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Effect of Translucency of Lithium Disilicate Ceramics on Degree of Water Sorption of Two Resin Cements

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Abstract:

Background : Degrees of translucency in a restorative material are important for masking tooth color alteration. Clinicians must be aware of the relationship between a decrease in translucency and loss of light penetration to avoid the clinical degradation of an improperly cured luting material.

Aim: The aim of this research is to study the effect of 2 degrees of translucency of lithium disilicate ceramics on two types of resin cements.

Materials and methods:

Twenty eight discs were sliced from IPS e-max CAD blocks using two translucencies, divided into two groups (High translucency group and low translucency group)with glass as a control group, used over two types of resin cements (dual and light cured). Water sorption and solubility tests were measured for each resin cement sample.

Result: lithium disilicate translucency has a great influence over the degree of water sorption and solubility of underlying resin cement.

Introduction:

Advancements in adhesive dentistry has encouraged the preservation of tooth structure (1)Based on a minimally invasive approach, restorations are designed to gain retention from the adhesive material rather than the preparation design, thus preserving tooth structure. Lithium disilicate is among the best known and most widely used types of glass ceramics Lithium disilicate (E-max) is a highly aesthetic, high-strength material that can be conventionally cemented or adhesively bonded. (2)

Since the degree of polymerization depends on the amount of light transmitted, therefore it depends on the translucency of the ceramic material used. Adequate polymerization is crucial for determining the life of resin bonded ceramic restorations. Incomplete polymerization of the cement may lead to color instability, toxicity from residual monomer, decreased bond strength, and post-operative sensitivity, leading to increased risk of microleakage and caries. (3) (4)

Aim:

The aim of this research is to study the effect of 2 degrees of translucency of lithium disilicate ceramics on two types of resin cements.

Materials and methods:

Lithium disilicate ceramic blocks :

Two translucencies of the same lithium disilicate ceramic, shade A2 were used with two resin cement types; light cured and dual cured to assess the effect of two degrees of translucency of lithium disilicate ceramics on the degree of water sorption of two resin cements.

Light cured resin cement:

A light-cured, methacrylate resin-based luting material. RelyX Veneer cement is a single component, translucent shade was used

Fig. relyX veneer

3. Dual cured resin cement:

RelyX Ultimate cement is delivered in an automix syringe containing 8.5g base paste/ catalyst paste, For color coordination there are four different shades: Translucent, B0.5 (Bleach), A1 and A3 Opaque

Translucent shade was used.

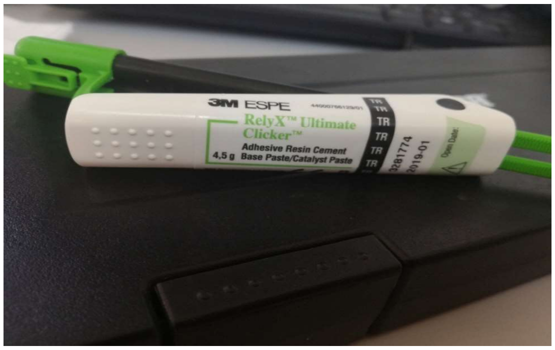

Fig. (3): Dual cured cement.

Sample grouping :

Twenty eight disks were sliced from IPS e-max CAD blocks using two translucencies, divided into two groups:

1st Group : LT Lithium disilicate veneers (n=14)

2nd Group : HT Lithium disilicate veneers (n=14)

Resin cement was also cured through clear transparent glass disks as a control group (n=14).

The cements were divided into 2 groups:

Group I: light cured resin cement

Group II: Dual cured resin cement

Sample preparation:

The specified Lithium disilicate ceramic blocks were sliced (14×14 mm) of thickness 0.5 mm using the (Isomet saw 4000) (Fig. 4) from their respective blocks. All the samples were prepared by the same operator following manufacturer's instructions for the purpose of standardization.

Slices were finished according to manufacturer's instructions and placed into a ceramic furnace; Ivoclar Vivadent Programat P310 for crystallization.

Teflon mould was fabricated to ensure a standard thickness of resin cement samples, with an external diameter of 20 mm. An inner dimension 14*14 square shape was cut with thickness 0.5mm, and a cement space of thickness 0.1 mm

Light curing:

A high intensity LED light(*)* was applied for 20 seconds through the discs, whilst the tip of the curing unit was in contact with the ceramic disc

Water sorption and solubility evaluation:

