cements is lesser when compared with non-adhesive cements like zinc oxide eugenol and polycarcoxylate cements. But results are fluctuating in between GIC, RMGIC and Resin cements brand to brand, so this study carried out.

In the present study, extracted maxillary and mandibular primary molars were used due to relative ease of availability and higher probability over retained and furthermore useful to study as preformed SSC mostly use for primary molars. All specimens were disinfected in 3% sodium hypochlorite for 15 minutes and then stored 0.1% thymol. This was in accordance with William et al who have demonstrated that there is no change in the physical properties of tooth structure after storage in thymol for upto 5 years. [19]

With regard to tooth preparation for SSC Conventional tooth preparation performed and the occlusal surface will be reduced by approximately 1-1.5 mm with 169 L diamond bur as indicated by Waggoner WF [20]mesial and distal undercuts will be removed. SSC will be chosen and adapted onto the tooth.[1]

Microleakage test isn't an absolute measure of significance for luting cement. Dye penetration has been used in many investigations, to evaluate the presence of marginal leakage around the cement- enamel interface. Penetration of a dye can demonstrate the absence of a perfect seal. In our study we have used quantitative technique of dye penetration to survey the microleakage. Clinically, this may suggest that the microgap could be a factor for formation of secondary caries by microleakage. In our study we use 0.5% for 24 hours because it is cheap, easy to manipulate and also has high degree of staining and lower molecular weight than bacterial toxins.[36]

Each one of the samples were viewed under stereomicroscope at 10X magnification along with Image Analysis Tool Software to qualitify the length of dye penetration in millimeters from the margin of the SSC through the interfaces between the tooth and the cement.[1] Stereomicroscope gives unique viewing angels for both eyes as it has two objectives and eye pieces. This arrangement creates a 3D representation of the sample being analyzed.[37]

For our study we used scoring system which utilized by Memarpour et al.[1] Dye penetration measure the length of dye infiltration in millimeters from the margin of the SSC through the interfaces between the tooth and the cement.[1]

In the present study, all the groups demonstrated some amount of microleakage. The result uncovered that microleakage among all three groups have high significant difference (p=0.000). It was observed that the maximum microleakage was seen in GC Fuji I group (mean being 2.4507mm) compared to GC Fuji CEM (mean being 0. .4121mm) group and RelyX U200 (mean being 0.4029 (Table 2 and Graph 1). The maximum and minimum values in group 1 were 0.70 mm and 5.56 mm respectively maximum and minimum values in group 2 were 0.00 mm and 1.24 mm respectively while the values in group 3 were 0.00 mm

and 1.50 mm (Table 1).

Wilson and Ken introduced GIC in 1969, earlier named as aluminosilicate polyacrylic acid. It was produced from need for luting cement which release fluoride, translucent and which have better adhesion than earlier non adhesive cements.[38]

In the 1980s,a new classification of luting cement called RMGIC i.e. resin modified glass ionomer cement introduced for enhance toughness and reducing dissolution of conventional GIC.[39,42] For this, in conventional GIC part of glass polyalkonate which is a water component was supplanted with water –hydromethyl methacrylate mixture Resin-modified glass-ionomer is a dual-cure hybrid, because setting happens by a combination of the long-term, complex acid-base reaction common of glass-ionomer cement and chemical or light-initiated polymerization of the added resin.[39]

RMGI has many superior properties when compare to conventional GIC like it is less erosive less dissolvable also has higher compressive and tensile strength.[41] On other hand, with respect to conventional GIC, RMGIC has some disadvantages too, like dehydration shrinkage, volumetric expansion due to hydroplastic properties of resin, all these may happen after several months of insertion.[41] Because of all these properties lone term dimensional stability and consistency of physical properties of RMGIC may turn into doubt.

Since 1952,resin cement has been assessable for cementation of prosthesis or indirect restorations.[44] Then ,from last 20 years it get upgrade and reformulate to achieve more success.[45] Basically resin cements are methyl methacrylate-, Bis-GMA dimethacrylate and fillers like silica or barium glass.[46] Resin cements available in variety of formulations like, encapsulated, powder/liquid or paste-paste form, also according to curing they comes into different forms as self-cured , dual cured or light-cured. Resin by micromechanical interlocking. However, for dentin has more complex micromechanical process containing removal of smear layer, demineralization and application of primer, bonding agent A resin luting agent would be the best choice for SSC as it has high-tensile strength and dentin-bonding ability which is necessary for endodontically treated teeth.[47]

In this study we used RelyX U200 which is a new material promoted by RelyX in 2011. It is newer generation self- adhesive resin cement. 1st generation RelyX luting require pre-treatment of tooth like etching, primer and bonding agent. All these steps can avoid with regard to RelyX U200. Also as it comes in two paste system it gives homogeneous matrix and ease of performance. Its PH value start increases within couple of minutes after mixing and it achieves neutral level within 24 hrs. which gives long term stability to cement. In addition, RelyX U200 is hydrophobic in nature so that water absorption and microleakage of cement reduce.

Also, to all these properties of RelyX U 200 we can include one more property like it has least microleakge when use as luting agent and compared with GIC and RMGIC. In this manner, the results of the present study prove Fuji CEM and RelyX U200 has somewhat similar microleakage, GC Fuji CEM has one advantage of fluoride realize so, we can recommend that, especially in high-caries risk patients. Additionally as ease of use and property wise RelyX U 200 to be a promising luting agent and an effective in the pediatric dentists for time conservation with cooperation of children. We can recommend that, it may be beneficial non cooperative patients.

CONCLUSION

According to comparison of microleakage Resin Modified Glass Ionomer Cement GC Fuji CEM **(mean being 0.4121)**. And Resin Cement RelyX U200 **(mean being 0.4029**) shown lower of microleakge than Conventional GIC GC Fuji I **(mean being 2.4507**). There was a statistically high significant difference (p=0.000) in the microleakage among both the groups.The Resin Modified Glass Ionomer Cement GC Fuji CEM and Resin Cement RelyX U200 have very little difference in their microleakage. Though, GC Fuji CEM and RelyX U200 has same microleakage, GC Fuji CEM has one advantage of fluoride realize so, in case of high caries risk patients GC Fuji CEM can act more better. Otherwise RelyX U 200 is also improvising material n time consuming for cementation of SSC. Also newer improvement in RelyX U200 is auto-mix Syringe of RelyX U200 again consumes more time of mixing cement. Therefore, according to microleakage RelyX U200 and GC Fuji CEM both are improvising materials than Conventional GIC.

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