

Journal section: *Esthetic Dentistry*Publication Types: *Research*

doi:10.4317/jced.61174

<https://doi.org/10.4317/jced.61174>

Analysis of translucency parameter and fluorescence intensity of 5 resin composite systems

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Hirata R, Jde Abreu JLB, Benalcázar-Jalkh EB, Atria P, Cascales AF, Cantero JS, Sampaio CS. Analysis of translucency parameter and fluorescence intensity of 5 resin composite systems. J Clin Exp Dent. 2024;16(1):e71-7.

Received: 31/10/2023

Accepted: 18/12/2023

Article Number: 61174 <http://www.medicinaoral.com/odo/indice.htm>

© Medicina Oral S. L. C.I.F. B 96689336 - eISSN: 1989-5488

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Indexed in:

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Abstract

The natural outcome of dental composite restorations highly depends on the translucency of the enamel layer and fluorescence. This study aimed to evaluate the Translucency Parameter (TP) and Fluorescence Intensity (FI) of five different resin composite systems. Seven discs of each composite brand were prepared in a circular increasing thickness. For TP, a spectrophotometer measured the samples' colors. The color difference within the white/black backgrounds obtained the translucency parameter. For FI, samples were exposed to UV light, and ten photographs per group were taken. Each specimen was analyzed digitally. A mixed model analysis to a 95% confidence level analyzed groups differences. Higher values of TP were observed for ED and EL, followed by FZ. The lowest values were observed for EO and FO. FI values descending order was EL>FO>EO>ED>FZ. The composition of fillers and organic matrix influenced the behavior of fluorescence and translucency of resin composites.

Key words: *Resin composite, fluorescence, color, translucency parameter.*

Introduction

Resin composites are the most used restorative materials for direct restorations. Mechanical properties and optical behavior benefit the material used in anterior and posterior teeth, offering a long-term evaluation success (1-

3). Its range of clinical indications, adhesive properties associated with dental adhesives, and possible repair or replacements push clinical usage in daily practice. Color matching is a critical aspect of using resin composites in dentistry. The goal is to select a resin composite

material with color and shade closely resembling a patient's natural teeth, resulting in a seamless and aesthetically pleasing restoration.

Natural results of composite restorations depend on the optical properties of different opacities and translucencies used in the layers (1,4,5). Adequate opacities of dentin/opaque composite layers used in a correct thickness can block the oral cavity background (6). Opaque composites reproduce the natural dentin's opaque properties, while enamel shades reproduce the enamel's translucency. Translucency is an intermediate stage between total opacity and transparency, and enamel composites vary this behavior brand broadly to brand (1) and influence the final color of the composite (7). Final restorations' greyish and whitish effect often comes with dentin and enamel shades translucency mistakes.

The capacity of masking the background is defined as color masking used as a reference of the relative translucency parameter (8), evaluated by the ΔE of the resin composite over black and white backgrounds obtained with a spectrophotometer (9). This method was also applied in our tests.

Besides translucency aspects of restorative materials, the natural tooth structure presents visible light emission when exposed to ultraviolet rays, called fluorescence (10-12). This behavior makes teeth appear brighter, presenting a whitish-blue appearance (13), and dentin substrate presents stronger fluorescence intensities than enamel (14).

Restorative materials should reproduce the same properties; otherwise, a low luminosity aspect would be

presented, for instance, during the day and at nightclubs under the black light (15,16). Ideally, composites' fluorescence intensities should be similar to natural dentin and enamel, even after aging (17). Inorganic fillers such as luminophore agents like ytterbium, cerium, europium, and terbium were included in the composition to provide a fluorescence behavior (10,11).

Fluorescence can be measured using a fluorescence spectrometer (17,18), photography attached to a UV illumination (19), a direct spectrometry (20), and a monochromator-based multi-mode reader (21). Our test was conducted using UV light emission captured by a digital camera and data with specific analysis of values of red (R), green (G), and blue (B) displayed field (22). This study aimed to analyze the translucency parameter (TP) and fluorescence intensities (FI) of five composite resin systems. The null hypothesis is that all composite systems will have no difference between translucency and fluorescence levels.

