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Comparative Evaluation of the Effects of Various Drug Syrups on The Colour Stability of Glass Ionomer Cements and Composite Resin Restorative Material: An In-Vitro Study

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KEYWORDS

Drug Syrups, Ionomer Cements, Composite Resin Restorative Material

ABSTRACT:

Background: Physicians regularly prescribe different liquid pharmaceutical formulations to the patients. Regular use of some medications may cause discoloration of dental restorations, which may also compromise their durability and longevity. In this study, the impact of various medication formulations on the colour stability of two most commonly used aesthetic restorative materials in patients is to be assessed.

Aim: The current study aims to compare and evaluate the effect of oral drug syrups on colour stability of most commonly used aesthetic restorative materials in patients.

Materials and Methods: Two different restorative materials namely composite resin, and conventional glass ionomer cement (GIC) were used to prepare total 40 disc-shaped specimens having diameter of 15 mm × 2 mm thickness, Through the use of stratified random sampling, the samples of each material were split into four experimental groups and submerged in four different liquid medications: Group I Antibiotic Syrup (Augmentin DUO), Group II Analgesic Syrup (Ibugesic Plus), Group III Multivitamin Syrup (A to Z), and Group IV Cough Syrup (Ascoril LS). To mimic circumstances seen in the oral environment, all samples were stirred for 1 minutes, and the cycle was then repeated eight hours a day for two weeks. With the use of a spectrophotometer, the colour stability of each specimen was assessed. For statistical analysis, Tukey's post hoc HSD test and one-way ANOVA were utilised.

Results: Results obtained revealed that Δ E* (color difference) elevation was significantly low with GIC ($P < 0.001$) and high with composite for all four groups.

Conclusion: GIC showed better color stability with all drug formulations. The highest color alteration was observed in composite resin, whereas GIC showed color stability.

INTRODUCTION:

A beautiful smile is becoming more and more important to patients, as both adults and children are becoming more conscious about it. Because of this aesthetic appeal is becoming more and more important in modern dentistry. One's appearance has a significant influence on their quality of life and is often associated with both social acceptance and professional success. Primary

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tooth restoration is essential for children's physiological and psychological development in addition to resolving cavities.[1]

Dental restorative materials play a pivotal role in modern dentistry, serving to restore the functionality and aesthetics of damaged teeth. In particular, for restorative dentistry, glass ionomer cements and composite resin restorations are frequently used due to their positive characteristics like anti-cariogenic qualities.[2] Glass ionomer cements are well known for their ability to release fluoride and adhere to tooth tissues, whereas composite resins are appreciated for their superior aesthetic results and wide range of uses. Nevertheless, there are intrinsic weaknesses in both materials, such colour stability, that may affect how dental restorations look over time.

The most important aspect of dental materials is colour stability, which has a direct impact on patient satisfaction and cosmetic results. Several things can cause the discolouration of restorative materials, including oral contact to chemicals, drinks, and medications. Among these factors, drug syrups are of particular interest in the context of color stability, as they are commonly administered to the patients for therapeutic purposes. [3]

Discoloration in restorative materials has been identified as a major problem associated with the use of medication formulations. Analgesics, antibiotics, multivitamins, and cough syrup are the paediatric liquid medications that are most frequently prescribed to treat paitient's ongoing medical needs. Thus, utilizing these formulations for short period could also have long-term effects. Their sugar containing properties might result in erosive and/or cariogenic potentials on teeth surfaces because of increased acidity. [5]These medications improve and protect the health by means of active ingredients they contain, but they may have undesired side effects from their inactive contents. Thus, it is important to consider the long-term results when using these formulations.[6]

Clinicians should take great care for understanding how medicine syrups affect the colour stability of composite resin restorative materials and glass ionomer cements. Research in this particular field is, however, extremely limited. Color changes have been considered as the major problems after using dental materials for a long period of time and these effects are mainly known as intrinsic and/or extrinsic factors which can be explained by the absorption and adsorption mechanisms.[8] Intrinsic factors have been shown as variations that occurred between resin matrix and filler components. Moreover, the staining effect of extrinsic factors have been indicated in the literature including various exogenous liquids/drinks in restorative dentistry[9-10.]

This in-vitro study seeks to bridge this gap by providing a comparative evaluation of the impacts of various drug syrups on the color stability of these two prevalent dental restorative materials. The aim is to elucidate whether these drug syrups induce color changes and, if so, to what extent, providing valuable insights for clinicians in selecting appropriate restorative materials and informing patients about potential aesthetic consequences.

This in-vitro study holds the promise of shedding light on an underexplored aspect of dental materials science, ultimately contributing to the development of evidence-based clinical guidelines for dental practitioners. By comparing the responses of glass ionomer cements and composite resins to various drug syrups, this research strives to provide a more comprehensive understanding of the color stability dynamics in restorative dentistry, promoting the delivery of high-quality, long-lasting dental care.

