COLOR STABILITY OF ESTHETIC RESTORATIVE MATERIAL AFTER TOPICAL FLUORIDE APPLICATION

ABSTRACT

AIM: Present study was conducted to compare the effect of topical fluoride agents on color change of three aesthetic restorative materials. **MATERIAL AND METHODS:** Restorative material used were Ketac Fill type II (GIC), Filtek Z350(Composite) and Beuttifull II (Giomer). Topical Fluorides used were Pascal (1.23% APF gel) and Fluoride Varnish (Bifluoride). 24 samples of each restorative material were prepared, which were divided into 8 each, among three groups. Treatment of Group A with APF gel, Group B with Varnish was done and Group C with distilled water which was used as a control, followed by immersing of samples in artificial saliva for 48 hr. Samples were then subjected to colorimetric analysis. Data collected was statistically analysed using one way ANOVA and Tukys Post Hoc Test. **RESULTS:** GIC showed statistically significant change in color in both APF and Varnish group compared to composite and Giomer after 48 hr. **CONCLUSION:** Present study concludes that Topical fluoride agents have detrimental effect on color of aesthetic restorative materials. Giomer was least effected out of the three restorative materials and this can be used as alternative to other restorative material.

CHHABRA, Chaya*
TAVARGERI, Anand**
ANEGUNDI, Rajesh**
PATIL, Shruti**
CHHABRA, Kumar Gaurav***

KEYWORDS

GIC. Composite. Giomer. Topical fluoride. Colorimeter.

Department of Pedodontics and Preventive Dentistry, Jodhpur Dental College General Hospital, Rajasthan, India*
Department of Pedodontics and Preventive Dentistry, SDM College of Dental Sciences & Hospital, Karnataka, India**
Department of Public Health Dentistry, Jodhpur Dental College General Hospital, Rajasthan, India***
Correspondence: chaya.mendon@gmail.com (CHHABRA C)

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INTRODUCTION

Increased demand for esthetic dentistry has been coupled with a rapid rate of development of new restorative material[1]. Numerous tooth colored material such as high viscosity glass ionomer cements, resin composites and poly acid modified resin composite are available for the restoration of primary teeth[2]. In pediatric dentistry glass ionomer cement has been recommended as restorative material for variety of preventive and restorative procedures including occlusal, proximal, labial and lingual glass ionomer restorations, tunnel restoration and cementation of orthodontic bands. It has been suggested as restorative material and as a base for various restorative materials[3].

Composites are frequently used in dental treatment of adolescent and in children. Composites are used extensively to restore the fractured teeth or carious teeth, to splint periodontally diseased and traumatized teeth, as a sealant and as a part of space maintainer[4].

Hybrid material combining the technologies of glass ionomer and resin composite have been developed to help overcome the limitations of conventional GIC such as moisture sensitivity, low compressive strength, mechanical properties and inferior translucency and at the same time maintain their clinical advantage such as fluoride release and adhesiveness to tooth structure . Recently new category of hybrid aesthetic restorative material which differ from both resin modified GIC's and compomer have been introduced known as Giomer[5].

Fluoride therapy as a mean of reducing dental caries has yielded impressive results. Various form of administrating fluoride has been used such as professionally applied topical fluoride, ingestion of fluoride tablets, rinsing with fluoride solution and use of gels containing fluoride[6].

Topical 1.23% Acidulated phosphate fluoride (APF) treatment are recommended for children and adolescent who are at risk for dental caries. In addition daily topical fluoride dentifrices are prescribed to control rampant dental caries, decalcification and plaque accumulation[7].

For more than 30 years fluoride varnishes has been the practice standard for the professionally application of topical fluoride in western countries. Their use as anti-cavity varnish and in treatment for hypersensitivity teeth is increasing among the dentist. The primary reason for the wide acceptance of fluoride varnishes is the ease of application, safe and convenient procedure. With fluoride varnish the amount of fluoride exposure for patients can be better controlled. Fluoride varnish covers the teeth with an adherent film, thereby enhancing the uptake of fluoride ions into the tooth structure[8].

The possible adverse effect of topical fluoride treatment on esthetic restorative

material has been the subject of many studies during last decade. Considerable work has been conducted on the effect of professionally applied APF and Sodium Fluoride agent on ceramic, composite and sealant which revealed important structural alteration and loss of weight that were dependent on the composition of the fluoride agents used .Various formulation of APF contain phosphoric acid and hydrofluoric acid which are known etchant of glass[9].

During application of fluoride gels it applies on both the tooth structure and restorative materials so the effect of fluoride gels on the surface of restorative material are as important as on their effect on dental tissues[10]. Given its color and resinous nature fluoride varnish coating might affect a temporary change in the color of restorative material,[8] however data reporting the effect of fluoride varnish on the color of esthetic material are scanty.

