|| ISSN(online): 2589-8698 || ISSN(print): 2589-868X ||
International Journal of Medical and Biomedical Studies
Available Online at www.ijmbs.info
NLM (National Library of Medicine ID: 101738825)
Index Copernicus Value 2020: 79.44
Original Research Article Volume 6, Issue 04; April: 2022; Page No. 103-108

Assessment of the Color Variation of the Various Nanocomposites: An Invitro Study

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Article Info: Received 07 March 2022; Accepted 17 April 2022
doi: https://doi.org/10.32553/ijmbs.v6i4.2508
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Conflict of interest: No conflict of interest.

Abstract

Aim: The goal of this study was to see how accelerated artificial ageing (AAA) affected the colour of composite resins used in dentistry.

Materials and Methods: We piloted an invitro study with 2 nanofilled Premise and Filtek Z350 and microfilled Spectrum TPH. A total of 90 specimens equally distributed for the three composites were selected. The color measurements were obtained with a Spectrophotometer before and after invitro aging. Data were analyzed using chi square test with $p < 0.05$.

Results: There was observed a significant variation in the shades of all the composites. There was a significant variation between the Nanocomposites and the microfilled composites.

Conclusions: All composite resins depicted a color change and the size of the particles may have impacted the staining of the composites in vitro.

Key words: Color, Composite Resins, Aging.

Introduction

Because of the materials available, cosmetic dentistry is now possible, but it may create concerns when it comes to selecting restorative materials, given the ambiguity about the effects of time on chemical compounds, which can lead to faults and a loss in durability. The demand for high-color-stability restorative materials has risen. [1] A number of laboratory experiments have looked at the mechanical and aesthetic qualities of the composite resins that are available in order to reduce mechanical failures and colour change. [2-5]

These researches are important for the development of composite resins, as well as the creation of novel materials and application methodologies. [6-9] This has resulted in a significant scientific, industrial, and technical advancement, demonstrating an expanded utilisation of such materials beyond their original intended purpose of anterior tooth replacement. [10]

Surface deterioration, superficial and marginal colouring, and other structural changes occur in these materials over time.

[11,12] Furthermore, there is evidence that their colour stability and particle composition are linked. The interface between the organic matrix and the filler particles has long been thought to be a crucial location for water absorption and, as a result, for composite resin colour instability. [13,14]

According to studies, composite resins with bigger particles degrade more quickly and are more vulnerable to water absorption and colour change. [13,15] When it comes to colour stability, another thing to consider is the shade, since clearer composite resins absorb more colours than darker composite resins. [13]

Color change is definitely one of the most difficult changes that composite resins go through, resulting in rapid and severe patient displeasure and throwing doubt on the necessity for entire or partial replacement.

[11,16]

Composite resins can discolour with time for a variety of causes, both inherent and extrinsic. Because it replicates the very complicated oral environment, artificial ageing might create such a change by the effect of UV radiation, humidity, and temperature variations. [17]

The goal of this study was to see how accelerated artificial ageing (AAA) affected the colour of composite resins used in dentistry.

Materials and Methods

We piloted an invitro study using 2 nanofilled Premise and Filtek Z350 and microfilled Spectrum TPH. A total of 90 specimens equally distributed for the three composites were selected. The color measurements were obtained with a Spectrophotometer before and after invitro aging.

The Teflon matrix was designed with a flawlessly smooth inner coating to suit the criteria for specimens with dimensions of 15 mm in diameter and 2 mm in height, resulting in samples with opacity and diameter consistent with spectrophotometer calorimeter colour readings.

The protocols were followed for curing the specimen based on manufactures instructions.

After the initial reading, the samples were placed for artificial staining with the coffee and tea drinks for aging. [19]

Post aging, the specimens were again read with the spectrophotometer. Thus, we obtained measures of color change (ΔE) before and after artificial accelerated aging, which was automatically calculated by the formula:[20,21] Values of Δ L*, Δa*, Δb*, correspond to the difference of the values L*, a*, b*, respectively, compared to the first color reading (initial). ΔE

values ≥ 3.3 are considered clinically unacceptable.[22]

Data were analyzed using IBM SPSS ver21 and applying chi square test with $p < 0.05$.

Results

We observed a significant variation for all the composites before and after the aging. The colorimetric results of the samples obtained before and after the artificial accelerated aging are shown in Tables 1,2

We also observed there was a significant variation between the three composites. Table 3.

