Interaction of fluorescence of resin cements with glass ceramics

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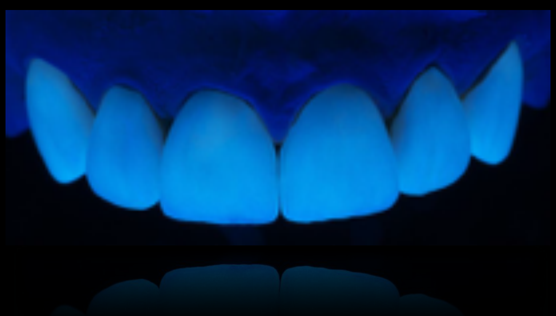
INTRODUCTION

Dental ceramics are today known for their natural appearance and durability of the chemical and optical properties [1,2] Beside this three primary optical properties, there are other secondary properties that affect the overall appearance of the restoration. These include translucency, opalescence and fluorescence. [3] Fluorescence is defined as the absorption of light by a substance and spontaneous emission light at a greater wavelength at 10 -8 seconds of activation. It consists in the emission of a longer wavelength, when a shorter wavelength is used as an illuminant. [4,5,6] In order to give the aesthetic rehabilitation a natural appearance, the ceramic restorations must have a similar fluorescence in terms of color and intensity to the natural teeth, not only under natural light but also under different light sources. [7] The color of the ceramic restoration and the very color of the prepared tooth will affect the appearance of the restoration. However, not only these parameters influence the final result but also, the cement used for rehabilitation. [8] Nowadays, cement systems include several shades since final adjustment of color is often obtained by changing the color of the cement. [9]

OBJECTIVE

To evaluate the emission intensity of fluorescence between resin cement and glass-ceramic, changing the thickness of the ceramic.
As null hypotheses we have: the fluorescence of the resin cement does not affect the fluorescence emission of the glass-ceramic and the thickness of the ceramic does not influence the fluorescence interaction of the resin cement with the glass-ceramic. As alternative hypotheses: the fluorescence of the resin cement affects the fluorescence emission of the glass ceramic; the thickness of the ceramic influences the fluorescence interaction of the resin cement with the glass-ceramic.



MATERIALS AND METHODS

Two self-adhesive resin cements were used: (RelyX Unicem 2 Automix color A2 VITA (RA2) and Translucent (RT); (3M ESPE, Seefeld, Germany) and SpeedCem Transparent color (SCT) and Yellow (SCY) (Ivoclar Vivadent, Schaan, Liechtenstein). Ingots of pre-fabricated glass-ceramic (IPS e.max Press HT A2 (IPS); (Ivoclar Vivadent, Schaan, Liechtenstein) and resin discs (Filtek Supreme XTE A3.5 Body; 3M ESPE) were used. Control groups of ceramic with 0.5 (n=10) and 1 mm (n=10) thickness were formed (Control 1 and Control 0.5), as well as study groups (n=80) of the samples cemented (RA2 0.5; RT0.5; SCY 0.5, 0.5 SCT; RA2 1, RT 1; SCY 1; SCT1). Subsequently, the ceramic cylinders were cut with 12mm diameter and thicknesses of 1mm (RA2 1, RT 1; SCT 1 and SCY 1) and 0.5 mm (0.5 RA2; RT 0.5; SCT 0.5 and SCY 0.5) with a microtome (Isomet 1000, Buehler, Lake Bluff, IL, USA) at a speed of 250 rpm, with refrigeration, in order to obtain 10 samples per group for a total of n = 100. (Fig. 1). The resin disks were produced using a silicone mold with a diameter of 12mm and thickness of 1 mm, polymerized with curing (Elipar S10 LED; 3M ESPE, Seefeld, Germany) for 20 seconds, according to the manufacturer's instructions, in a total of n = 80. To ensure a uniform surface roughness the samples were polished with sandpaper grit 1200 SiC (Buehler, Ltd, Lake Bluff, IL, USA) and the surface roughness measured with an atomic force microscope (AFM, Veeco CP -II), obtaining topographical images (40x40 μm2) in contact mode. The ceramic disks were adhered to the composite resin by the cements in study, with a constant pressure of 50 Newtons (N) for 60 seconds [10] and polymerized for 40 seconds with curing (Elipar S10 LED; 3M ESPE, Seefeld, Germany). The light polymerization was regularly checked with radiometer (Demetron; Kerr, Orange, CA, USA). After polymerization the samples were stored for 24 hours in dry and protected from light environment, prior to testing. Fluorescence spectra were obtained on a SPEX Fluorolog spectrofluorometer 2I2I. (Fig. 2) All spectra were obtained at a wavelength of 380nm at room temperature (Fig. 3). For statistical analysis Student's t-test and one-way ANOVA were used, for a significance of $p < 0.05$.

Fig. 1.Cut of the ceramic discs IPS e.max Press HT (Ivoclar Vivadent, Schaan, Liechtenstein).

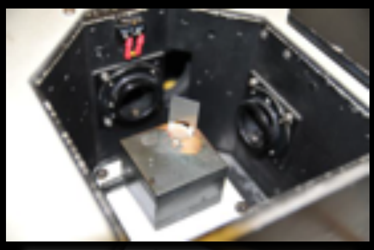


Fig. 2. spectrofluorometer SPEX Fluorolog 2I2I. Sample ready for lecture.