Aim of the study was to compare in vitro effect of topical fluoride on three esthetic restorative materials and compare the color change on application of these topical fluorides such as APF gel and varnish on esthetic restorative materials.

MATERIAL AND METHODS

The study was conducted to compare the effect of application of APF gel and Fluoride varnish on color stability of aesthetic restorative materials.

Three different aesthetic restorative test materials used in the study were (A) Conventional Glass Ionomer cement (Type II, A_2 shade, Ketac™ fill Plus 3M Dental Products, St Paul, MN, USA); (B) Composite (Filtek Z350 nanofilled, A_2 shade, 3M Dental Products, St Paul, MN, USA); (C) Giomer (Beautiful II, A_2 shade, Shofu INC, Tokyo Japan). Topical fluoride agents to be used in the study were (A) 1.23% Acidulated Phosphate fluoride gel (Pascal ,60 second Taste gel); (B) Fluoride varnish (Bifluoride 12 ,VOCO cuxhaven Germany).

Specimens were prepared from three different restorative materials, which were mixed and / or cured as per the manufacturer's instructions. The A2 shade was chosen for all the materials to minimize the effect of shade variation.

Sufficient amount of the material was placed into a mould with a specification of 8mm Inner diameter x 2mm thickness, which ensured the standardization of shape and size of each pellet. The material was pressed between Mylar strips supported by glass slabs on either side. For the light cure materials, glass slabs were replaced by microscopic slides during curing. The material was cured for 40 seconds as per manufacturer's instructions on either side using a visible light curing unit.

Twenty four specimens were thus prepared for each restorative material. Finishing procedures were not done as surfaces were cured against matrix, which resulted in a satisfactory finish.

A total of 72 specimens were prepared from three restorative materials i.e. 24 samples of each restorative material which were grouped as follows: Group A: For treatment with APF Gel (Figure 1); Group B: For treatment with Fluoride Varnish (Figure 2); Group C: For treatment with distilled water. (Figure 3).

Figure1. For Treatment with APF Gel.

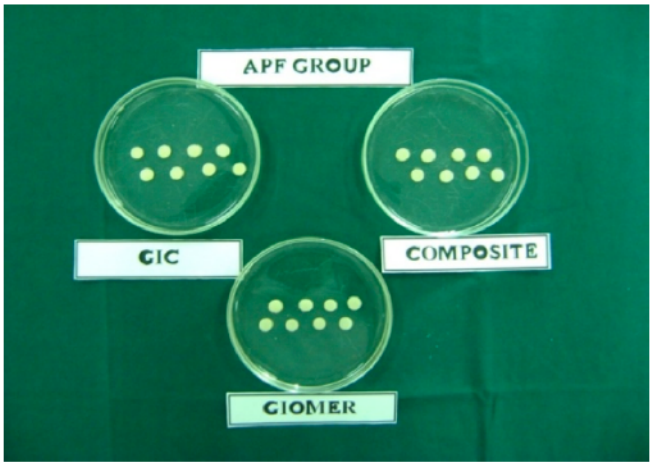


Figure2. For treatment with Fluoride Varnish.

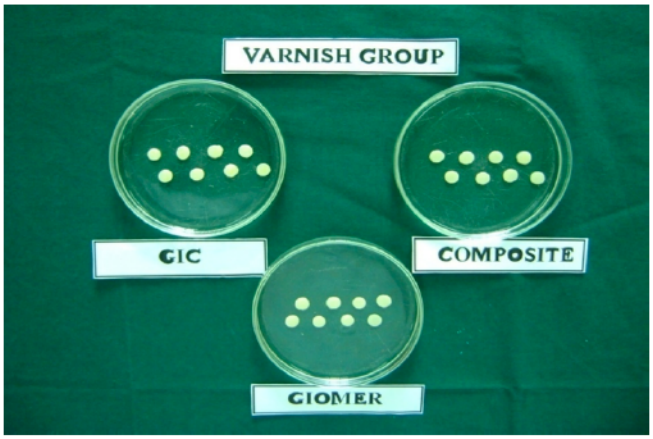
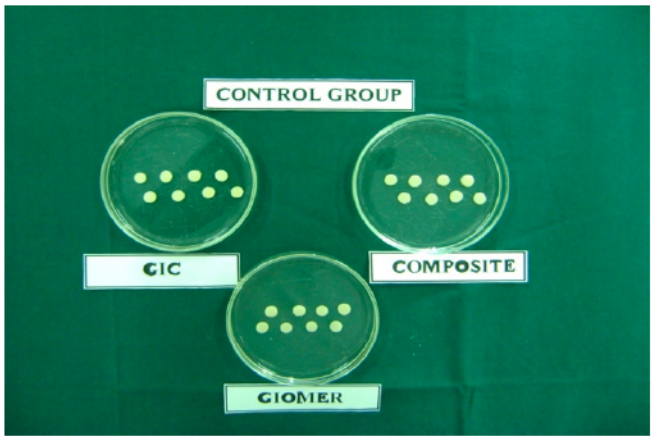


Figure3. For treatment with distilled water.