Material and Methods

Materials tested are listed in Table 1. Groups were divided into: Group EO: Estelite Omega EA2 (Tokuyama, Tokyo, Japan), Group FZ: Filtek Z350XT A2E (3M Oral Care, Saint Paul, MN, US), Group ED: Empress direct A2 enamel (Ivoclar Vivadent, Schaan, Lichtenstein), Group FO: Forma A2E (Ultradent, Indaiatuba, Sao Paulo, Brazil), Group EL: Essentia LE (GC, Tokyo, Japan). Disc-shaped specimens ($n=7$) of each composite brand were prepared using a Teflon mold in a circular shape in increasing thickness (6 mm diameter X 3 mm thickness).

Table 1: groups and composition of materials tested [23-25].

Groups	Materials	Manufacturer	Type	Monomers and fillers	Batch
EO	Estelite Omega EA2	Tokuyama, Tokyo, Japan.	Supra-nano filled	Bis-GMA, TEGDMA, silica/zirconia spherical particles. 78 wt% 82 vol% Mean 0.2 μm	8041
FZ	Filtek Z350XT A2E	3M Oral Care, Saint Paul, MN, US.	Nanofilled	Bis-GMA, UDMA, Bis-EMA, PEGDMA, TEGDMA 72.5 wt%/ 55.6 vol%	NA51854
ED	Empress direct A2 enamel	Ivoclar Vivadent, Schaan, Lichtenstein.	Nanohybrid	UDMA, Bis-GMA, TCDMA, ytterbium trifluoride, prepolymer, mixed oxide and glass particles. 75-79 wt%/52-59 vol%	Y13928
FO	Forma A2E	Ultradent, Indaiatuba, Sao Paulo, Brazil.	Nanohybrid	Bis-GMA, TEGDMA, Bis-EMA, UDMA. Filler load is 64.5% by volume for the body shades, 64.8% for the enamel shades, and 63.5% for the dentin shades. 5-50 nm range.	D083H
EL	Essentia LE	GC, Tokyo, Japan.	Microhybrid	Bis-GMA, UDMA, TEGDMA, Bis-EMA, Bis-MEPP. 81 wt%/52-65 vol% prepolymerised fillers (17 μm): strontium glass (400 nm), lanthanide fluoride (100 nm), fumed silica (16 nm) FAISi glass (850 nm)	1704282

The composite from each brand was filled in the mold, covered with glass plates in both directions, and filled in 2 different increments (light polymerized between increments). Light pressure was applied on both sides of the samples to eliminate the filling excess to obtain a smooth plane. All specimens were light polymerized for 40 seconds by a Spectrum Curing Light through the glass plates' top and bottom. The samples were kept in distilled water at 37 °C for 24 hours. After this period, the samples were removed from the mold and polished using a series of silicon carbide papers (600-, 1000-, and 1500-grits) to mimic clinical polishing systems (26).

-Translucency parameter

Two different backgrounds were used to calculate the translucency parameter (TP) and reproduce the discolored or stained tooth structures and the oral cavity's darkness (27): a black and white background. The same background was used for all samples measured in the same room to ensure light standardization. A spectrophotometer (Vita Easyshade V; Vita Zahnfabrik) measured the samples' colors and calibrated them according to the manufacturer's instructions. Values were obtained according to the CIE L*a*b color system, the same used for the previously described test. The color difference (ΔE^*ab) within the white and black backgrounds obtained the translucency parameter.

Statistical analysis was performed with a 1-way analysis of variance and a Bonferroni test to a 95% level of confidence.

-Fluorescence

From each group, one specimen at a time was placed in a box (with its inside walls painted black) under UV light (DW 54828, Damar). Afterward, a reflex digital ca-

mera, Nikon D90 with 105-mm f/2.8 Macro lens (Nikon Corporation, Tokyo, Japan), was used without the flash to capture an image of each specimen placed, in a predetermined position, inside the box. Ten photographs per group were taken. Subsequently, a digital photo editing program (Aperture 3.0, Apple, Inc.) was used to analyze each specimen's central portion as shown on the digital photographic image, as previously described (28).

