ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 3, Issue – 1, January - 2020, Page No. : 244 - 250

Effects of modelling liquid resin & polishing on the colour change of composite resin: An in vitro study

[1]Dr. Srirekha., M.D.S., Professor and head, Department of Conservative dentistry and Endodontics.The oxford dental college and hospital, Bommanahalli, hosur road Bangalore – 560068

[2]Dr. Jayakumar., M.D.S. ,Professor, Department of Conservative dentistry and Endodontics, The oxford dental college and hospital, Bommanahalli, hosur road, Bangalore – 560068

[3]Dr. Sheetal .S, 3rd year PG student, Department of Conservative dentistry and Endodontics, The oxford dental college and hospital, Bommanahalli, hosur road, Bangalore – 560068

[4]Dr. Lekha., M.D.S., Professor, Department of Conservative dentistry and Endodontics, The oxford dental college and hospital, Bommanahalli, hosur road Bangalore – 560068

[5]Dr. Nishat .M. Hussaini, 3rd year PG student, Department of Conservative dentistry and Endodontics.The oxford dental college and hospital, Bommanahalli, hosur road Bangalore – 560068

[6]Dr. Faiqah Lanker, 3rd year PG student, Department of Conservative dentistry and Endodontics, The oxford dental college and hospital, Bommanahalli, hosur road Bangalore – 560068

[7]Dr. Noufal kallingal usman, 3rd year pg student, Department of Conservative dentistry and Endodontics, The oxford dental college and hospital, Bommanahalli, hosur road Bangalore – 560068

Corresponding Author: Dr. Sheetal .S, 3rd year PG student, Department of Conservative dentistry and Endodontics, The oxford dental college and hospital, Bommanahalli, hosur road, Bangalore – 560068

Citation of this Article: Dr. Srirekha., Dr. Jayakumar., Dr. Sheetal .S, Dr. Lekha., Dr. Nishat .M. Hussaini, Dr. Faiqah Lanker, Dr. Noufal kallingal usman, "Effects of modelling liquid resin & polishing on the colour change of composite resin: An in vitro study", IJDSIR- January - 2020, Vol. – 3, Issue -1, P. No. 244 – 250.

Type of Publication: Case Report

Conflicts of Interest: Nil

Abstract

Objective: The present study evaluated the effects of modelling liquid between the layers of composite and the finishing/polishing state of the material on the change in colour overtime.

Methodology: A total of 40 specimens were prepared by plating four increments of composite (filtekZ350; 3M ESPE),half of which were prepared by applying modelling liquid (Scotchbond adhesive, 3M ESPE) between the layers of composite, whereas the other half were prepared without the modelling liquid, following which the specimens were light activated for 20s. These two groups were further subdivided into two groups each, based on the polishing criteria. Initial baseline measurements were made using a spectrophotometer. Half the specimens were stored in coffee and the remaining half in artificial saliva

for 48 hrs and colour measurements were re-assessed and the data was statistically analysed.

Results: All materials showed significant colour change after 30 days of immersion in liquids. The presence of modelling liquid resulted in lower overall colour change. The non-polished specimens showed higher colour changed than the polished specimens.

Conclusion: The use of modelling liquid between layers of composite showed potential for application to delay the staining process over time. Moreover, polishing is essential to provide increased colour stability of the composite restoration.

Keywords: Composite resin, colour measurement, modelling liquid, colour alteration, surface polishing.

Introduction

Since the mid 1960's, resin composites have been the most used dental restorative materials.[1] Composite resins are mostly used in direct/indirect restorations and also for the intraoral repair of porcelain restorations to enhance the tooth contour and colour.[2] Consistency of the color and the color stability of the material are the primary basis for the success of an esthetic restorartion.[3]The properties of a dental composite are highly dependent upon the extent of curing reaction and care taken in placement, but are also heavily influenced by the material's formulation as defined by the manufacturers, and both of which are controlled by the clinician.[4]

The polymerisation shrinkage and the esthetics of the light cured restoration, were found to be the limitations of curing which lead to the introduction of alternative build up procedures such as curing the material incrementally until the entire restoration is placed. The bond developed between adjacent layers is the main basis of this technique.[5]The application of several layers of material is therefore a common clinical step during the sculpting process of composite restorations.[6] However, despite of all satisfactory properties expected when using current composites,[7] some materials are comprised of viscous resin monomers that make it difficult to sculpt and model the composite resin material in the anatomical shape of the tooth. Practitioners have suggested the use of low viscous materials as modeller liquids of resin composites (eg. Dental adhesives), as the surface tension of composite material is reduced by this approach and also enhancing the handling and placement of the restorative material in the preparation.[8] However, the effect of these wetting resins on the physical and mechanical properties of composites is not known.[1]