Table 1: Values before the aging of the composite resins

Composite resin	L	A	B	ΔL	ΔA	ΔB	ΔE
Premise	61.38	1.91	16.52	−0.31	0.07	−0.71	1.19
Filtek Z350	68.73	1.01	12.74	−0.52	0.42	0.41	1.92
Spectrum TPH	61.87	1.12	15.64	0.86	0.11	−0.26	1.52

Table 2: Values after the aging of the composite resins

Composite resin	L	A	B	ΔL	ΔA	ΔB	ΔE
Premise	66.39	2.57	10.09	3.22	0.17	−8.67	9.44
Filtek Z350	69.63	2.77	13.69	3.3	−0.81	−8.33	9.19
Spectrum TPH	70.48	3.36	13.82	2.52	−0.96	−11.41	13.2

Table 3: Comparison of the aging between the composite resins for the ΔE.

Composite resin	Premise	Filtek Z350	Spectrum TPH	p
Before				
Premise	-	2.57	2.09	0.001
Filtek Z350	9.63	-	3.69	0.04
Spectrum TPH	7.48	3.36	-	0.021
After				
Premise	-	2.51	6.09	0.01
Filtek Z350	6.63	-	2.69	0.001
Spectrum TPH	6.48	2.31	-	0.05

Discussion

Although light-colored composite resins have a higher colour change than dark-colored resins because they absorb more pigment, the results showed that all composite resins had an unacceptable colour change after the procedure, which was influenced primarily by the strong tendency of these resins to submit bluish colour. This can be explained by the potential of a significant breakdown of the organic matrix resins, resulting in the filler particles' tones being expressed in the final colour measurements. Because colour changes are connected to the porosity of the surface, the theory is that ageing promotes an erosion aspect on the surface of restorative materials, exposing the load components and contributing to an increase in staining of composite resins. [23-30]

The same was observed in our study as a difference in the color as calculated by the spectrometry. This demonstrates that the color varies depending on the composition and trademark.

According to studies, the presence of urethane dimethacrylate (UDMA) can result in better conversion and thus greater colour stability of the material, whereas the combination of bisphenol a glycidyl methacrylate (BisGMA) and triethyleneglycol dimethacrylate (TEGDMA) can result in lower colour stability due to a higher propensity to water absorption. [17] In this study, all the composites had similar constituents and hence same was observed.

The size, kind, and volume of charged particles, the type of matrix and monomer employed, the depth of polymerization, and the degree of adhesion to the composite resin matrix and colourants, according to some writers, are all directly connected to the colour stability of these materials. [25-28] Schulze (2003)[18] discovered that composite resins with a smaller number of inorganic particles underwent major colour changes, demonstrating a link between this property and the composition of these materials. This contradicted the findings of the current study, which found that despite all composite resins exhibiting unacceptable colour change after the EAA, the microcomposite resin showed the most colour change.

Composite resins containing big particles, according to Kawaguchi [15], are more vulnerable to water absorption and colour alteration. Since a result, these findings contradict the findings of the current investigation, as the greater viscosity composite resin hybrid, with its resulting low flow, did not show the greatest colour shift when compared to composite resins with smaller particle sizes.

There were few limitations like it being an invitro study and the shades were not similar for all the composites and hence may have impacted the outcome.

Conclusion

Within the limitations of the study it can conclude that all composite resins depicted a color change and the size of the particles may have impacted the staining of the composites in vitro. Further studies are suggested to confirm the present results.

References

1. Dietschi D, Campanile G, Holz J, Meyer JM. Comparison of the color stability of ten new-generation composites: An *in vitro* study. Dent Mater 1994;10:353-62.
2. Cooley RL, Barkmeier WW, Matis BA, Siok JF. Staining of posterior resin restorative materials. Quintessence Int 1987;18:823-7.
3. Douglas WH, Craig RG. Resistance to extrinsic strains by hydrophobic composite resin systems. J Dent Res 1982;61:41-3.
4. Fontes ST, Fernández MR, de Moura CM, Meireles SS. Color stability of a nanofill composite: Effect of different immersion media. J Appl Oral Sci 2009;17:388-91.
5. van Dijken JW. A clinical evaluation of