The fluorescence analysis was conducted for each specimen as follows: each photograph was opened with the "Aperture software," then the "Adjustments window" on the left side of the screen was selected, and a graph showing the values of red (R), green (G), and blue (B) was then displayed (Fig. 1). The Loupe tool was selected, setting it to "focus on loupe" and 100% expansion. Then this Loupe was positioned over the specimen pictures, and the cursor was placed at the center of the area to be evaluated. The B value (in the "Adjustments window") was visualized in the screen's left-side graphic. B shade's brighter pattern in the evaluated image area corresponds to the specimen's more significant fluorescence.

Statistical analysis was performed with the Kolmogorov-Smirnov test to check normality and mixed model analysis to a 95% confidence level to analyze group differences.

Results

-Translucency parameter

The mean ΔE values \pm standard error (SE) for the Translucency Parameter (TP) are described in Table 2 and graphed in (Figs. 2,3).

The highest values were observed for ED and EL ($p=0.00$), followed by FZ ($p=0.00$). The lowest values

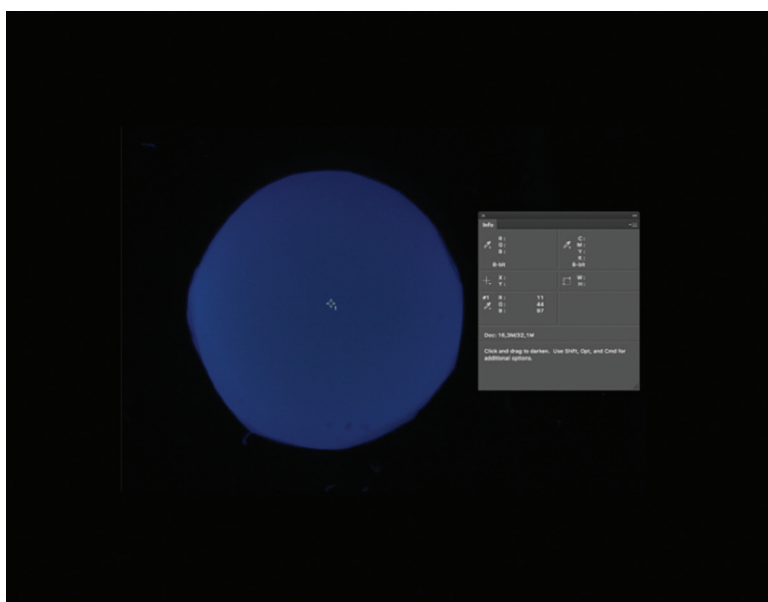


Fig. 1: Digital photo editing program (Aperture 3.0, Apple, Inc.) analyzing the central portion shown on the digital photographic image.

Table 2: Mean ΔE values (Translucency parameter) with investigated composites' standard deviations (SD). Means followed by different letters differ from each other in the same column ($p < 0.05$).

Group	E ± SD
ED	18.36 ± 4.92 A
EL	20.51 ± 4.97 A
EO	8.9 ± 3.61 C
FZ	13.88 ± 1.8 B
FO	8.27 ± 1.59 C

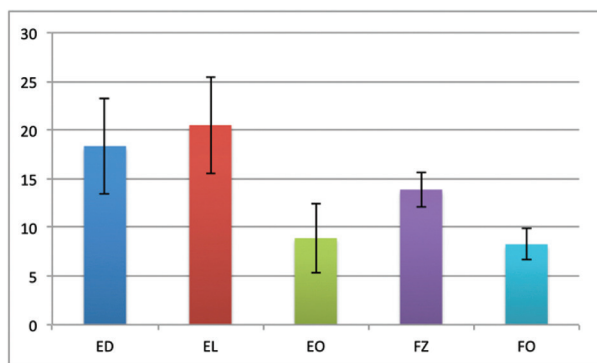


Fig. 2: Graph showing translucency parameter values for each composite tested.