To serve as a long term esthetic restorative material, composite resin should retain the colour and polish over a long period. Colour stability is defined as the ability of any dental material to be able to retain its original colour. The oral cavity has a dynamic environment with the continuous presence of saliva, micro flora and frequent intake of coloured foods, the colour stability of an esthetic material may be compromised. However, while making a choice over other physical and mechanical properties, the property of colour stability of esthetic dental materials is often ignored.[9] The quality of esthetic restorations greatly depends on finishing and polishing techniques used.[10] Plaque accumulation, secondary caries and gingival irritation serve as a major influence on surface roughness. A roughened surface a resin composite restoration is also likely to be stained by exogenous sources, such as tea, coffee, red wine, leading to discoloration of the material.[1]Meanwhile, accurate finishing and polishing procedures could be used to overcome this problem.[6]

While considering the above mentions factors, the present study evaluated the effects of modelling liquid/resin & polishing on the colour change of composite resin.

Methodology

Specimen Preparation: A total of 40 specimens (6mm diameter x 3mm thickness) were prepared by plating four increments of composite (filtekZ350; 3M ESPE). These specimens were divided into two different groups where, one group of the specimens were prepared by applying modelling liquid (Scotchbond adhesive, 3M ESPE) between the layers of composite (0.5mm thick), whereas the other group of specimens were prepared without the modelling liquid, resulting in a total application of four increments of composite and three layers of modelling liquid simulating an incremental restoration similar to that usually performed in a clinical scenario. Following which the specimens were light activated for 20s using an LED (light emitting diode) Light curing unit.These two groups were further subdivided into two groups each, based on the polishing criteria. Here one subgroup of each group underwent undergo polishing of the surface using a diamond polishing paste and a complete sequence of the polishing kit (shofu) for 15 seconds each by holding the specimens with the help of tweezers.

Staining of Specimens

After 24hr incubation, half of the composite resin specimens (n=10) were immersed in coffee and the remaining half in artificial saliva for 48hrs in an incubator to mimic human oral conditions. The procedure was repeated for 30 days and the solutions were renewed each day.The artificial saliva was prepared in the biochemistry department using the formula given by Shannon[11]. The composition of artificial saliva was 4.2mg/L NaF, 1280 mg/L NaCl, 166.49 mg/L CaCl2 ,125 mg/L MgCl2, 6H2O, 44.74 mg/L CH3COOK, 386mg/L K3PO4.3H2O, 0.05 mg/L H3PO4 (85%) (pH 7).

Color Measurement : Before the immersion of composite specimens in the liquids, the initial colour measurements were made using a spectrophotometer (Vita Easyhade Advance, VITA Zahnfabrik, Bad Sackingen, Germany), and subsequent colour measurements were taken after 30 days of immersion in the liquids.

Before the measurements, the spectrophotometer was calibrated according to the manufacturer's instructions. Each of the specimens were removed from the immersed liquids and rinsed in distilled water and dried with an absorbent paper. Three measurements were conducted at the centre of each specimen against a white background and the mean value was calculated. Colour alterations were determined using the Commission Internationale d'Eclairge L*a*b* colour system (CIE L*a*b*). The CIE L*a*b* system is a three-dimensional colour measurement system where L* is the lightness coordinate, and a* and b* is the chromacity coordinates in the red-green axis and the yellow-blue axis, respectively. Colour alteration values between initial and at the end of 30 days were computed from the mean ?L, ?a and ?b values for each sample with the formula;

?E= [(?L)2 + (?a)2 + (?b)2]

According to this formula, ?L, ?a and ?b are the variation of the L, a and b values, respectively at baseline and after immersion at the end of 30 days.

Statistical Analysis

Statistical analysis was done using in the SPSS software version 22.0. All data were analysed by the Kruskal Wallis test followed by Mann Whitney post hoc analysis. Mann Whitney test was used to compare the mean delta E values between coffee and artificial saliva in each group. The level of significance (p value) was set at $p<0.05$.

