# COMPARATIVE STUDY REGARDING THE FLUORESCENCE OF DIFFERENT TYPES OF COMPOSITE RESINS

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## ABSTRACT

The aim of study was to compare the level of fluorescence emission of two types of composite resins customary used in dental practice. **Material and method**. Two composite resins were used in this study: Herculite XRV (Kerr Company) and Z250 (3M ESPE). The enamel was restored with shades A3 for both composite resins, while dentine was restored with A3 for Herculite and universal dentine shade for Z250. From each material were performed 6 samples having 50 mm in lenght, 5 mm in width and 1mm in height. The samples were obtained by materials photopolymerisation between two glass plates with a LED lamp (LED B, Guilin Woodpwcker Medical Instrument Co., Ltd, China) for 40 seconds. The fluorescence emission of the composite resins was assesed by spectrometry (using spectrometer device LS 55, Perkin Elmer Inc, USA). The samples were excited using an UV fascicle with wavelength spectrum between 330-630 nm. The spectrum of emission was recorded using software FL Win Lab. **Results**. Considering this spectrum, the fluorescence emission for Herculite XRV dentine had the peak around 452 nm. For Herculite XRV enamel, considering the same spectrum of wavelenght, the fluorescence emission had the peak around 443,5 nm. The fluorescence emission of Z 250 dentine recorded the peak for wavelenght spectrum of UV fascicle between 330 şi 630 nm. **Conclusions**. For both tested materials, the fluorescence emission of dentine shades was higher comparing with enamel shades. The highest values of fluorescence emission were recorded for highest values of wavelengths, for both composite resins included in study.

**Keywords:** composite resins, fluorescence, spectrometry

## INTRODUCTION

The development of adhesive dentistry allowed obtaining excellent features of aesthetic direct restorations, similar with those of natural teeth. To reach virtuousness, dental practitioners should possess actual information about the composition and properties of the dental aesthetic materials and to be in control of modern restorative techniques. More, the dental practitioner must have knowledge about dental morphology and optical properties of dental tissues (1,2,3,4). The optical properties of dental materials include translucence, opacity, fluorescence and opalescence.

Fluorescence is a type of photoluminescence characterized by the adsorption of the energy emitted by UV radiations, by an object that emits afterwards a light energy in visible spectrum. The natural

fluorescence of dental tissues should be reproduced in the composite resins restorations, assigning vitality and luminosity (5). The natural teeth are polychromatic structures. The crown is performed by superposing the enamel and dentine shades, with complementary roles in the teeth final aesthetic expression. The dentine presents low translucence and high chroma and is responsible for the basis shade and chroma of natural teeth. The enamel is more translucent, and has the role to attenuate the chroma and to act like an optical fiber able to transmit light to the dentinal base (6,7,8). As enamel contains hydroxylapathite crystals, smaller than wavelength of visible light, the penetrating light is dispersed. Thus a blue aspect is observed in incisal areas, where there is no superposition of dentine shade. The dispersion of light appears in higher range of wavelengths, specifically in the oral areas, attributing an orange shade (9).

The UV light is found both in night clubs and in usual daily light. Because of the industrial atmospheric pollution associated with destruction of ozone protective layer, the quantity of UV light considerably raised. The fluorescence is responsible by the brighter and whiter aspect of natural teeth. However this property alters the characteristic color of teeth in natural light that attribute the vital aspect of natural teeth. Also the fluorescence is responsible for the lack of correspondence between direct or indirect restorations and natural teeth. Despite to the fact that visible color of the tooth fits in with that of restoration, the different degree of fluorescence conducts to the lack of harmony with adjacent dental structures.

The **AIM OF STUDY** was to compare the fluorescence of two types of composite resins customary used in dental practice.

## MATERIAL AND METHODS

Two brands of composite resins were used to restore enamel and dentine- Herculite XRV (Kerr Company) and Z250 (3M ESPE). The enamel was restored with shades A3 for both composite resins, while dentine was restored with A3 for Herculite and universal dentine shade for Z250. From each material were performed 6 parallelepipedal samples with 50 mm lenght, 5 mm width and 1mm height. The samples were obtained by materials photopolymerisation between two glass plates with a LED lamp (LED B, Guilin Woodpwcker Medical Instrument Co., Ltd, China), 850-1000mW\cm2 and wavelenght 420-480 nm, for 40 seconds. The fluorescence of both composite resins was assessed with spectrometer LS 55, Perkin Elmer Inc, USA. This type of spectrometer contains a xenon source with high energy, with role to maintain the samples integrity. The other advantages are as follows: minimal whitening of samples, longer time interval for sample photo-stimulation to obtain stability and accuracy, detection ability using lower wavelength of light comparing with other sources, large UV spectrum (up to 200 nm) with higher flexibility regarding the selection of photo-stimulating fascicle, and the possibility to keep close the sample for the assessing of chemo-luminescence and bio-luminescence. The samples were stimulated with UV fascicle with wavelength spectrum between 330-630 nm. The spectrum of emission was recorded using software FL Win Lab.