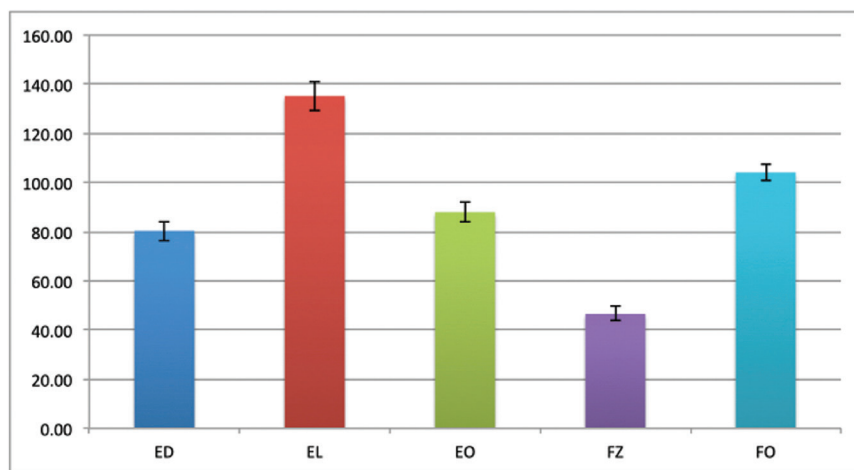


Fig. 3: Graph showing mean fluorescence values for each composite tested.

were observed for EO and FO without statistical differences ($p=0.69$).

-Fluorescence

The mean values and standard deviation of Fluorescence Intensity (FI) for each group are given in Fig. 4 and Table 3.

The mean B Values ± SD of the resin composite was sta-

tistically different for all groups ($p=0.000$). The highest values were recorded for EL (135.25 ± 6.08), followed by FO (104.14 ± 3.45), EO (88.00 ± 4.15), ED (80.4 ± 4.03), and FZ (46.60 ± 2.91) (level of significance of 5%).

Discussion

The null hypothesis was rejected once all groups showed differences in TP (translucency parameter) and the FI (fluorescence intensity).

The high translucency behavior of an enamel composite allows light to pass through the restorative material highlighting the chroma and opacity of the dentin layer used in the restoration (1). For an artificial enamel to reproduce the natural aspect of the tooth structure, adequate translucency is necessary.

TP or translucency parameter is defined as the color difference found for the material at a specified thickness. It is an alternative method compared to %T (Percentage of Translucency) measured by light transmittance (29). For TP, the color difference between the material in optical contact with ideal black and white backings is captured by a spectrophotometer (30). For samples with less than 2mm., the average TP was from 8 to 21 (31). Absolute TP values of materials tested obtained in our study are according to the literature (29).

EL group demonstrated a higher translucency parameter (20.51) than other groups but was not statistically

different from ED (18.36). Both are statistically different from all other materials. This result reflects the highly translucent appearance of the enamel shades of both brands (El and ED). The reference of translucency should always be the natural human enamel that presents a TP of 18.7 in 1mm thickness (32), which is very close to the ED group of our study.

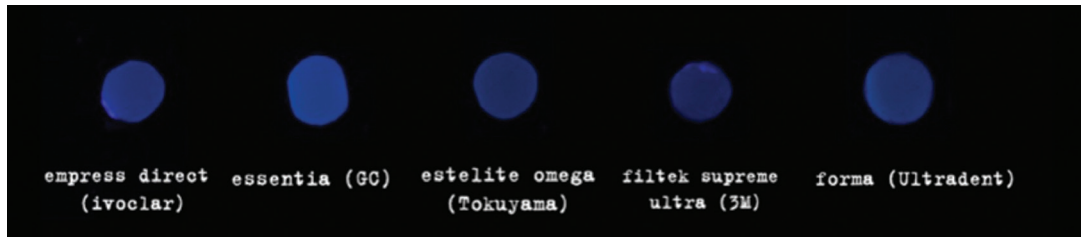


Fig. 4: Composite groups under UV light in a dark box.

Table 3: Mean fluorescence values with standard deviations (SD) of investigated composites. Means followed by different letters differ from each other in the same column ($p < 0.05$).

