EFFECT OF PRE-HEATING COMPOSITES ON FILM THICKNESS

ABSTRACT

INTRODUCTION: Resin composite has been suggested as a luting material for aesthetic indirect restorations and temperature affects material viscosity. Reports of film thickness from new composites are important. **OBJECTIVE:** The aim of this study was to analyze the influence of pre-heating two resin composites on its film thickness in order to use it as a luting agent for indirect restorations (inlays and onlays). **MATERIALS AND METHODS:** Three materials were divided into 5 groups. Two resin composites, nanofilled (Z350 XT/3MESPE) and microhybrid (Opallis/FGM), pre–heated and room temperature, and a resin cement (AllCem/FGM) were tested. Following the guidelines from ISO 4049, each material (0,05mL) was pressed under 15kg between two glass plates covered with polyester film for 180 seconds. After pressed, the material was light polymerized with a LED for 40s and the film thickness measured using a digital micrometer. When testing the groups of pre-heated resin composites the material was heated (64°C) on a specific device (CalSet/AdDent) before all procedures. Data were analyzed using t-Student, ANOVA and Tukey post hoc test (α =.05). **RESULTS:** Resin cement group showed the lower film thickness mean (28,2 µm), followed by the pre-heated microhybrid (45,3 µm). The higher values were obtained with nanofilled composite. Nanofilled room temperature group presented the highest thickness (96,1 µm). Statistical difference was found between all groups. **CONCLUSION:** Pre-heating influenced the film thickness of both composites. In this study a microhybrid composite showed better results among resin composite groups. Although not presenting the lower film thickness, as resin cement, some composites could be used for luting indirect restorations when heated.

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KEYWORDS

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INTRODUCTION

Composite and ceramic inlays and onlays have been used for many years and some clinical studies prove their effectiveness.[1-3] Findings from a randomized clinical trial with 11 year follow-up show less fractures and good durability on composite indirect restorations, compared to direct restorations. Although, some bad rates for this treatment are related to the luting material, such as margin discoloration or even restoration debonding.[4]

Resin cements are currently the most employed materials for aesthetic indirect restorations luting. Clinical studies have shown good results for conventional resin cements.[5] Recently, pre-heated resin composite has been suggested as a luting material for this purpose.

The use of resin composite could provide some benefits such as: 1) better mechanical properties compared to the resin cement. 2) Absence of chemical activation responsible for color instability. 3) Increased amount of colors for aesthetic purposes. 4) Ease of manipulation.

The main factors that influence the luting agent choice are the film thickness formed by the material, wear resistance, marginal sealing, stain resistance and the ability to cure. It is known that composites have improved wear resistance due to their higher percentage of inorganic filler.[6] Another advantage lies in the resin stain resistance due to their better mechanical properties in the tooth-restoration interface. Resin cements present color instability which is partially explained by the presence of chemical activators.[7-8] Also, the degree of conversion of light activated heated resin composites under ceramics blocks of 2, 3 and 4 mm is similar to dual resin cements.[9]

Resin composite viscosity is affected by the material temperature. The film thickness of composites was already described in the literature.[10] Although, the film thickness of new commercial composites and a comparison with a resin cement is necessary.

Thus, the aim of this study was to analyze the film thickness from two light-curing composite resins pre-heated and a dual resin cement used for cementation of indirect restorations. The null hypothesis was that there would be no difference between the resin based materials tested.

MATERIAL AND METHODS

In this study, 3 materials were divided into 5 groups. Two resin composites, a nanofilled (Z350XT / 3M ESPE, St. Paul, MN, USA) and a microhybrid (Opallis / FGM, Joinville, SC, Brasil), and a resin cement (AllCem / FGM, Joinville SC, Brasil) were tested. Resin composites were tested at room temperature and pre-heated at 64° C. All tests were realized in a room with controlled temperature of 21° C. Composition of each material and groups are reported on table 1. Film thickness test followed ISO 4049 guidelines. A total of 10 specimens were made for each material tested.

Table I. Material filler load and composition.

Material	Wt (%)	Vol (%)	Composition
Z350 XT (3M/ESPE)	78.5 %	63.3 %	Bis-GMA, UDMA, TEGDMA, Bis-EMA, and fillers.
Opallis (FGM)	79.5 %	58 %	Bis-GMA, Bis-EMA, TEGDMA, UDMA and fillers.
AllCem (FGM)	68 %	N/I	Bis-GMA, Bis-EMA, TEGDMA and fillers.

N/I = Data not informed by the manufacturer.