Results

Comparison Of Mean Delta E Values Between Different Groups Under The Influence Of Two Different Solutions Using Kruskal Wallis Test

Solution	Groups	N	Mean	SD	Min	Max	P-Value
Coffee	Group 1	5	4.03	3.14	0.5	7.6	0.001*
	Group 2	5	25.36	5.57	18.0	33.3	
	Group 3	5	4.32	2.48	2.0	7.2	

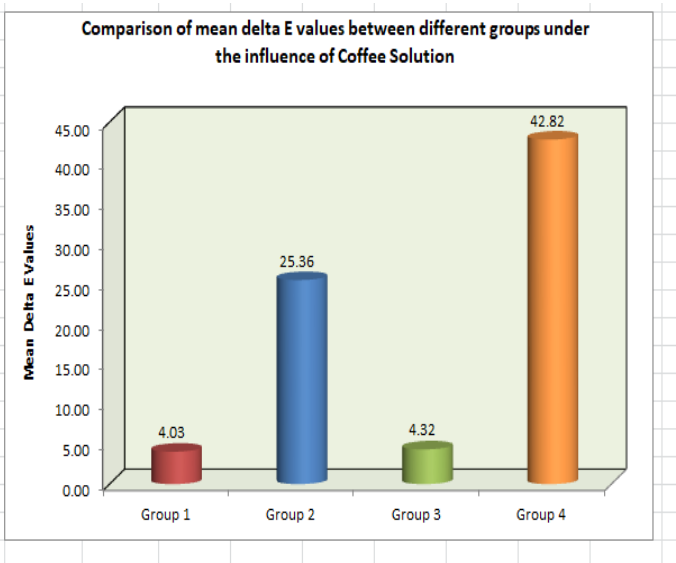
	Group 4	5	42.82	6.65	31.5	48.0	
Art. Saliva	Group 1	5	2.12	1.36	0.5	4.2	0.09
	Group 2	5	5.16	3.15	3.1	10.7	
	Group 3	5	2.90	1.62	1.5	5.6	
	Group 4	5	4.24	1.42	2.1	5.5	

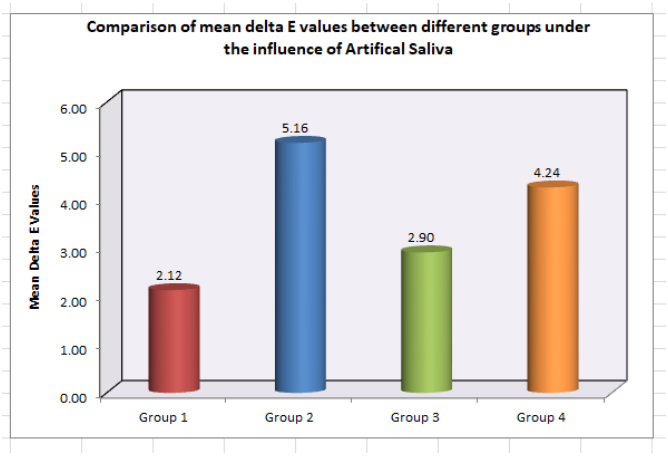
Comparison Of Mean Delta E Values Between Coffee and Artificial saliva in each Group Using Mann Whitney Test

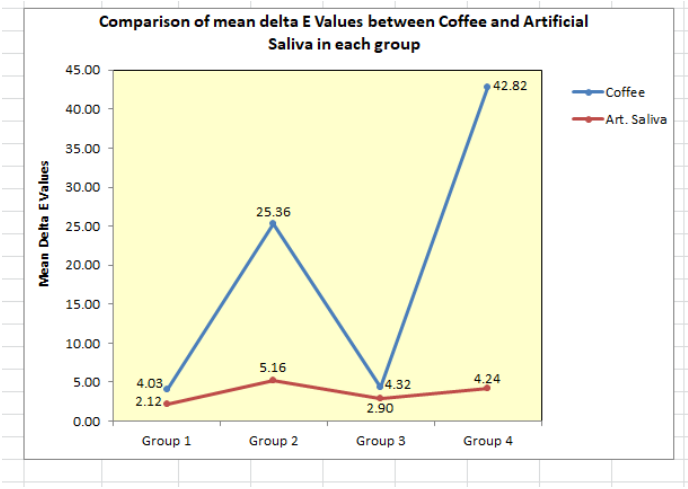
Subgroup	Group	N	Mean	SD	Mean diff	Z	P-Value
Group 1	Coffee	5	4.03	3.14	1.91	-0.841	0.40
	Art.Saliva	5	2.12	1.36			
Group 2	Coffee	5	25.36	5.57	20.20	-2.611	0.009*
	Art.Saliva	5	5.16	3.15			
Group 3	Coffee	5	4.32	2.48	1.42	-1.257	0.21
	Art.Saliva	5	2.90	1.62			
Group 4	Coffee	5	42.82	6.65	38.58	-2.611	0.009*
	Art.Saliva	5	4.24	1.42			