Water sorption and solubility were determined according to the ISO specification 4049. Immediately after polymerization, specimens were kept for twenty-four hours in a dark container to prevent further polymerization the specimens and placed in a dessicator containing fresh silica gel; to ensure complete dehydration and removal of any remaining water in the specimens and prevent any water absorption from air humidity. (5) The dessicator is then transferred to a pre-conditioning incubator at 37ºC. The specimens were repeatedly weighed after 24h intervals using analytical balance of accuracy 0.001 g until a constant mass (*m*1) was obtained (i.e., variation was less than 0.2mg in any 24h period). Thickness, length and width of the specimens were measured using a digital caliber, rounded to the nearest 0.01mm, and these measurements were used to calculate the volume (V) of each specimen (in mm^3). Then, specimens were individually placed in sealed glass containers containing 10 mL of distilled water (pH 7.2) at 37 ºC. and placed in an incubator at 37ºC

After 7 days of storage, the containers were removed from the incubator and left at room temperature for 30 min. The specimens were washed in running water, gently wiped with a soft absorbent paper, weighed in an analytical balance (m^2).

The specimens were dried inside a desiccator containing fresh silica gel and weighed daily until a constant mass (*m*3) was obtained The water sorption (WS) and solubility (Sol) for the seven days of storage in water will be calculated using the following formula:

where, m1 is the mass of the sample in micrograms before immersion in distilled

* 3 (*)M ESPE Elipar^Tm LED curing light

water, m2 is the mass of the sample in micrograms after immersion in distilled water for seven days, m3 is the mass of the sample in micrograms after being conditioned in a dessicator with silica gel (6)

Statistical analysis:

Numerical data were explored for normality by checking the data distribution, calculating the mean and median values and using Kolmogorov-Smirnov and Shapiro-Wilk tests. Data showed parametric distribution so; it was represented by mean and standard deviation (SD) values. Two-way ANOVA was used to study the effect of different tested variables and their interaction on water sorption and solubility. One-way ANOVA followed by Tukey's post hoc test was used to analyze simple main effects in case of significant two-way interaction. The significance level was set at P ≤0.05 for all tests. Statistical analysis was performed with IBM*® SPSS**® Statistics Version 25 for Windows.

Results:

1-Degree of water sorption of resin cements:

A. Effect of type of cement within the two translucencies :

For High translucency (HT) and the control group, dual cured cement had a significantly higher (mean±SD) value than light cured cement. For low translucency (LT), light cured cement had a significantly higher (mean±SD) water sorption value than dual cured cement.

B. Effect of degree of translucency within the two types of cements:

For both types of cement, there was a significant difference between the two degrees of translucency and pairwise comparisons showed both groups to be significantly different from each other. For both types of cement, low translucency (LT) had the highest (mean±SD) value followed by high translucency (HT) then the control group.

2-SOLUBILITY OF RESIN CEMENTS (µg/mm^3)

A. Effect of type of cement within each degree of translucency:

For high translucency (HT), dual cured cement had a significantly higher (mean±SD) value than light cured cement. For other translucencies, light cured cement had a significantly higher (mean±SD) value than dual cured cement.

B. Effect of Degree of translucency within different types of cement:

For both types of cement, there was a significant difference between different degrees of translucencies and low translucency (LT) had the highest (mean±SD) value followed by high translucency (HT) then the control group. Pairwise comparison for dual cured cement, showed all translucencies to be significantly different from each other. While for light cured cement it showed low translucency (LT) to be significantly different from other translucencies.

DISCUSSION

Inadequate polymerization of resin cements under ceramic restorations may be related to an insufficient amount of light radiation passing through the restorative material to reach and activate the monomers (7).

The water sorption and release of residual monomers; i.e. solubility, are related to the degree of polymerization, the composition of the material: organic matrix and filler particles; and also the solvents used for in vitro studies (8), (9) (10) (11) (12)

Besides the polymerization protocol, sorption and solubility are also explained by the affinity of the organic and inorganic components with water. Hydrophilic monomers and monomers with polar characteristic may account for

* ® IBM Corporation, NY, USA.

** ® SPSS, Inc., an IBM Company.

greater water sorption than hydrophobic monomers (13) (14)

RelyX veneer light-cured cement was used because light cured resin cements are usually used with veneers because of their high esthetic properties and extended working time (15).

RelyX ultimate was also used to compare the difference between light and dual cured cements because chemical activation of this agent could compensate for the loss of light intensity (7)

According to the results of this study, even with the presence of the chemical activation system, the dual-resin cement suffered the negative effects of the limitation of the passage of light, indicating that proper photo-activation has a fundamental role in improving the physical properties of this material. (16)

CONCLUSION

In the light of this study based on the results the following conclusions could be drawn:

Based on the observations described in this study, there is a relationship between ceramic translucency and resin cement water sorption and solubility for both types of cements tested.

Therefore, for surfaces with greater translucency, the resin cements studied provide acceptable values of water sorption and solubility. In contrast, for surfaces with lower translucency, dual-cured resin cements should be preferred.

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