Group	Fluorescence \pm SD
ED	80.40 (4.03) D
EL	135.25 (6.08) A
EO	88.00 (4.15) C
FZ	46.60 (2.91) E
FO	104.12 (3.48) B

It has to be pointed out that the Essentia System (GC) doesn't present a chromatic enamel like the other brands tested, so the EL (achromatic enamel) was used, which could partially explain the higher translucency obtained compared to other groups (1). The number of pigments of the "chromatic" enamel A2 used for other brands could interfere with the translucency of these materials (33).

A translucency in enamel layers is fundamental to reproducing natural teeth' optical properties and creating natural effects (1,5). Good opacity offered by dentin/opaque shades and translucency from enamel shades would allow a thriving esthetic outcome (34). From this perspective, a less translucent enamel composite like EO (TP 8.9) could produce a more opaque and artificial result than a more translucent material like EL or ED. The same result of less translucency (TP) of Estelite Sigma Quick, a similar composite to EO used in this test, compared to Empress Direct was obtained in other studies (29,35).

Translucency is related to the size and shape of the fillers, as well as the monomeric composition of the composite resin. An increase in the size and irregular shape of fillers could increase the scattering of the resin, decreasing the translucency (36), which could partially explain the lower values for FO that present more irregular fillers but couldn't support the same low values for EO that has spherical and small filler particles. Other authors affirm that more minor fillers, like in the EO (20 nm.), could make complex the passage of the light inside

the material (37), explaining the low TP obtained by EO. A higher amount of fillers with lower content of organic matrix should relate to a low TP, but this was also not supported by results once EL presented the higher translucency despite the high filler content (29). More research should be conducted on this matter to define a pattern.

The amount of BIS-GMA used in comparing UDMA and TEG-DMA could influence each composite system's translucency level. BIS-GMA has a refractive index much closer to silica than other monomers (38). The refraction index of the resin matrix and the filler play a fundamental role in TP (39). Bis-GMA (RI = 1.54) has a refractive index similar to that of the silica filler (RI = 1.53) than that of TEGDMA (RI = 1.46); the difference in translucency may be attributable to this (39). Bis-EMA showed higher translucency compared to Bis-GMA and TED-GMA when compared to the composites formulated with the other base monomers(40). Still, even FO and FZ presenting Bis-EMA in composition, the translucency was low, maybe due to filler size (nanometric fillers and nano spherical particles).

The fluorescence of restorative material influences the value/brightness of the final restoration, becoming a vital behavior needed in an esthetic composite system. Nevertheless, some authors point out that natural teeth' UV-induced fluorescence did not influence tooth color under standard daylight conditions (41).

Also, many patients, especially younger ones, complain about missing this brightness under UV light at parties and social events in restaurants, pubs, and nightclubs once these are the night lights in these environments.

Specific fillers in the resin formulation can control and increase the fluorescence of various restorative materials (15,16). The organic composition of resin composites also influences the intensity of the fluorescence (42). Manufacturers control technology and fabrication, keeping most of the information confidential. Resin matrix and filler dispersion could lead to less space for embedding the fluorescent pigments, which can be one cause of low values for a pure nanofiller composite like FS, with high particle dispersion inside the monomer (22).

Despite many techniques being used for the analysis of fluorescence behavior, like fluorescence spectrometer (17,18), photography attached to a UV illumination

(19), direct spectrometry (20), monochromator-based multi-mode reader (21), among others, the use of digital photography measuring the intensity of composite resins is reliable and easy to be conducted, and had been used by other authors (19,43). Our test was conducted using UV light emission captured by a digital camera and data with specific analysis of values of red (R), green (G), and blue (B) displayed field (22).

Many wavelengths of excitation were tested (375, 395, and 410 nm), and they were similar for the three brands analyzed, with a maximum emission peak of emission at 450 nm (17). According to Meller & Klein (2012), the best emission peak was 398 nm (15). The Lamp used in this study emits a wavelength from 300 to 400 nm., with a peak I 368nm, the light usually used in nightclubs and bars (UV-A). The same light with a similar methodology was used in previous studies (44). Different composite thicknesses could interfere with the intensity of the fluorescence (18), but samples used in this study used 3mm—thicknesses to standardize results.

