

## Evaluation of Marginal Adaptation of Metal Ceramic Crown with Different Luting Cement

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### Key words

microleakage,  
luting cement,  
variolink ii, glass  
ionomer cement.

### Abstract

The study aims to evaluate and compare the microleakage of three different luting materials. The materials compared are Zinc phosphate cement, Variolink II Refill and Glass ionomer resin cement. Eighteen recently extracted caries-free wisdom teeth were used. The teeth were cleaned then stored in distilled water until use. The molars were assigned randomly into three groups of 6 teeth of each. The metal ceramic crowns were constructed by means of an indirect laboratory technique. In group A, the crowns were cemented with a traditional Zinc Phosphate. In group B, the tooth preparations were sealed with Variolink II Refill. In group C, the tooth preparations were sealed with glass ionomer resin cement prior to cementation with the crowns. The results showed higher value of microleakage for Zinc phosphate cement. While the least value was for the Variolink II. The value for Glass ionomer resin cement was low. Statistically analysis revealed difference between the Zinc phosphate cement, Variolink II and Glass ionomer resin cement in microleakage. There was no significant difference in microleakage between Variolink II and Glass ionomer resin cement. This may indicated that the degree of microleakage may influenced by the type of the luting system used.

### Introduction

Several types of luting agents are available and the choice for a material depends on various factors. Geometric configuration of the prepared tooth, reduction of convergence angle, higher axial surface and minimal occlusal reduction contribute to increase the retentive capability of the prepared tooth<sup>(1,2,3)</sup>. Zinc phosphate cement is still the most used for crown luting due to its low cost, easy of handling and good mechanical properties<sup>(4,5)</sup>. However, it has

some negative properties namely solubility in oral environment and absence of adhesive bonding<sup>(6)</sup>. Glass ionomer cements exhibit several clinical advantages. They include physico-chemical bonding to tooth structures, fluoride release and low coefficient of thermal expansion. Glass-ionomer's mechanism of bonding is based on bond formation between the carboxyl groups of polyacrylic acid with hydroxyapatite at the tooth surface<sup>(7)</sup>. It has the advantage of superior physical and mechanical properties and absence of dissolution in the oral cavity. It have shown lower microleakage values in vitro and it has

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proved to be effective luting agents<sup>(8)</sup>. The adhesive cements have been shown to be less soluble, biocompatible<sup>(9)</sup>. Nevertheless, the use of these materials requires several steps, mainly for treatment of dental substrate, which make them technically sensitive<sup>(10)</sup>. Variolink II refill adhesive is a clinically accepted adhesive luting material, and the results are in line with the accepted idea that adhesive luting is the basis for fracture prevention of dental ceramics<sup>(11)</sup>. This study is to evaluate and compare the microleakage of three different luting materials (Zinc phosphate cement, Variolink II Refill luting and Glass ionomer resin cement).

## Materials and Methods

Eighteen recently extracted caries-free wisdom teeth were used. The teeth were cleaned and scaled with ultrasonic scaler (Guilin Woodpecker Medical scaler, China) and checked under stereomicroscope to exclude cracking. During the entire experiment, specimens remained in distilled water at room temperature. The teeth were centrally inserted into PVC cylinders (25-mm height x 20-mm internal diameter; Tigre, Joinville, SC, Brazil) containing self-curing acrylic resin (Jet; Classico Artigos Odontologicos Ltda., São Paulo, SP, Brazil). The acrylic resin was maintained 2 mm below to the cemento-enamel junction and stored in distilled water until use. The specimens were assigned randomly into three groups of 6 teeth of each. The preparation of teeth were made with a diamond burs of 1.2 mm diameter (Cerinlay Set, Intensiv, Viganello, Lugano, Switzerland) to achieve a 6-degree converge angle in a high-speed handpiece by means of a stationary handpiece secured in a clamp with sufficient water cooling were used to perform preparations of metal-ceramic crown on each tooth. A shoulder margin of 0.5 mm buccally located with chamfer margin lingually, and an occlusal reduction of 1.5 mm from the tip of the buccal cusp for each preparation with 4 mm in height were made. All line angles

were rounded, the margin was localized along its full length to the dentine at the level of the cemento-enamel junction. An impression was made for each tooth with light hydrocompatible Oranwash® (Zhermack®) impression material. Crowns were constructed by means of an indirect laboratory technique by a specialist. The preparation was cleaned using rotary brush and pumice in low-speed hand piece, washed and then dried using sterile cotton<sup>(12)</sup>. In group A, each crown was cemented with a traditional Zinc Phosphate (Adhesor® Sofa Dental) cement on unsealed tooth preparations, the cement was mixed for about 60 seconds and applied in a thin layer according to manufacturer instructions. Crowns in group B were cemented with Variolink II Refill (Ivoclar Vivadent Schaan Liechtenstein) resin luting cement, cement was applied on the inner surface of the restoration and/or on the preparation and light cured by Lediton Ivoclar vivadent light-curing unit. The margins of the preparation were then light-cured for 30s at each face. In group C, the crowns were cemented with glass ionomer resin cement (Ionocem ITENA®). Luting procedure was performed according to each manufacturer's instructions. For all groups the cement mixture was applied onto the internal crown surface and mounted on the prepared tooth by compression to be exposed immediately thereafter to 5 kg load for 10 minutes that allowed cement flow and correct crown fit on the preparation. Excess material was removed with a sharp explorer<sup>(13-15)</sup>. Final crown adaptation was considered acceptable when no discrepancies were detected. The samples were immersed into 1% methylene blue solution for hours at 37°C, rinsed, dried and cut the specimens using 1 mm thick diamond gauge disc parallel to the axial tooth axis in one directions mesio-distally of each sample for measurement of dye penetration degree. Penetration depth was measured with stereomicroscope (motic Incorporation LTD. Hongkong) at 40× magnification. The amount of dye penetration and microleakage measurement was measured in millimeters for the three types of luting cement used. The distance between the