A standard portion (0.05 ml) of material was placed between two round glass plates covered by polyester films. The pair of plates was pressed for 180 seconds on the top with a 15 kilograms load. After pressed, the upper glass plate was removed and the material was light polymerized with a LED curing device (Optilight Max / Gnatus, Ribeirão Preto, SP, Brasil) for 40 seconds. Then, the polyester films were removed and a disc of material was obtained. The film thickness of each polymerized disc of material was measured with a digital micrometer. Discs were measured 3 times on 3 different spots near its center and the mean for each disc was reported in micrometers. Means of film thickness for each group were recorded.

Resin cement was dispensed on a glass plate and mixed for 10 seconds before the test. The portion of material to be used on the test was measured with a plastic disposable syringe to follow resin composite groups (0.05 ml).

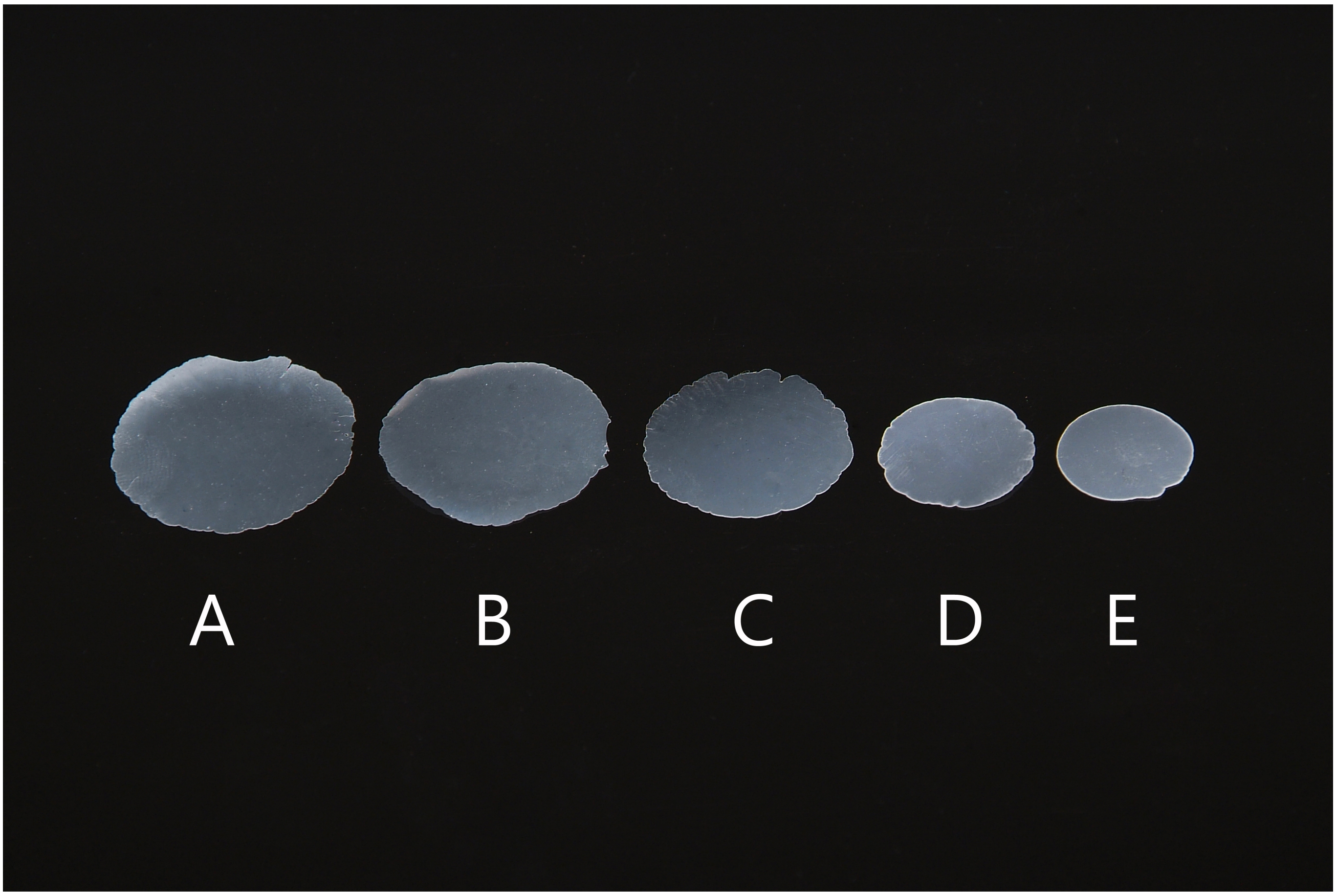
On the groups that pre-heating was used, some additional steps were realized before the film thickness test. A specific device used for heating dental composite materials was used (CalSet / AdDent, Danbury, CT, USA). The same portion of material from other groups was heated inside this device until it reached 64ºC. Temperature was controlled with a digital thermometer inside the device and material was left in the device for 1 minute after it reached final temperature to stabilize. After heating all procedures made were the same as for the other groups. The load was applied on the composites within 1 minute after removal from the heating device, so that the composite could not loose the effect of pre-heating.