Comparison Of Mean Delta E Values Between Groups in Coffee Solution Using Mann Whitney Post hoc Analysis

Groups	G1 Vs G2	G1 Vs G3	G1 Vs G4	G2 Vs G3	G2 Vs G4	G3 Vs G4
p-Value	0.008*	0.75	0.009*	0.009*	0.02*	0.009*







The delta E values between coffee and artificial saliva in each group showed statistically significant difference in group 2 (with modelling liquid) (graph 1) and group 4(control group) ($p<0.001$). There was a statistically significant difference in the mean delta E values between different groups under the influence of coffee ($p<0.001$) as compared to artificial saliva($p=0.09$)(graph 2).

On intergroup comparison, results were not statistically significant between Group I (both) and Group III (polishing only).($p=0.75$).

Discussion

The ease of handling of resin composite restorations resulting from the use of modelling liquids has led to several dental professionals using this technique[6].This technique is reported as a way of achieving good clinical results with an adequate insertion and especially

modelling of resin composite increments, but scientific evidence that supports this use is lacking.[8] The findings of this study showed favourable results when compared with the conventional technique (without the use of modeller liquid), showing similar or superior physical and mechanical properties and colour variations.[8]

Firstly, it is important to note that the incremental technique used here was carefully performed, playing a crucial role on the preparation of defect-free specimens[8]. A chemical bonding between increments is ensured by the use of an air-inhibited surface layer[12]. An incremental or layering technique has been reported to produce clinically acceptable bond strength, in that it exceeds or is at least comparable to the cohesive strength of the material.[16] Wetting or moistening the composite instrument with a lubricating agent is required to facilitate the insertion and condensation of the composite. Alcohols, bonding resin, and dentin adhesive have been recommended for use to prevent adherence of the composite[14-17].

The layering technique used in this study simulated the clinical application of horizontal composite increments from the apical surface toward the occlusal surface. This technique presents some axial defects due to polymerization shrinkage compared with the flow relaxation method[18], but provided controlled handling for the testing and reliable curing conditions.[5] All of the tested double-layer treatments resulted in clinically acceptable strength values because according to finite element analysis the maximum shear strength a composite would be subjected to is approximately 9 MPa[19]. Even if this is the clinical situation, improvement of interlayer bonding provides a more coherent structure with less geometric variation.[5]

During the build-up process of resin composites, some defects (e.g., air voids, un-packed zones) may remain in the bulk of the material[20],leading to accelerated hydrolytic degradation of the resin matrix[21] or crack initiation/propagation while the material is undergoing a stress event[22]. It can be suggested that the low viscous resin adhesive applied within the composite increments avoided the occurrence of defects/voids during the modelling of the material, making the composite more cohesive and densely-packed and more resistant to degradation[23.] Despite no clear structural and morphological differences could be detected among specimens prepared with or without modeller liquid, specimens prepared with SBMP exhibited considerably higher mechanical stability when compared to the other groups.[8]

Discoloration can be evaluated with various equipments. Since measurements eliminate the subjective interpretation of visual-colour comparison, spectrophotometers and colorimeters have been used to measure colour change in dental materials[24]. In this study, coffee was used as a colorant agent because of its frequent consumption in daily life. Staining of composite resin surface is a complex phenomenon that can involve several mechanisms.

The specimens prepared with the modelling liquid exhibited considerably less discoloration, compared with the specimens prepared without modelling liquid, and this may be explained by the fact that the modelling liquid used, a hydrophobic resin, might have enhanced the cohesion between the composite increments, thus improving the chemo-physical stability of the material; this has been confirmed in a recent study.[8]

Consequently, the hydrolysis of the material was limited, leading to lower surface staining.[8]

Finishing and polishing procedures may influence surface smoothness, which is related to early discoloration and rough surfaces mechanically retain surface stains more than smooth surfaces. Güler, et al. reported that the groups

in which the diamond paste was used were more color stable than the others, which is in concordance with the results from the present study.[25]

Conclusion

The use of modelling liquid between the layers of composite showed potential for application to delay the staining process over time. Moreover, polishing is essential to provide increased colour stability of the composite restoration.