prepared tooth surface and the crown's fitting surface was measured at 3 different locations (mid-marginal, mid-axial and mid-occlusal) <sup>(16)</sup>.

## Results

As shown in Figure (1,2,3). At the mid-occlusal points, Zinc phosphate cement presented the highest value of microleakage (0.93) which was significantly different from both Variolink II value (0.44) and Glass ionomer cements (0.57) at ( $p \leq 0.05$ ). The lowest values of microleakage were observed in Variolink II, to be somewhat higher in Glass ionomer cement. While, there was no significant difference between Variolink II and Glass ionomer cement values. At the mid-marginal points, Zinc phosphate cement presented the highest mean (0.76) which was different significantly from Variolink II (0.34) and Glass ionomer cement (0.43) at ( $p \leq 0.05$ ). While there was no statistical difference between Variolink II and Glass ionomer cement values at the mid-marginal points. This was shown in Figure (1,2,3). In the mid-axial points, there was no significant difference between Zinc phosphate (0.64), Variolink II (0.22) and Glass ionomer cement (0.33) values. This was shown in Figure (1,2,3). The examination of specimens under motic stereomicroscope at 40X magnification showed that the highest penetration of dye was for Zinc phosphate cement. This was shown in Figure (4), then Variolink II and Glass ionomer cements (GIC) as shown in Figures (5 and 6) respectively measured in millimeters at mid-marginal, mid-axial and mid-occlusal points.

## Discussion

Cement disintegration through its decomposition or dissolution in oral fluids, shrinkage on setting, strength and weakening of the bond between the cement and dentine or cement and restoration are reported as possible causes of microleakage and loss of bonding effect <sup>(17)</sup>. The higher degree of microleakage of Zinc phosphate cement

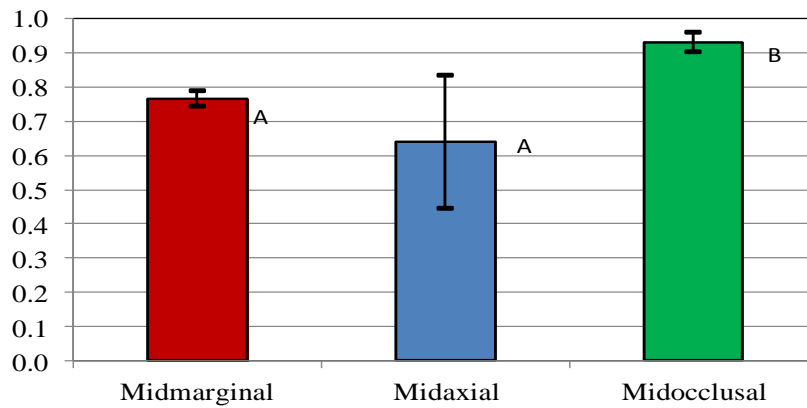
may be due to that the cement, does not have chemical adhesion to any dental substrate, acting only as luting agent by mechanical or frictional retention <sup>(18)</sup>. Hansen (2000) <sup>(19)</sup> demonstrated that acid component of Zinc Phosphate cement may demineralize smear layer and intact dentin. Exposed collagen fibers undergo hydrolysis over time under the influence of oral fluids and water, which impairs the bond and leads to micro cracks and microleakage. In spite of its well documented disadvantages such as high clinical solubility, lack of adhesion and low setting pH, a recent clinical data revealed a survival rate of 74.0% after 15 years <sup>(20)</sup>. Resin glass ionomer produced lesser degree of microleakage compared to Zinc phosphate cement as, the resin cements showed chemical adhesion to the tooth and affinity for metal ions, fluoride release can promote optimal sealing and consequently protect against marginal infiltration, could be correlated to the lower penetration of dye in resin samples <sup>(21,22,23)</sup>. Calheiros et al; <sup>(24)</sup> demonstrated that resin cement may effectively reduce microleakage and this may be attributed to formation of a hybrid layer which ensures adhesion and resistance to various stresses. The best least degree of dye penetration for Variolink II may be attributed to its high degree of adhesion because of dual (chemical and light-cured) polymerization, fluoride release, polishability, decreased sensitivity, very high radiopacity and high abrasion resistance. Also, it may be contributing to complete removal of the smear layer with dentin and the maintenance of the structural integrity of these structures should greatly improve the final stability of the hybrid layer. Elguindy et al., <sup>(25)</sup> found that, the adhesion of Variolink to tooth interface is more effective than to the ceramic interface and that is responsible for the best values of microleakage of Variolink. Further studies are needed for the recommendations of the use or non-use of Variolink II adhesive systems clinically, in regarding to sealing ability, acidity, strength, microleakage and biocompatibility.