MATERIALS AND METHODS:

This an in-vitro study performed at Department of endodontic and conservative dentistry, and the present in-vitro study was approved by the Institutional Research committee.

Estimated sample size for present study as calculated was 40.

Materials included in this In vitro Study are as follows.

1. GIC: GC type 2
2.Composite: 3M ESPE Filtek
3.Syrup Augmentin DUO
4. Syrup Ibugesic plus
5.Syrup A to Z
6. Syrup Ascoril LS

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Another list of instruments required for present study were:

- Artificial saliva
- Other materials like petroleum jelly
- The spectrophotometer
- Customised metal mould
- Agate spatula and mixing pad
- Cement carrier
- Mylar strip
- LED Light cure unit
- Polishing burs
- Small containers for dispensing medicinal syrups

METHODOLOGY:

1.Specimen preparation:

The current study will include four liquid medications.

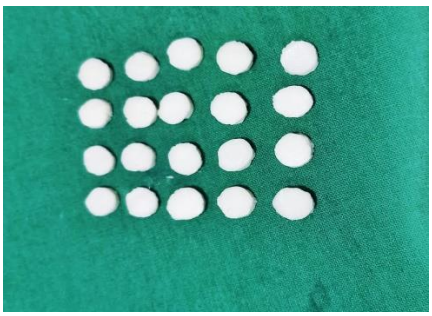
Brand name	Therapeutic class
Augmentin DUO	Antibiotic
Ibugesic plus	Analgesic
A to Z	Multivitamins
Ascoril LS	Cough syrup

And two frequently used restorative materials in pediatric patients namely Glass ionomer cements and Composite resins.

40 disk-shaped specimens of GIC and Composite will be prepared with diameter of 15 mm ×2mm thickness, with the help of a customised metal mould. (The manufacturer's instructions will be followed in preparing samples of both the restorative materials.)

GIC SPECIMEN : Non-reactive lubricant i.e. petroleum jelly will be applied on all sides of mould and material will be mixed with the help of agate spatula on mixing pad and will be placed in mould with carrier. Mould will be covered with Mylar strip and Glass slab will be placed on it to eliminate air entrapment and voids.

COMPOSITE SPECIMEN: The material will be placed in mould and covered with Mylar strips followed by LED light curing unit for 20sec for each increment. After completing the polymerization process, the specimens will be polished using polishing burs with an electric headpiece, at 15,000 rpm for 10 s on each side



2.Subgrouping of specimens

A total 40 specimen of two restorative materials (i.e. 20 specimen of each material) will be sub divided in 4 subgroups according to drug formulation

Drugs name	Group A	Group B
Sub Group-I Antibiotic syrup(Augmentin)	**5**	**5**
Sub Group-II Analgesic syrup (Ibugesic plus)	**5**	**5**
Sub Group-III Multivitamin syrup (A to Z)	**5**	**5**
Sub Group-IV Cough syrup (Ascoril LS)	**5**	**5**

Group A: GIC Group B: Composite

3.Colour change measurement :

After polishing, the specimens will be rinsed and dried with tissue paper, and baseline colour measurements will be performed by using spectrophotometer. The

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spectrophotometer will be calibrated with its own calibration instrument, and measuring will be performed at the center of each specimen. The color stability for all the samples will be measured against a standard white background using a spectrophotometer in laboratory.

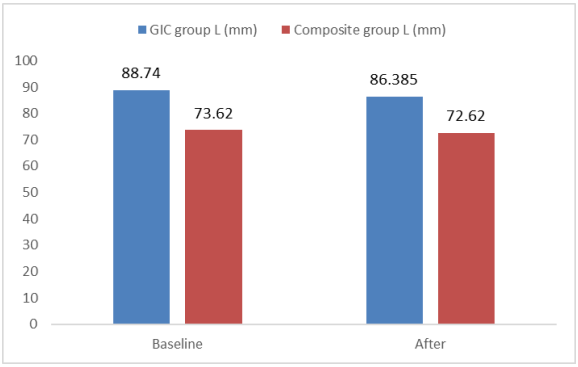
Specimens were randomly divided into four solution groups (n = 5).All specimens will be kept in artificial saliva until assigned to a medication group (4 undiluted pediatric liquids). Then all specimens will be dipped in respected medication group for 1 min, three times a day (at 8 hour intervals). This protocol will be repeated for 2 weeks.

Results-

Table-1: Comparison between GIC and composite group with baseline and after.

