

Comparative Evaluation of Effect of Commonly used Multivitamins in Pediatric Patients on Color Stability of Different Restorative Materials: An *In Vitro* Study

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Abstract

Background: There is an increased intake of pediatric medicine. It may affect the esthetic and physical properties of the dental material, thereby undermining the quality of restorations. **Aim:** The aim of this study was to evaluate the color stability of three glass-ionomer cement (GIC) after immersing into two different liquid multivitamins medication. **Materials and Methods:** 42 standard specimens were prepared by packing the material into the mold and divided into two subgroups. The samples were immersed in each medication for 2 min each day for 7 days. Color change measurements were noted at the baseline and on the 7th day. **Results:** All tested materials showed color change; however, when comparing the three different restorative materials, Maxxion R exhibited the least colour changes whereas Ionolux was the least colour-stable. **Conclusion:** Multivitamins used in the study had a staining effect on the tested GICs. The discoloration increased with aging time.

Keywords: Colorimeter, Glass-ionomer cements, Multivitamins.

INTRODUCTION

Restoring a decayed primary tooth is a prime requisite not only for the psychological development of the child but also for the physiological development of the permanent dentition.^[1] The color, shape, and surface texture of the teeth are very important in giving a beautiful smile.^[2] A variety of esthetic materials are available in dentistry, including glass-ionomer cements (GICs), polyacid-modified composite resins (compomers), and composite resins.

When utilizing dental materials for a long time, color changes have been identified as the main problem. These impacts are mostly known as intrinsic and/or extrinsic variables, which may be explained by the absorption and adsorption mechanisms.^[3-5] Moreover, there are various literatures that indicated the staining of extrinsic factors, including exogenous liquids/drinks in pediatric dentistry.^[6,7]

Pediatric liquid medications, such as multivitamins, analgesics, antibiotics, antihistaminics, and antiepileptics, are typically given to children due to their increasing requirements. Although the contact of a solution with the teeth during intake is usually not as long as when the liquid is rinsed, at least one of the daily medication doses is designated to be given at bedtime.^[8-10]

In addition, liquid medicines usually take a longer time to clear from the mouth compared to tablets and capsules. Hence, these drugs can place patients at risk for dental caries and dental erosion, especially when used on a regular basis.^[11]

Hence, the purpose of the current study was to evaluate how the color of pediatric restorative materials changed after using specific pediatric medications for a week. Common tools used to assess staining and discoloration include spectrophotometry, colorimetry, and digital cameras.

MATERIALS AND METHODS

The list of pediatric drugs and materials used in this study is given below:

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Restorative materials used are – Ketac™ Molar (3M ESPE, Seefeld, Germany), Maxxion R (FGM, Joinville, Brazil), and Ionolux (VOCO, Germany).

Liquid multivitamins used are – Zincovit (Apex Laboratories Pvt. Ltd.) and A to Z NS syrup (Alkem Laboratories Ltd.)

Methods

The study was approved by the Institutional Ethics Committee on July 27, 2022; the ethical approval number is ECR/748/Inst/MP2015/PR-22.

Specimen preparation

$n = 7$ /one drug specimens (8 mm × 2 mm). A total of 42 restorative ($n = 14$ for each) materials were prepared according to the manufacturer's instructions. After mixing of glass ionomer cements materials were placed into a cylindrical mould (8 mm × 2mm) which was placed on a glass slab and then covered with polyester strip to remove the excess and to standardize the finishing of samples.

Measurement of color change and immersion cycles

The whole assembly (with mold) was stored at 37°C and a relative for 1 h. The cement specimens were carefully removed from the molds after the specimens were removed from the mold; baseline values were done and recorded for color measurements.

The color was measured using a colorimeter. Before measurement, the colorimeter was calibrated according to the manufacturer's recommendations. After that, the specimens of each restorative material were randomly divided into 2 subgroups according to the immersion medium Zincovit syrup, A to Z NS syrup. In this investigation, the immersion cycling protocol was utilized to mimic the actual use of the multivitamins. The samples were immersed in 10 mL of the multivitamin syrup for 2 min each day for 7 days, with 24 h breaks in between cycles of immersion. The specimens were rinsed and kept in deionized water until the following cycle of immersion.

The syrups were refreshed before each immersion. After 1 week of cumulative immersion, second measurements were performed.

After immersing, the specimen was dried with blotting paper. Values were examined using a colorimeter with the same procedure, under the same conditions, and in the same manner, as specified for the baseline measurements, and recorded as 1-week values.

Statistical analysis

The mean, median, and standard deviations were calculated by descriptive statistics, and the groups were compared. The P -value was taken as significant when <0.05 . To compare groups Wilcoxon signed rank, Kruskal–Wallis test were used. The dependent two groups were analyzed using the Wilcoxon signed-rank test. When groups were more than two, the test used was the Kruskal–Wallis test.

RESULTS

In Table 1, Ketac Molar and Ionolux both show significant changes post immersion. In Table 2, material immersed into the A to Z syrup shows significant changes compared to Zincovit syrup.

DISCUSSION

In modern-day dentistry, a major challenge of emphasis is laid over esthetics. The color, translucency, and surface texture of the ideal esthetic restorative material must resemble those of the natural tooth, and it must also exhibit color stability over an extended period.^[12,13]

Wilson and Kent first invented GIC in 1972. It has a low coefficient^[14] of thermal expansion, physiochemically bonds to enamel and dentin, and releases fluoride.^[1]

Materials used in our study are well recognized by pediatric dentists as the best-suited restorative materials to fulfill both restorative and preventive aspects.