### Conclusions

1-Ceramic crowns cemented with (Variolink II) Refill resin luting system offer better degree of microleakage compared to traditional cementing system (Zinc phosphate cement).

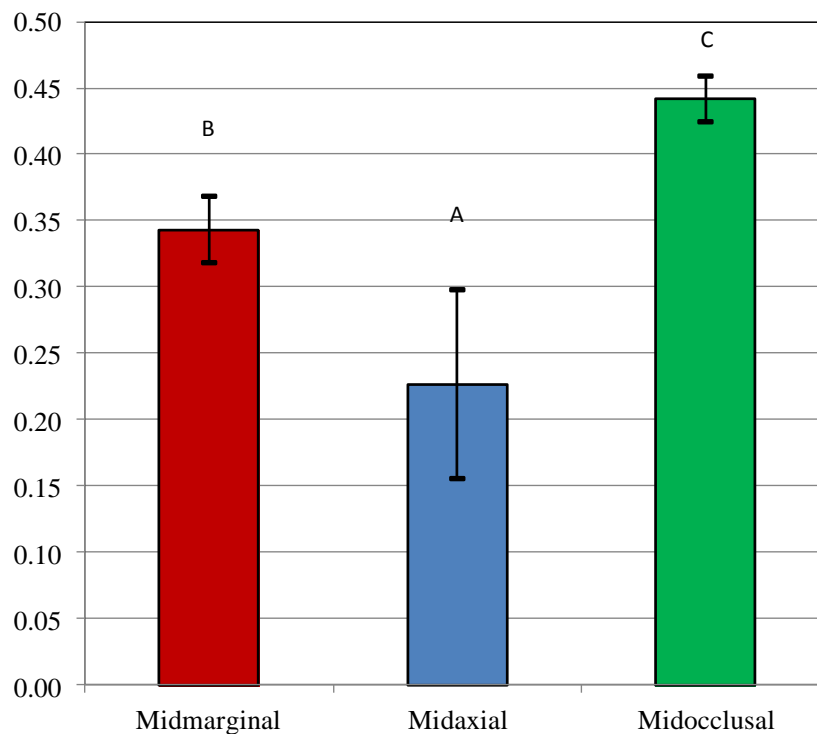
2-The value of microleakage was influenced by the type of cementing media that are used for cementation of ceramic crown.

3-The least value of microleakage of resin luting adhesives (Variolink II) mean the recommendations for its use clinically; because of fluoride release, polishability, decreased sensitivity, lower solubility and high abrasion resistance are an important factors in practice and may affects the microleakage of the restorations in the future.



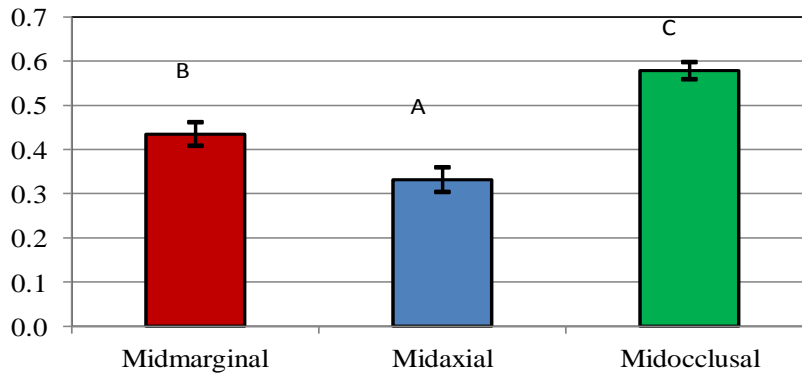
Means with different letters were statistically significant at  $p \leq 0.05$ .

Fig.(1):- A histogram representing the mean of microleakage (mm) of Zinc phosphate cement used at mid-marginal, mid-axial & mid-occlusal points.



Means with different letters were statistically significant at  $p \leq 0.05$ .

Fig.(2):- A histogram representing the mean of microleakage (mm) of Variolink II used at mid-marginal, mid-axial & mid-occlusal points.



Means with different letters were statistically significant at  $p \leq 0.05$ .

Fig.(3):- A histogram representing the mean of microleakage (mm) of Glass ionomer cement used at mid-marginal, mid-axial & mid-occlusal points.



Fig.(4):-A figure representing a dye penetration for Zinc phosphate cement in stereomicroscope at 40X magnification.



Fig.(5):-A figure representing a dye penetration for Variolink II cement in stereomicroscope at 40X magnification.



Fig.(6):- A figure representing a dye penetration for Glass ionomer cement in stereomicroscope at 40X magnification.

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