References

1. Tuncer S, Demirci M, Tiryaki M, Unlu N, Uysal O. The effect of modelling resin and thermocycling on the surface hardness, roughness and color of different resin composites. J Esthet Restor Dent. 2013 Dec;25(6):404-19.
2. Özdaş DÖ, Kazak M, Çilingir A, Subaşı MG, Tiryaki M, Günal Ş.Color Stability of Composites After Short-term Oral Simulation. Open Dent J. 2016 Aug 31;10:431-437.
3. Nasim I, Neelakantan P, Sujeer R, Subbarao CV. Color stability of microfilled,microhybrid and nanocomposite resins- An invitro study. J Dent 2010;38(2):137-42.
4. Ferracane JL. Resin based composite performance: are there some things we can't predict? Dent Mater 2013;29:51-8.
5. Eliades GC, Caputo AA.The strength of layering technique in visible light-cured composites. Prosthet Dent. 1989 Jan;61(1):31-8.
6. Sedrez Porto JA, Munchow EA,Brondani LP, Cenci MS. Effects of modeling liquid/resin and polishing on the color change of resin composite. Braz Oral Res.2016;30(1):88.
7. Chen MH. Update on dental nanocomposites. J Dent Res 2010;89:549-60.
8. Munchow EA, Sedrez Porto JA, Piva E, Cenci TP, Cenci MS. Use of dental adhesive as modeller liquid of resin composites. Dental Mater.2016;32:570-577.
9. Ashok NG, Jayalakshmi S. Factors that influence the color stability of composite restorations. Int J Orofac Biol 2017;1:1-3.
10. Beltrami R, Ceci M, De Pani G, Vialba L, Federico R, Poggio C. Effect of different surface finishing/polishing procedures on discoloration of esthetic restorative materials: A spectrophotometric evaluation. Eur J Dent 2018;12:49-56.
11. Shannon IL, Mc Crazy BR, Starcke ENN. A saliva substitute for use by xerostomia patients undergoing radiotherapy to the head and neck. Oral Surg 44:656-661, 1977.
12. Craig RG. Restorative dental materials. 7th ed. St. Louis. The CV Mosby Co,1985;231-41.
13. Tjan AHL, Glancy JF. Interfacial bondstrengths between layers of visible light activated components. J Prosthet Dent 1988;59:25-8.
14. Suzuki M, Jordan RE, Boksman L. Posterior composite resis restoration-Clinical consideration. Netherlands; Peter Szulc Publishing Co,1985:455.
15. Wilder AD. Clinical techniques of placement for posterior composite resins. Netherlands; Peter Szulc Publishing Co. 1985:456.
16. Sneed WD, Draughn RA. Effect of alcohol on the strength of composite resin. Oper Dent 1980;5:47-8.
17. Boksman L, Jordan RE. Posterior composite restorations. In: Jordan RE. 1986:224.
18. Davidson CL, de Gee AJ. Relaxation of polymerization concentration stresses by flow in dental composites. J Dent Res 1984;63:146-9.
19. Caustan B. Repair of abraded composite filling. Br Dent J 1975;139:286-8.

20. Kwon SR, Oyoyo U,Li Y. Influence of application techniques on contact formation and voids in anterior teeth composite restorations. Oper Dent 2014;39:213-20.
21. Ferracane JL. Hygroscopic and hydrolytic effects in dental polymer networks. Dent Mater 2006;22:211-22.
22. Lohbauer U, Belli R, Ferracane JL. Factors involved in mechanical fatigue degradation of dental resin composites. J Dent Res 2013;92:584-91.
23. Ye Q, Spencer P, Wang Y, Misra A. Relationship of solvent to the photopolymerization process,properties and structure in model dentin adhesives. J Biomed Mater Res A 2007;80:342-50.
24. Spina DR, Grossi JR, Cunali RS, Barratto F, da Cunha LF, Gonzagaa CC, Correr GM. Evaluation of discoloration removal by polishing resin composites submitted to staining in different drink solutions. Int Sch Res Notices 2015;34:150-5.
25. Guler AU, Yilmaz F, Kulunk T, Guler E, Kurt S. Effects of different drinks on stain ability of resin composite provisional restorative materials. J Prosthet Dent. 2005;94:118-124.