Statistical analysis from data was made with SPSS 10.0 software. A two-way analysis of variance test was used to compare means and the post-hoc Tukey test was used to identify different groups (=0.05).

RESULTS

Discs obtained from the test of each light cured material indicate the differences of viscosity between different groups (Figure 1). Table 2 describes results for film thickness for each material. Resin cement group showed the lower film thickness mean. The higher values were obtained with nanofilled composite and both composites presented lower film thickness when heated. Statistical difference was found between all groups, including materials heated and not heated ($p < 0.001$).

Figure 1 – Discs obtained after film thickness test.



Note the difference between the discs obtained with each group related to material viscosity. Disc A was taken from Resin cement group, B from Micro-hybrid at 64º, C from Micro-hybrid, D from Nanofilled at 64º and E from Nanofilled.

Table II. Film Thickness mean for each material.

Groups	% Reduction (for heated groups)	Mean	Std. Dev.	P
Nanofilled at room temperature		96.1A	4.9	<0.001
Nanofilled 64°C	12.5 %	84.1B	3.2	<0.001
Microhybrid at room temperature		59.7C	6.9	<0.001
Microhybrid 64°C	24.2 %	45.3D	2.6	<0.001
Resin Cement at room temperature (Control)	-	28.2E	4.1	<0.001

Different letters present significant statistical difference.

Film thickness reduction with pre-heating was higher for the microhybrid resin (24,2 %) than for the nanofilled resin (12,5 %). Pre-heated microhybrid group presented the lowest resin composite groups film thickness.

DISCUSSION

To achieve a proper cementation of indirect esthetic restorations, several factors must be taken into account. Thus, the mechanism of adhesion, degree of conversion and the film thickness from the cement are determinant for the restoration clinical success. Results from this study showed that heat has a positive influence on resin composite film thickness. This shows how the heat reduces the viscosity of the material causing it to flow more easily. Also, some composites present better film thickness than others. In this study a microhybrid composite presented close thickness to the conventional resin cement. As differences were found among resin composites, pre-heated or not, and resin cement, the null hypothesis of this study was rejected.

Resin cements present lower viscosity than resin composites to serve as a luting agent. This difference is explained by their composition and filler content. Good results of behavior from a microhybrid resin heated to 64ºC were found in this study. Significant film thickness reduction for pre-heated composites was also observed by other authors10. Thus, resin composites can be considered as a good option for luting procedures for their better mechanical properties, price and color options. The use of pre-heated composites on luting procedures was already reported recently in a clinical case.[11]

Some laboratorial tests can measure the rheological properties from materials. The film thickness test shows how the material can flow and how thin it becomes under some load. Unfortunately, this test has been reported with several different methods. Then, comparing results from studies may not be an easy task and should only be done when they present the same procedures. Results from other studies with same methods showed resin cements with similar film thicknesses from the pre-heated microhybrid from this study.[12-13]

Film thickness of composites may vary according to the load volume, load contact surface, shape and size of particles.[14] Smaller particles have bigger contact surface when compared to bigger particles with same load volume. In this study the composite with smaller particles presented the higher film thickness, as expected. Other authors reported the same relation between particle size from this study.[10,14] However, composites with similar load volume and size may present different viscosity. Other factors on the composition of resins can also modify their rheological properties. Manufacturers can adjust the product handling using organic monomers with different properties10. Hence, it is hard to make predictions for some materials because of the many interactions between different structures. Some authors report that it is necessary to carry out tests to observe the behavior of each material.[16]

One aspect that is important when using heated materials on a vital tooth is the potential harm that this could lead to the pulp. Considering that, it was reported that room temperature composite polymerization causes more rise of temperature inside the pulp chamber than the insertion of a heated composite, on the same heating device.[17] Thus, this procedure presents less potential harm to the pulp then a regular direct composite restoration.

CONCLUSION

Based in this study, it can be concluded that pre-heating has an influence on composites film thickness. Also, composition plays major role on material viscosity, and in this study a microhybrid composite showed better results among resin composite groups. Although not presenting the lower film thickness, as resin cement, some composites could be used for luting indirect restorations when pre-heated.

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