## RESULTS

Considering the wavelenght spectrum of excitation fascicle between 330-630 nm, the peak of fluorescence emission for Herculite XRV dentine was around 452 nm. The same peak was found for a wavelenght spectrum between 370-650 nm. For Herculite XRV enamel, considering the same spectrum of wavelenght, the peak of fluorescence emission was found around 443,5 nm. Using

wavelenght spectrum between 370-650 nm, the peak of fluorescence emission was found around 440,5 nm. Filtek Z250 enamel fluorescence emission presented a peak around 446 nm, for a wavelenght spectrum between 330-650 nm. Also the peak of fluorescence emission was found for a stimulative fascicle with wavelenght spectrum between 370-650 nm. Filtek Z 250 dentine recorded the peak of fluorescence emission around 446,5 nm, for wavelenght spectrum between 330 şi 630 nm. For the same dentine shade and a wavelenght spectrum between 370-650 nm, the peak of fluorescence emission was around 452,5 nm.

Considering wavelenght spectrum between 330-630 nm, the material that presented the peak of fluorescence emission was Z 250 dentine. For both tested materials, dentine shades presented higher peak of fluorescence emission comparing with enamel shades. For wavelenght spectrum between 370-650 nm, the peak of fluorescence emission decreased as follows: Z 250 dentine, Z250 enamel, Herculite dentine and Herculite enamel.

The increasing of stimulative fascicle wavelenght spectrum was associated with an increasing of fluorescence emission peak, both for Herculite and Z250, enamel and dentine shades.

## DISCUSSIONS

The last years recorded an increase of patient demands for aesthetic direct restorations, as well as an increase of informed patients. New aesthetic materials have emerged on market, to satisfy the patients and dentists requests. (10, 11). The restoration of aesthetic function requests adequate treatment plan and high accuracy of restoration technique. The concept related to the optical properties of dental aesthetic materials is new. The dentist is confronted with a difficult decision regarding the selection of a composite resin able to satisfy both patient and dentist requests.

The natural teeth have the ability to emit visible light when exposed to UV light, phenomenon known as fluorescence. As emitted light is combined with reflected light, there is a perceptible increasing of structure luminosity. The fluorescence phenomenon can be created by UV light emanated from sun light, that excite the dentine photo-sensibility (12). This phenomenon is produced by dentine, presenting higher degree of fluorescence because of the high concentration of organic pigments photo-sensitive to UV spectrum.

Different researches aimed to determine the translucence/opacity and fluorescence of different composite resins used for direct coronal restorations (13). The different degrees of translucence for the tested composite resins were attributed to the variations in the material composition. The diameter and volume of fillers should be controlled for better reproduction of composites color as the color is correlated with dispersing and adsorption features directly related to the translucence (14).

The fillers are responsible for the light inner dispersion, producing a phenomenon similar in that observed in enamel (11). Even when the fillers present transparency, the opacity can be correlated with dispersed light that can reach maximum values when the diameter of fillers is similar with wavelength of visible light. The translucence degree is influenced by the material composition. Thus the translucence of nano-fillers could be related to the fillers diameter.

The analysis of fluorescence properties in the study of Pachaly et al.(2008) revealed that composite resins as Charisma (Heraeus Kulzer), Z350 (3M/ESPE), Supreme XT (3M / ESPE), and Z250 (3M/ESPE), presented low fluorescence. This research agreed with the study of Villarroel et al. (2004), that assessed the fluorescence of composite resin Charisma.

The composite resins that presented an average fluorescence were Opallis E (MGF), Opallis D (MGF), Nova Charisma (Heraeus Kulzer), Durafi ll (Heraeus Kulzer), Natural Look (DFL), TPH Spectrum (Dentsply), Tetric Ceram (Ivoclar Vivadent). Similar results were also observed when TPH Spectrum and Tetric Ceram were assessed.

The basic components of restorative materials do not present fluorescence, but the fluorescence appears because of the aggregation in some degree of fluorescent components attributing to the material diverse degrees of fluorescence. These differences can be related to the existent variations in their composition (13). The results of other studies revealed a correlation between the composition of composite resins and their optical properties, as well as between translucence and fluorescence (13). However, it was difficult to establish an accurate relation, as the scientific data and technical information related to these materials, do not expose details related to composition, that information being considered industrial secret. The best available parameters are comparative studies between different materials and the studies that compare natural teeth with restorative materials.

The dentine fluorescent bands are similar with enamel fluorescent bands. Some authors found fluorescent bands with wavelengths of 400 nm in enamel attributing this fluorescence to a compound similar to dityrosine (15). The positions of peaks of fluorescence emissions, in dentine, are similar but were attributed to a cromophore using different techniques. The fluorescence emissions were observed in enamel (16, 17). These fluorescence emissions present the same spectral features. The biochemical analysis of cromophore is not yet performed. Thus research seems useful regarding the possibility to use these emissions in the dental caries detection (18). The visual aspect of dentine can be attributed to the wavelength spectrum of adsorption and dispersion, last being related to the high density of dentinal tubules in the inner layers of dentine. The fluorescence emission bands of dentine and enamel are very similar, but the fluorescence emission bands of 400 nm for both tissues are the same, because of different cromophores. The factors that produce fluorescence emission at highest wavelengths are unknown.

The data presented in this study influence the clinical practice, as the performance of the aesthetic restorations is directly related to the proper choice of the restorative material, that request the knowledge of composite resins optical properties.

## CONCLUSIONS

1. Excitation with wavelenght between 330-630 nm and 370-650 nm, Z250 dentine recorded highest level of fluorescence emission.

2. Excitation with wavelenght between 410-650 nm, Herculite dentine recorded highest level of fluorescence emission.

3. For both tested materials, the fluorescence emission peaks of dentine shades were higher than enamel shades.

4. For highest wavelenghts spectrum of stimulative fascicle were recorded the highest values of fluorescence emission for both tested composite resins.

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