FI values are compatible with similar studies using the same methodology (19). Group EL composite showed the highest fluorescence value, significantly higher than other groups (135.25 ± 6.08). The reason for including enamel shades in this analysis is because the layer that offers final fluorescence in composite restorations is the enamel shade, different from the natural tooth, where the behavior comes from the dentin substrate (45). In this sense, the Light Enamel shade provided high final fluorescence.

The Fluorescence of all groups was different statistically under the UV light. Forma presented the second higher intensity of fluorescence, followed by EO and ED. The Absolut FI value obtained for ED was different from studies using the same methodology, probably due to light distance from the sample, the setting of the camera, and other variables (19).

In previous research, 3M Oraltch composites like Filtek Supreme and Z-250 had shown lower intensities of fluorescence peaks, following our results where group FZ (3M Oralcare) showed the lowest results of FI (2,17,21). A low fluorescence composite used as an enamel layer could produce a low luminosity restoration with an incorrect value/brightness and a more greyish effect (45). Other authors that had used composites compared to natural enamel concluded that despite having lower intensity peaks of fluorescence, 3M composites are closer to natural fluorescence than other brands (20). In our test, natural teeth weren't used as a reference being a limitation of the study.

Clinically speaking, more fluorescence intensity (even higher to the natural teeth) could be positive, once aging decreases the fluorescence is about 70% after ten years. Fluorescence is also provided by organic matrix, so the hydrolysis of monomers could cause a decrease in fluo-

rescence levels (42). In ceramic veneers, a highly fluorescent ceramic is used when an increase in luminosity is necessary without losing the translucency of the veneer when covering a dark background (46). From this perspective, a high-intensity fluorescence is attractive, independent of the intensity demonstrated by the natural tooth structure.

Conclusions

With the limitations of this study, it can be concluded that:

The composition of fillers and organic matrix highly influenced the different behavior of fluorescence and translucency of resin composites.

EL and ED presented the highest translucency parameter, which was more similar to the natural human enamel.

The pure nano-filled composite (FZ) showed the lowest FI, while EL presented the highest.

References

1. M. Villarroel, N. Fahl, A.M. De Sousa, O.B. De Oliveira, Jr., Direct esthetic restorations based on translucency and opacity of composite resins, *J Esthet Restor Dent* 23(2) (2011) 73-87.
2. B.R. Kim, S.M. Kang, G.M. Kim, B.I. Kim, Differences in the intensity of light-induced fluorescence emitted by resin composites, *Photodiagnosis Photodyn Ther* 13 (2016) 114-119.
3. F.H. van de Sande, P.A. Rodolpho, G.R. Basso, R. Patias, Q.F. da Rosa, F.F. Demarco, N.J. Opdam, M.S. Cenci, 18-year survival of posterior composite resin restorations with and without glass ionomer cement as base, *Dent Mater* 31(6) (2015) 669-75.
4. S. Diamantopoulou, E. Papazoglou, V. Margaritis, A. Kakaboura, Change of optical properties of contemporary polychromatic resin composites after light curing and finishing, *Int J Esthet Dent* 9(2) (2014) 224-37.
5. N. Fahl, Jr., G.E. Denehy, R.D. Jackson, Protocol for predictable restoration of anterior teeth with composite resins, *Oral Health* 88(8) (1998) 15-22.
6. J.S. An, H.H. Son, S. Qadeer, S.W. Ju, J.S. Ahn, The influence of a continuous increase in thickness of opaque-shade composite resin on masking ability and translucency, *Acta Odontol Scand* 71(1) (2013) 120-9.
7. F.P. da Costa J, Ferracane J, Comparison of various resin composite shades and layering technique with a shade guide. , *J Esthet Restor Dent* 22(2) (2010) 114-24.
8. P.J. Atria, I. Lagos, C.S. Sampaio, In vitro evaluation of surface roughness, color stability, and color masking of provisional restoration materials for veneers and crowns, *Int J Comput Dent* 23(4) (2020) 343-350.
9. B.G. Perez, L.L. Miotti, A.H. Susin, L.B. Durand, The Use of Composite Layering Technique to Mask a Discolored Background: Color Analysis of Masking Ability After Aging-Part II, *Oper Dent* 44(5) (2019) 488-498.
10. M.Y. Park, Y.K. Lee, B.S. Lim, Influence of fluorescent whitening agent on the fluorescent emission of resin composites, *Dent Mater* 23(6) (2007) 731-5.
11. T. Jablonski, M.K. Takahashi, R.T. Brum, R.N. Rached, E.M. Souza, Comparative study of the fluorescence intensity of dental composites and human teeth submitted to artificial aging, *Gen Dent* 62(1) (2014) 37-41.
12. M. Uo, M. Okamoto, F. Watari, K. Tani, M. Morita, A. Shintani, Rare earth oxide-containing fluorescent glass filler for composite resin, *Dent Mater J* 24(1) (2005) 49-52.
13. S.H. Song, B. Yu, J.S. Ahn, Y.K. Lee, Opalescence and fluorescen-

