

Original Article

Effect of pediatric drugs on color stability of various esthetic restorations in pediatric dentistry

ABSTRACT

Background: Maintenance of color throughout the functional lifetime of restorations in teeth is needed for its durability. Color changes have been considered as the major problem of dental restorations. Long-term usage of pediatric liquid medications can stain the tooth as well as the restorative materials whose longevity and acceptability are directly proportional to its color stability.

Aim: The present study aims to evaluate and compare the effect of pediatric drugs on the color stability of different esthetic restorations.

Methodology: Three different restorative materials such as glass-ionomer cement, composite, and ACTIVA KIDS were used to prepare a total of 150 (50 from each) specimens. These specimens were divided into five experimental subgroups ($n = 10$), which were immersed in 5 different liquid medicines. The color stability of all specimens was evaluated by colorimeter before and after the immersion period.

Results: Composites in iron supplements showed the highest color changes, and the least changes were seen in the ACTIVA KIDS - Ibuprofen group.

Conclusion: ACTIVA KIDS is found to be the most resistant to discoloration followed by GIC and composite. Iron supplements showed the highest staining ability among all the medications.

Keywords: ACTIVA KIDS, color stability, composite, glass-ionomer cement, pediatric drugs

INTRODUCTION

Dental esthetics has become very important to satisfy patients regarding high self-esteem through the creation of beauty and attraction.^[1] This demand toward natural appearance by children and parents has led to research for the development of dental materials that simulate natural teeth.^[2] The success of these materials is determined on the basis of functional results and esthetic outcomes.^[3]

Glass Ionomer cements (GIC), compomers, and composites are commonly used esthetic pediatric dental restorations.^[4] Recently, a novel bioactive restorative material has been developed by Pulpdent Company known as ACTIVA KIDS. It is an opaque white shade ideally suited for pediatric dentistry.^[5] These esthetic restorative materials are used for restoring decayed posterior as well as anterior teeth, which helps in

improving disfigured teeth. However, their longevity and acceptability depend directly on their color stability.^[6]

The color changes of these esthetic restorations are due to various intrinsic and extrinsic factors such as food, beverages,

**HITAKSHI P. KATHIRIA¹, ANUP K. PANDA²,
MIRA VIRDA³, VARSHA BUDAKOTI³,
PARA R. DAVE⁴, RAJESHKRISHNA MALGE⁵**


¹Post Graduate Student, ²M.D.S, Head of the Department,

³Senior Lecturer, Department of Paediatrics and Preventive Dentistry, College of Dental Sciences and Research Centre, Ahmedabad, ⁴Post Graduate Student, Department of

Paediatrics and Preventive Dentistry, College of Dental Science and Hospital, Bhavnagar, Gujarat, ⁵M.D.S, Paediatric and Preventive Dentist, Gulbarga, Karnataka, India

Address for correspondence: Dr. Hitakshi P. Kathiria, 3, Satyam Bungalows, Opp. Karnavti Club, S. G. Highway, Satellite, Ahmedabad - 380 015, Gujarat, India. E-mail: hitakshikathiria@gmail.com

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and drug formulations containing coloring agents/additives.^[4] These drugs are in the form of syrups or suspensions that are usually administered to young children facing acute and/or chronic disease conditions.^[7] Low endogenous pH and high titratable acidity of all these medicines may pose unfavorable effects such as erosion, intrinsic/extrinsic staining of tooth surfaces, and dental restorations.^[8] Considering this background and lack of evidence available in the literature, the present study was planned to evaluate and compare the effect of different pediatric medications on the color stability of various esthetic restoration.

METHODOLOGY

The present study was designed as an *in vitro* study on extracted primary anterior teeth which were stored in 10% formalin till its further use in the study. A total of 150 specimens were prepared to receive three different restorative materials (50 in each): GIC, composite, and ACTIVA KIDS. Each tooth from formalin was cleaned with distilled water and a Class V cavity was prepared on each with No. 330 bur. Materials were mixed as per the manufacturer's instructions and restorations were done. Specimens were then stored in artificial saliva for the first 24 h before immersing in liquid formulations. All the specimens were then rinsed again with distilled water and dried with filter paper, and baseline color values were recorded using a colorimeter (Systronics, India). All procedures performed in the study were conducted in accordance with the ethics standards given in 1964 Declaration of Helsinki, as revised in 2013. The study proposal was submitted for approval and clearance was obtained from the ethical committee of our institution.