Previous studies measured color alterations using CIE L*a*b with proper spectrophotometry and colorimetry, which have

Table 1: Comparison of color values of restorative cements before and after immersion in liquid multivitamin medications

Immersion compound	Test material	Stage	n	Mean	Median	Standard deviation	Z	Asymp. Sig. (2-tailed)
Zincovit syrup	Maxxion R	Pre-immersion	7	0.131	0.135	0.015	–1.352	0.176
		Post-immersion	7	0.136	0.134	0.012		
	Ketac Molar	Pre-immersion	7	0.142	0.131	0.019	–2.371	0.018*
		Post-immersion	7	0.149	0.151	0.019		
	Ionolux	Pre-immersion	7	0.119	0.115	0.015	–1.781	0.075
		Post-immersion	7	0.127	0.128	0.015		
A to Z Syrup	Maxxion R	Pre-immersion	7	0.338	0.138	0.358	–0.169	0.866
		Post-immersion	7	0.137	0.140	0.025		
	Ketac Molar	Pre-immersion	7	0.137	0.134	0.010	–2.371	0.018*
		Post-immersion	7	0.149	0.147	0.016		
	Ionolux	Pre-immersion	7	0.109	0.114	0.021	–2.384	0.017*
		Post-immersion	7	0.120	0.125	0.019		

Test: Wilcoxon signed-rank test. *Significant $P < 0.05$

Table 2: Comparison between color values of restorative cements before and after immersion in liquid multivitamin medications

Group	Stage	Test material	n	Mean rank	Chi-square	df	Asymp. Sig.
Zincovit syrup	Pre-immersion	Maxxion R	7	12.14	3.636	2	0.162
		Ketac Molar	7	13.43			
		Ionolux	7	7.43			
	Post-Immersion	Maxxion R	7	10.86	4.294	2	0.117
		Ketac Molar	7	14.5			
		Ionolux	7	7.64			
A to Z Syrup	Pre-immersion	Maxxion R	7	14.29	8.996	2	0.011*
		Ketac Molar	7	13.43			
		Ionolux	7	5.29			
	Post-Immersion	Maxxion R	7	11.64	5.634	2	0.06*
		Ketac Molar	7	14.57			
		Ionolux	7	6.79			

Test: Kruskal–Wallis test. *Significant $P < 0.05$

advantages such as repeatability, sensitivity, and objectivity. Colorimetry was used in this study.^[13,14]

As Mylar strips were used to create smooth surfaces and we only examined the color stability between baseline and a 1-week interval, we did not include the factors that could have increased the surfaces' resistance to liquid discoloration.

While the 1-week testing period could be considered minimal, it was typically advised that children take liquid multivitamins every 24 h for 10 days or 1 week. As a result, the current research has been designed to be as appropriate to the clinical situation as possible. Furthermore, it should be remembered that continuous medication use will cause additional problems with the staining effectiveness of pediatric medications.

Due to its increased water content, investigators have found GICs as the most resistant material.^[6,15,16]

Other parameters that affect color stability include the type/size of resin/filler particles and the adsorption and absorption characteristics of the colorants.^[3,4,16] GIC is known to have high water content and hence low water absorption which is responsible for reducing staining.^[4,6] A study by Azer *et al.* evaluated the effect of pH on tooth discoloration using food colorant and stated that although food/beverage pigments are associated with extrinsic staining, the degree and type of stain are influenced by pH.^[17] In the present study, all materials were discolored by staining agents tested. The most significant color change occurred following immersion in A to Z NS syrup, followed by Zincovit syrup.

In the present research, Maxxion R showed less color change than Ketac Molar and Ionolux among the three studied restorative materials in both media and immersion regimes. Citric acid's H⁺ ions infiltrate into the glass-ionomer component in acidic solutions, where they may substitute metal cations and induce their dissolution. As a result, the material has a rough surface and voids,^[18] and the undissolved glass particles cause a higher absorption of water and food colorings.^[19] The relative susceptibility of GIC for staining is

due to the glass particles' porosity, the dehydration that occurs during setting and drying, and the microcracks that allow staining and discoloration of the material.^[20-23]

This study reported that Ketac Molar and Maxxion R had the least staining compared to Ionolux. Studies have shown the higher water sorption of RMGIC in comparison to conventional GIC to be due to the rapid water sorption of HEMA,^[24] a significant resin component found in RMGICs. It has also been suggested that materials containing hydrophobic monomers, like composite resin, are more stain-resistant than materials containing hydrophilic monomers, like RMGICs.^[4,6]

According to the results of the current study, despite efforts to mimic oral conditions, specific staining issues for pediatric dental restorative materials may be influenced by dosing irregularly, the composition and structural characteristics of drugs, and individual differences in salivary and fluid content with regard to buffering capacity.^[3,18] As a result, this *in vitro* model usually does not correspond to actual oral environmental circumstances, which might be seen as a shortcoming. By the way, a precise comparison with published literature was impossible due to the lack of prior studies that examined the same materials and methodology. Moreover, the various staining properties of tested pediatric drugs on the color stability of restorative dental materials possibly in relation to their pH levels and sugar contents should be kept in mind by pediatric health professionals and parents as similarly reported for possible long-term undesirable outcomes in terms of erosion and caries.^[15,25,26]

CONCLUSION

Within the limitations at present, it can be determined that: All materials tested were susceptible to staining by all solutions tested, with A to Z NS syrup showing significantly higher susceptibility than Zincovit syrup. In this study, when the comparisons between the three groups were tested, no significant difference was found.

Pediatricians, pedodontists, and parents should be informed about the staining potential of frequently prescribed pediatric medications when combined with various restorative materials to warn them of the possibility of clinical discoloration. *In vivo* study approaches for more research that incorporate widely used medications and restorative materials in pediatric dentistry are required.

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