All the prepared specimens were immersed in artificial saliva for 48 hrs, subsequently were removed, dried and tested accordingly. Twenty four specimens in each group were then subdivided into eight each to evaluate color stability using the colorimeter.

The effect of various experimental condition on the color of the restorative material was assessed by using the Colorimeter [(Spectrolino, (Figure4)] and the CIEL*a*b* measuring system. "L" indicates the brightness (a value of 100 corresponds to perfect white and that of zero to black). "a" determine the amount of red (positive values) and green (negative values) ."b" determine the amount of yellow (positive value) and blue (negative values). For a* and b* scales, a zero value corresponds to a grey. This reflectance colorimeter device was set to produce color parameter based on average daylight.

Colorimetric measurements were performed over 4mm surface by placing the sample over the white standard reflector. This

reflector is a colorles ceramic material exhibiting the following characteristics (D65 mode) L=96, a*= -0.4 and b* =2.3. For all the group the measurements were made after 48h. The measurement of experimental group was compared with that of control group. All comparison of colorimetric values were subjected to statistical analysis by taking the "ΔE" which is obtained by using the formula: $\Delta E=[(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2]$.

Figure 4. Color assessment of the restorative material by using the Colorimeter (Spectrolino).

Difference among groups were ascertained using One Way ANOVA followed by pair wise comparison using Turkey's multiple post hoc test to check the statistical difference between the pair. A 5% level of significance was applied to all the statistical analysis and the results were tabulated accordingly.

RESULTS

The data was entered into the MS Excel (MS Office version 2007 developed by Microsoft, Redmond, WA) and Intercooled STATA version 9.2 (StataCorp, TX, USA) was employed to perform statistical analysis. The level of significance was set at 5%. All the mean comparisons between the groups were done by using ANOVA followed by Post hoc Tukey's HSD test. There is no significant difference in the mean score among the control groups. The mean difference among the APF groups was statistically significant as shown by ANOVA. Post hoc analysis revealed that the mean change in color for GIC was significantly higher than Giomer and Composite (0.029 and 0.026 respectively) p value (0.014).The mean difference among the Fluoride varnish groups was statistically significant as shown by ANOVA, p value (0.009). Post hoc analysis revealed that the mean change in color for GIC was significantly higher than Giomer and Composite (0.01 and 0.045 respectively) as shown in the table 1.

DISCUSSION

Discoloration is a multifactorial phenomenon. There are external and internal causes for this discoloration. Unfortunately all tooth colored restorative materials are known to be susceptible to various degree of discoloration on prolonged exposure to the oral environment[11]. Color stability is one of the

critical factors for long term success of aesthetic restorations[8].

Table1. The color stability of Giomer, GIC and Composite in three different groups.

Group		N	Mean	SD	Post hoc test	P value
Control	Giomer	8	24.66	1.19		
	GIC	8	23.71	0.89		
	Composite	8	24.33	2.02		
APF	Giomer	8	25.30	0.99	GIC>Giomer (0.029)	
	GIC	8	26.64	1.32	GIC>Composite (0.026)	0.014*
	Composite	8	25.28	0.28		
Fluoride Varnish	Giomer	8	23.35	0.96	GIC >Giomer (0.01)	
	GIC	8	25.86	2.38	GIC>Composite(0.045)	0.009*
	Composite	8	23.88	0.78		

Colorimetry is a branch of the science of colors, which assess on the digital expression of the color perceived from the object. In assessing chromatic differences, generally two systems are used: the Munsell color system and the Standard Commission Internationale de L, Eclairage (CIELAB) Color System. The American Dental Association recommends the use of the CIELAB color differential system.

According to this system, all colors in nature are obtained through the blending of 3 basic colors: red, blue, and green in various proportions[12].

The CIELAB color system was used for the determination of the color difference. According to this system, colors in nature are obtained through the bleaching of three basic colors (red, blue, and green) in certain proportions[12]. L - Depicts the lightness/ value. a - Depicts the chromacity in the red- green axis. b - Depicts the chromacity in yellow- blue axis.