- ce properties of indirect and direct resin materials, *Acta Odontol Scand* 66(4) (2008) 236-42.
14. Y.K. Lee, H. Lu, J.M. Powers, Changes in opalescence and fluorescence properties of resin composites after accelerated aging, *Dent Mater* 22(7) (2006) 653-60.
 15. C. Meller, C. Klein, Fluorescence properties of commercial composite resin restorative materials in dentistry, *Dent Mater J* 31(6) (2012) 916-23.
 16. B. Yu, Y.K. Lee, Differences in color, translucency and fluorescence between flowable and universal resin composites, *J Dent* 36(10) (2008) 840-6.
 17. T.M. Garrido, L.C. Hoshino, R. Hirata, F. Sato, A.M. Neto, V.H. Guidini, R.S. Terada, In vitro evaluation of composite resin fluorescence after natural aging, *J Clin Exp Dent* 12(5) (2020) e461-e467.
 18. M.H. Tabatabaei, A.M. Nahavandi, S. Khorshidi, S.S. Hashemikamangar, Fluorescence and Opalescence of Two Dental Composite Resins, *Eur J Dent* 13(4) (2019) 527-534.
 19. L.D. Conceicao, A.S. Masotti, A.H. Forgie, F.R.M. Leite, New fluorescence and reflectance analyses to aid dental material detection in human identification, *Forensic Sci Int* 305 (2019) 110032.
 20. T. da Silva, H. de Oliveira, D. Severino, I. Balducci, M. Huhtala, S. Goncalves, Direct spectrometry: a new alternative for measuring the fluorescence of composite resins and dental tissues, *Oper Dent* 39(4) (2014) 407-15.
 21. C. Meller, C. Klein, Fluorescence of composite resins: A comparison among properties of commercial shades, *Dent Mater J* 34(6) (2015) 754-765.
 22. L.M. de Lima, J.D. Abreu, F. Cohen-Carneiro, D.F. Regalado, D.G. Pontes, A new methodology for fluorescence analysis of composite resins used in anterior direct restorations, *Gen Dent* 63(5) (2015) 66-9.
 23. N.F. Coelho, F.J. Barbon, R.G. Machado, N. Boscato, R.R. Moraes, Response of composite resins to preheating and the resulting strengthening of luted feldspar ceramic, *Dent Mater* 35(10) (2019) 1430-1438.
 24. E. Can Say, H. Yurdagüven, B.C. Yaman, F. Ozer, Surface roughness and morphology of resin composites polished with two-step polishing systems, *Dent Mater J* 33(3) (2014) 332-42.
 25. B. Korkut, C. Turkmen, Longevity of direct diastema closure and recontouring restorations with resin composites in maxillary anterior teeth: A 4-year clinical evaluation, *J Esthet Restor Dent* (2020).
 26. Y.K. Lee, B.S. Lim, C.W. Kim, Effect of surface conditions on the color of dental resin composites, *Journal of Biomedical Materials Research: An Official Journal of The Society for Biomaterials, The Japanese Society for Biomaterials, and The Australian Society for Biomaterials and the Korean Society for Biomaterials* 63(5) (2002) 657-663.
 27. J.-S. An, H.-H. Son, S. Qadeer, S.-W. Ju, J.-S. Ahn, The influence of a continuous increase in thickness of opaque-shade composite resin on masking ability and translucency, *Acta Odontologica Scandinavica* 71(1) (2013) 120-129.
 28. L.M. De Lima, J.D. Abreu, F. Cohen-Carneiro, D.F. Regalado, D.G. Pontes, A new methodology for fluorescence analysis of composite resins used in anterior direct restorations, *General dentistry* (2015).