Each group was further divided randomly into five subgroups ($n = 10$) according to the pediatric drug formulations to be tested: Subgroup 1, amoxicillin + clavulanic acid (amoxyclav DS); Subgroup 2, cephalexin (Phexin); Subgroup 3, iron supplements (Feton); Subgroup 4, ibuprofen (Ibugesic); and Subgroup 5, ibuprofen + paracetamol (Ibugesic plus). Each sample was immersed in 5 different 10 mL undiluted pediatric liquid drugs and agitated for 2 min at every 8 h for 1 week. After 1 week of the cumulative immersion cycle, color measurements were recorded again with the colorimeter.

RESULTS

The values for color change were analyzed using Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.) software version 23. Intergroup and intersubgroup comparisons were

done using one-way ANOVA. $P < 0.05$ was set as a significant value [Table 1]. The highest color changes were seen in Subgroup 3 in each restoration and the lowest color changes were seen in Subgroup 4. A highly statistically significant difference was found among all the restorations ($P < 0.0001$).

DISCUSSION

The importance of color stability of dental restoration is crucial for dental clinicians as well as for the patients.^[9] The medications taken are over-the-counter medicines which are commonly prescribed among children in fever, cough, and anemia.^[10] In the present study, the immersion period was taken for 1 week considering the clinical scenario in which the children are usually recommended to take these drugs for 10 days or 1 week, every 8 h.^[4]

The results showed that composite samples immersed in iron supplements showed the highest color change [ΔE], followed by amoxicillin + clavulanic acid, cephalexin, ibuprofen + paracetamol, and ibuprofen. The lowest ΔE was found in ibuprofen of ACTIVA KIDS restorations similar to that of the study done by Kale *et al.*^[11] and Tuzuner *et al.*^[4]

The composite exhibited significant changes in its color because of its higher water-absorbing property which induces a weaker bond between resin matrix and filler particles, leading to microcracks or interfacial gaps between matrix-filler interface which enables stain penetration and discoloration. Rueggeberg and Craig stated that composite resins with a high amount of resin matrix, low concentration, and larger size filler particles have more tendency toward discoloration.^[12] In the present study, the color stability of GIC was found to be in between composite and ACTIVA KIDS among all five groups. It had been found that GIC has high water content, which does not allow absorption of water into the bulk of the material, making it less susceptible to color changes; however, some water may get absorbed.^[11] ACTIVA KIDS has remarkably low water solubility when compared to composites and GIC resulting in the least color changes among all the restorative materials used in this study.^[5] It is stated that in the literature that if the material can absorb water, it can also absorb other fluids.^[3]

In the present study, the highest color change was seen in the iron supplement subgroup for all restorations as the insoluble ferric sulfide in iron supplements interacts with gingival cervical fluid and the bacterial hydrogen sulfide to produce iron stains.^[13] Furthermore, the high viscosity and the coloring agents of liquid medicines affect the color stability of these restorative materials.^[14,15] As primary tooth

Table 1: Mean of ΔE values of each sub-group and their comparison

Groups	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 4	Subgroup 5	P
GIC	4.886±0.116	4.542±0.084	5.086±0.056	3.988±0.110	4.194±0.105	<0.0001
Composite	6.164±0.078	5.970±0.099	6.490±0.105	5.266±0.070	5.580±0.108	<0.0001
P (GIC vs. composite)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Composite	6.164±0.078	5.970±0.099	6.490±0.105	5.266±0.070	5.580±0.108	<0.0001
ACTIVA KIDS	3.416±0.077	3.174±0.130	3.792±0.091	2.214±0.201	2.806±0.14	<0.0001
P (composite vs. ACTIVA KIDS)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
GIC	4.886±0.116	4.542±0.084	5.086±0.056	3.988±0.110	4.194±0.105	<0.0001
ACTIVA KIDS	3.416±0.077	3.174±0.130	3.792±0.091	2.214±0.201	2.806±0.14	<0.0001
P (GIC vs. ACTIVA KIDS)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	

GIC: Glass-ionomer cement

enamel is less mineralized than that of permanent tooth enamel, it is more prone to unfavorable effects such as dental caries, dental erosion, and staining of the tooth surface or restoration due to frequent usage of these low pH and high sucrose-containing liquid medicines.^[16] Thus, in children, it is advised to use these liquid medicines judiciously.

However, there are certain limitations of the study such as the role of saliva, oral environment or oral clearance of liquid drug formulations that is simulated through *in vitro* experimental conditions may not be adequate to mimic actual oral conditions. In addition, the sample size of the present study is much less, so further research is needed with higher samples.

CONCLUSION

ACTIVA KIDS is the most resistant to discoloration followed by GIC and composite. Among liquid medicines, iron supplements and amoxicillin + clavulanic acid showed the highest staining ability with composite. This information helps the child health caretakers, pediatric dentists, and parents by alerting them of the risk of discoloration of the tooth surface/restorations.

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Conflicts of interest

There are no conflicts of interest.

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