anterior conventional, microfiller, and hybrid composite resin fillings. A 6-year follow-up study. Acta Odontol Scand 1986;44:357-67.
6. Beun S, Glorieux T, Devaux J, Vreven J, Leloup G. Characterization of nanofilled compared to universal and microfilled composites. Dent Mater 2007;23:51-9.
7. Jeong TS, Kang HS, Kim SK, Kim S, Kim HI, Kwon YH. The effect of resin shades on microhardness, polymerization shrinkage, and color change of dental composite resins. Dent Mater J 2009;28:438-45.
8. Leinfelder KF. New developments in resin restorative systems. J Am Dent Assoc 1997;128:573-81.
9. Pereira SM, Castilho AA, Salazar-Marocho SM, Oliveira KM, Váquez VZ, Bottino MA. Thermocycling effect on microhardness of laboratory composite resins. Braz J Oral Sci 2007;6:1372-5.
10. Cerveira GP, Berthold TB, Souto AA, Spohr AM, Marchioro EM. Degree of conversion and hardness of an orthodontic resin cured with a light-emitting diode and a quartz-tungsten-halogen light. Eur J Orthod 2010;32:83-6.
11. Padipatvuthikul P, Mair LH. Bonding of composite to water aged composite with surface treatments. Dent Mater 2007;23:519-25.
12. Pereira RA, Araujo PA, Castañeda-Espinosa JC, Mondelli RF. Comparative analysis of the shrinkage stress of composite resins. J Appl Oral Sci 2008;16:30-4.
13. Pires-de-Souza Fde C, Garcia Lda F, Hamida HM, Casemiro LA. Color stability of composites subjected to accelerated aging after curing using either a halogen or a light emitting diode source. Braz Dent J 2007;18:119-23.
14. Celik C, Yuzugullu B, Erkut S, Yamanel K. Effects of mouth rinses on color stability of resin composites. Eur J Dent 2008;2:247-53.
15. Kawaguchi M, Fukushima T, Miyazaki K. The relationship between cure depth and transmission coefficient of visible-light-activated resin composites. J Dent Res 1994;73:516-21.
16. Mjor IA. Amalgam and composite resin restorations: Longevity and reasons for replacement. In: Anusavice KJ, editor. Quality Evaluation of Dental Restorations-Criteria for Placement and Replacement. Chicago: Quintessence; 1989. p. 618.
17. Mundim FM, Da Fonseca Roberti Garcia L, Silva Sousa AB, Cruvinel DR, De Carvalho Panzeri Pires-De-Souza F. Influence of artificial accelerated aging on the color stability and opacity of composites of different shades. Minerva Stomatol 2010;59:535-41.
18. Schulze KA, Marshall SJ, Gansky SA, Marshall GW. Color stability and hardness in dental composites after accelerated aging. Dent Mater 2003;19:612-9.
19. Gomes PN, Dias SC, Moyses MR, Pereira LJ, Negrillo BG, Ribeiro JC. Effect of artificial accelerated aging on Vickers microhardness of composite resins. Gen Dent 2008;56:695-9.
20. Stearns EI. Commission internationale de l'Éclairage. Color Res Appl 1988;13:65-6.
21. Pires-de-Souza Fde C, Casemiro LA, Garcia Lda F, Cruvinel DR. Color stability of dental ceramics submitted to artificial accelerated aging after repeated firings. J Prosthet Dent 2009;101:13-8.
22. Ruyter IE, Nilner K, Moller B. Color stability of dental composite resin materials for crown and bridge veneers. Dent Mater 1987;3:246-51.
23. Wendt SL Jr. The effect of heat used as secondary cure upon the physical properties of three composite resins. II. Wear, hardness, and color stability. Quintessence Int 1987;18:351-6.
24. Condon JR, Ferracane JL. *In vitro* wear of composite with varied cure, filler level, and filler treatment. J Dent Res 1997;76:1405-11.

25. Ergücü Z, Türkün LS, Aladag A. Color stability of nanocomposites polished with one-step systems. Oper Dent 2008;33:413-20.
26. Ikeda T, Nakanishi A, Yamamoto T, Sano H. Color differences and color changes in Vita Shade tooth-colored restorative materials. Am J Dent 2003;16:381-4.
27. Inokoshi S, Burrow MF, Kataumi M, Yamada T, Takatsu T. Opacity and color changes of tooth-colored restorative materials. Oper Dent 1996;21:73-80.
28. Nasim I, Neelakantan P, Sujeer R, Subbarao CV. Color stability of microfilled, microhybrid and nanocomposite resins – An *in vitro* study. J Dent 2010;38 Suppl 2:e137-42.
29. Astm Standards G154-00A: Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials. Annual Book of ASTM Standards. Vol. 14. Philadelphia: ASTM; 2006. p. 646-54.
30. Asmussen E. Factors affecting the color stability of restorative resins. Acta Odontol Scand 1983;41:11-8.