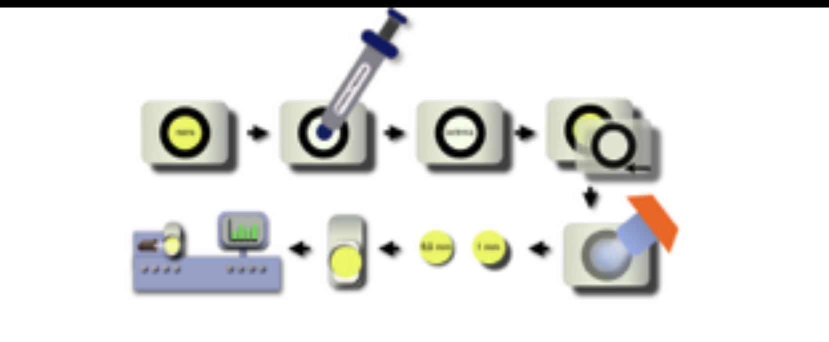


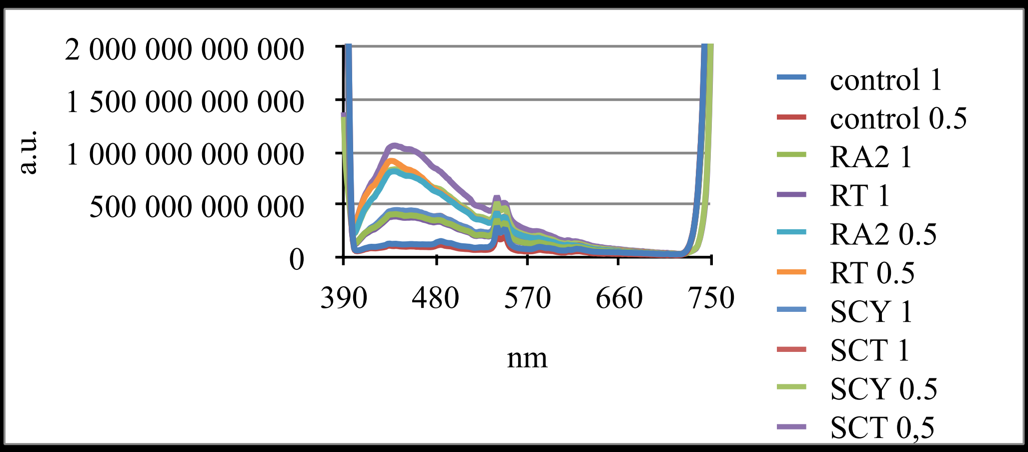
Fig.3. Diagram of the methodology of work. A silicon mold was used as template for production of the resin discs (1) placing the cement on the resin composite (2), placing the disc on the ceramic resin (3); pressure was performed to obtain a uniform thickness (4); sample polymerization (5) there were obtained two study groups with a thickness of 0.5 to 1mm ceramic (6), the samples were marked for later identification (7), each sample was placed in a holder and handles the spectrofluorometer (8).

RESULTS

Within the same group of each cement's manufacturer and equal values (RA2, RT SCY and SCT), groups with different ceramic thicknesses showed significant differences in the intensity of fluorescence emission (Table 1).
By the results obtained in this study, it was found that the intensity of fluorescence emission of resin cements can influence the behavior of the final ceramic restoration, in terms of fluorescence. These results were statistically significant to a thickness of 0.5 mm. Although they were not to a thickness of 1 mm, there was a tendency for a difference in intensity of fluorescence emission.

	Thickness		
Cements	0,5mm	1mm	
SCY	8,39E13 ±	4,49E13 ±	p=0,002 [c]
SCT	1,06E14 ±	4,33E13 ±	p<0,001 [c]
RA2	8,16E13 ±	4,10E13 ±	p= 0,002 [c]
RT	9,19E13 ±	3,87E13 ±	p=0,002 [c]
Control	1,99E13 ±	2,95E13 ±	
	p<0,001 [b] (*)	p=0,130 [a]	

Table 1. Maximum fluorescence intensity (a.u.) (medium value ± standard deviation) (a)ANOVA one-way; (b) ANOVA one-way with Brown-Forsythe correction (c) students *t*-Student(*); (b) Identifies statistically significant differences, for a 95% confidence level.



Graphic 1. Fluorescence spectra of the control groups and study groups.

CONCLUSION

Within the limitations of this study, the two null hypotheses were rejected, since the fluorescence emission intensity of resin cements influenced the fluorescence behavior of glass-ceramic and the thickness of the ceramic influence the fluorescence emission intensity of resin cement with glass-ceramic. We concluded that different cements have different fluorescence emissions; and different thicknesses of ceramic influenced the behavior of the final restoration; samples with a lower thickness showed higher fluorescence emission. (SCT 0.5> SCT 1 (p <0.001); SCY 0.5> SCY 1 (p = 0.002), RT 0.5> RT 1 (p = 0.002); RA2 0.5> RA2 1 (p = 0.002)). Further studies are required in order to consider the optical properties of cements and their influence on the final restoration.
Future studies should study the impact of use of different cement colors on the final color of the ceramic restoration; Study the influence of the subtract in the final behavior of the final ceramic restoration; compare the fluorescence behavior of more resin cements; analyze resin cement components and evaluate its iimportance in the fluorescence, towards an optical behavior similar to that of tooth structure.

CLINICAL IMPLICATIONS

This study reveals the importance of the cements choice and ceramic thickness in a rehabilitation work fully with ceramic.

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