The color of dental aesthetic restorative materials is routinely measured with a colorimeter or a spectrophotometer[12]. In our study we used Color Differential System to measure any color change of restorative material. The lightening of the specimens was depicted as an increase in "L" value while the actual hue - chroma change was demonstrated in changes seen in a or b values in CIELAB system. The amount of discoloration after a given period was represented by the color difference value (ΔE).A color difference of ΔE=2 in CIELAB color system are detectable by human eye under uniformly controlled condition. Therefore, a minimum difference of 2 can be used as criteria for the comparison of color changes in the restorative materials[12].

There was a hierarchy of color change by the type of material tested. Color measurements were recorded after immersion in artificial saliva for 48hrs to simulate clinically relevant oral environment. In control

group none of the material showed statistical significant change in color among the mean values. In APF group, GIC showed the statistical significant change in color when compared to Giomer (P<0.029)and Composite(P<0.026).

These result were comparable with those from other studies where APF treatment showed color change in GIC[13]. Although Glass ionomer cements possess anticariogenic property, they lack color stability due to the polyacid content of the material[12]. In this study, GIC showed a noticeable change in color which can be reasoned out due to the degradation of metal polyacrylate salts in the set cement[12]. In dentistry "value" is often considered the most critical and easily recognized component in shade matching[8]. It was observed that the thickness and smoothness of the specimen surface also reflect light differently so that the rougher specimens appear darker i.e. lower in the value[14]. This could be one of the reason why GIC showed more color change compared to other two material tested.

In varnish group GIC, showed statistically significant change in color when compared to Giomer (P<0.01) and Composite (P<0.045) respectively. In our study it was seen that glass ionomer specimen changed to darker color. when compared with other two test material after treatment with Fluoride Varnish after 48h. Similar results were seen in accordance with other study[8]. It was observed by Douglas and Craig[15] (1982) that hydrophilic materials stain more than hydrophobic materials. Hence in our study due to its hydrophilicity and greater surface degradation, glass ionomer material showed significant color change when compared to Composite and Giomer material.

According to Vangroengen rougher surface retain more stain than the smooth surface. The varnish may be deposited in the rougher area of the restorative material, causing increased color change. These results holds good for finding in our study[8].

The relative susceptibility of GIC for staining could be attributed to the porosity of the glass particles[8], dehydration after setting and drying[16], micro cracks[17], that allow for stain penetration and discoloration of restoration.

It was also observed that varnish application upon setting formed a layer on teeth or restorative material with an adherent film which might be the cause of the color change.

Color changes of composites may be influenced by the differences in resin shades, the chemical activator, initiator and inhibitor, polymer quality, type and quantity of filler, oxidation of C=C double bonds, resin thickness, or storage methods of specimens during observation[12]. Composite used in this study Filtek Z350 showed no significant change in the color after application of fluoride varnish.

This may be attributed to the amount of resin and filler particles present in the composite. It is suggested that the type of filler incorporated also influences the surface characteristic of the composite material[18]. According to Dietschi et al.[19], a low staining susceptibility was related to high inorganic filler content of the composite material, as Filtek Z350 contain, 78.5/59.5 wt%/vol% nanofiller particles, this may be the reason why it showed less color change when compared GIC. It was observed that in composite material filler particles appear to be the most likely sites of degradation[13] and resin component is the source of discoloration[12]. Lower discoloration of Filtek Z-350 may be ascribed to the lesser volume fractions of the resin matrix when compared with other material tested. Similar results were seen in the study conducted by Rao M et al.[12] (2009).

In APF and Varnish group, Giomer did not show any statistical significant color change. Even though it contains the pre reacted glass ionomer cement particle as filler these material were least susceptible for color change when compared to GIC material. This could be attributed to the increased amount of filler particle present compared to resin matrix. The study done by Hanan et al.[20] (2009) also showed the least susceptibility of Giomer to color change under different pH.

The results of the present study must be analyzed in the view of its limitations since it is In-vitro study, the exact mechanism of interaction of different restorative materials, topical fluoride agents and the oral environment cannot be delineated in terms of colour stability of different restorative material. The results of the present study must be affirmed by doing In- vivo study to make the conclusion more precise and accurate.

CONCLUSION

(1) 1.23% Acidulated phosphate gel and Fluoride Varnish caused statistically significant increase in color change (Colorimetric analysis) of GIC restorative material;

(2) There was no statistically significant color changes were seen in Giomer group on application of 1.23% acidulated phosphate gel and Fluoride varnish;

(3) Fluoride varnish and APF gel did not show any statistical significant color changes in Composite restorative material.

Therefore careful consideration must be given to the usage of these acidic fluoridated preparations in patients with these restorations. The present study may help paediatric dentist for better application of these new hybrid restorative materials to achieve better aesthetic for a child patient.

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