 29. D.H. Kim, S.H. Park, Evaluation of resin composite translucency by two different methods, *Oper Dent* 38(3) (2013) E1-15.
 30. W.M. Johnston, Review of translucency determinations and applications to dental materials, *J Esthet Restor Dent* 26(4) (2014) 217-23.
 31. B. Yu, Y.K. Lee, Translucency of varied brand and shade of resin composites, *Am J Dent* 21(4) (2008) 229-32.
 32. B. Yu, J.S. Ahn, Y.K. Lee, Measurement of translucency of tooth enamel and dentin, *Acta Odontol Scand* 67(1) (2009) 57-64.
 33. Y. Miyagawa, J.M. Powers, W.J. O'Brien, Optical properties of direct restorative materials, *J Dent Res* 60(5) (1981) 890-4.
 34. N. Fahl, Jr., G.E. Denehy, R.D. Jackson, Protocol for predictable restoration of anterior teeth with composite resins, *Pract Periodontics Aesthet Dent* 7(8) (1995) 13-21; quiz 22.
 35. V.E. Salgado, G.F. Rego, L.F. Schneider, R.R. de Moraes, L.M. Cavalcante, Does translucency influence cure efficiency and color stability of resin-based composites?, *Dental Materials* 34(7) (2018) 957-966.
 36. B. Yu, Y.K. Lee, Influence of color parameters of resin composites on their translucency, *Dent Mater* 24(9) (2008) 1236-42.
 37. J.A. Yearn, Factors affecting cure of visible light activated composites, *Int Dent J* 35(3) (1985) 218-25.
 38. N. Azzopardi, K. Moharamzadeh, D.J. Wood, N. Martin, R. van Noort, Effect of resin matrix composition on the translucency of experimental dental composite resins, *Dent Mater* 25(12) (2009) 1564-8.
 39. M. Oivanen, F. Keulemans, S. Garoushi, P.K. Vallittu, L. Lassila, The effect of refractive index of fillers and polymer matrix on translucency and color matching of dental resin composite, *Biomater Investig Dent* 8(1) (2021) 48-53.
 40. D. Leyva Del Rio, W.M. Johnston, Optical characteristics of experimental dental composite resin materials, *J Dent* 118 (2022) 103949.
 41. S. Hein, J.J. Ten Bosch, The effect of ultraviolet induced fluorescence on visually perceived tooth color under normal light conditions, *Dent Mater* 34(5) (2018) 819-823.
 42. C. Klein, D. Wolff, C.V. Ohle, C. Meller, The fluorescence of resin-based composites: An analysis after ten years of aging, *Dent Mater J* 40(1) (2021) 94-100.
 43. I. Brokos, M. Stavridakis, P. Lagouvardos, I. Krejci, Fluorescence intensities of composite resins on photo images, *Odontology* 109(3) (2021) 615-624.
 44. R. Sant'Anna Aguiar Dos Reis, L.A. Casemiro, G.V. Carlino, E.C. Lins, C. Kurachi, V.S. Bagnato, C. Pires-De-Souza Fde, H. Panzeri, Evaluation of fluorescence of dental composites using contrast ratios to adjacent tooth structure: a pilot study, *J Esthet Restor Dent* 19(4) (2007) 199-206; discussion 207.
 45. M.F. Sensi LG, Roesner TH, Fluorescence of composite resins: Clinical considerations, *Quintessence Dental Technology* 29 (2006) 43-53.
 46. E.A. McLaren, Luminescent veneers, *J Esthet Dent* 9(1) (1997) 3-12.

Conflict of interest

Non declared.