	GIC group			**Composite group**		
	L (mm)	**a (mm)**	**b (mm)**	**L (mm)**	**a (mm)**	**b (mm)**
Baseline	88.74 ± 1.07	-0.92 ± 0.22	34.30 ± 1.00	73.62 ± 0.30	-3.28 ± 0.16	29.53 ± 0.52
After	86.385 ± 0.83	-0.86 ± 0.41	34.15 ± 1.39	72.62 ± 1.86	-1.88 ± 2.37	30.73 ± 14.8
p value	**0.0001**	0.588	0.55	**0.034**	**0.01**	0.72

Graph-1:

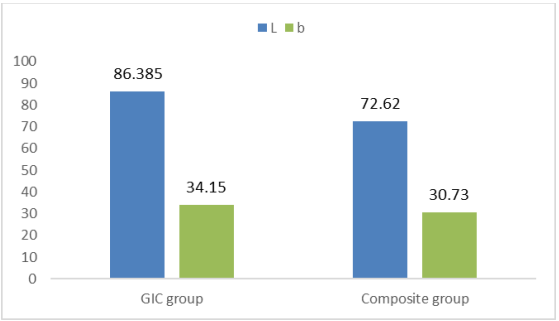


In the initial measurements, the GIC group recorded baseline values of 88.74 ± 1.07 for length (L), -0.92 ± 0.22 for parameter a, and 34.30 ± 1.00 for parameter b. Conversely, the Composite group displayed baseline measurements of 73.62 ± 0.30 for L, -3.28 ± 0.16 for a, and 29.53 ± 0.52 for b. After the intervention ("After"), the GIC group exhibited significant changes in L (86.385 ± 0.83) and b (34.15 ± 1.39), with a notable p-value of 0.0001 for L. In comparison, the Composite group experienced significant alterations in L (72.62 ± 1.86) and a (-1.88 ± 2.37), with respective p-values of 0.034 and 0.01. It's important to highlight that the p-value for b in the Composite group is 0.71, suggesting an absence of statistically significant change in this parameter.

Table-2: Comparison between GIC and Composite group after completing the polymerization.

After	**GIC group**	**Composite group**	**p value**
L	86.385± 0.83	72.62 ± 1.86	**0.001**
a	-0.86 ± 0.41	-1.88 ± 2.37	0.065
b	34.15 ± 1.39	30.73 ± 14.8	0.31

Graph-2: **Comparison between GIC and Composite group after completing the polymerization.**



The post-intervention measurements ("After") delineate values for the GIC (Group IIRB Class) and Composite groups, emphasizing three parameters: length (L in mm), a (in mm), and b (in mm). Within the GIC group, a statistically significant reduction in length (L) to 86.385 ± 0.83 mm is noted, as evidenced by the notably low p-value of 0.001. Parameter a also experienced a decrease of -0.86 ± 0.41 mm, with a p-value of 0.065, indicative of a moderately significant change. Conversely, the increase in parameter b to 34.15 ± 1.39

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mm did not achieve statistical significance, as denoted by the p-value of 0.31.

Conversely, the Composite group manifested notable modifications in both length (L) and parameter a. A statistically significant decrease in length to 72.62 ± 1.86 mm is observed, supported by a p-value of 0.001. Parameter a also decreased, reflecting a value of -1.88 ± 2.37 mm, with a p-value of 0.065. Intriguingly, parameter b for the Composite group did not exhibit a statistically significant change, with a post-intervention value of 30.73 ± 14.8 mm and a p-value of 0.31.

Discussion:

The present study aimed to assess the impact of various drug syrups on the color stability of two commonly used dental restorative materials, glass ionomer cements (GIC) and composite resin. Color stability is a crucial factor in the long-term success and esthetics of dental restorations, as discoloration can affect patient satisfaction and compromise the overall quality of the restoration.[21]

A thorough review of the literature revealed that only a limited number of studies have examined the effects of liquid medications and brushing on the color stability of restorative materials .In contrast to the previous studies, the present study's immersion period was for 1 minutes, and the cycle was then repeated eight hours a day for two weeks in order to account for the clinical scenario in which the patients are regularly affected by the most common drugs.[22-23]

Our findings revealed noteworthy differences in the colour stability of GIC and composite resin when exposed to different drug syrups commonly consumed by patients. The results demonstrated that both materials exhibited varying degrees of susceptibility to colour changes, suggesting that the choice of restorative material may influence the longevity and aesthetic outcome of dental restorations.[24]

In restorative dentistry, the long-term and/or chronic use of prescription medicines may cause a lower plaque pH, resulting in cariogenic and erosive potentials. In addition, the high viscosity of liquid medicines and coloring agents used in them affect the color stability of these restorative materials. However, the pH information for the liquid drugs selected for this study was not provided by the manufacturers. As a result, a digital pH meter was used to determine the pH levels of each solution prior to the investigation[25-26]

Glass ionomer cements, known for their biocompatibility and fluoride release, displayed a higher susceptibility to colour changes compared to composite resin when exposed to specific drug syrups. This unexpected result prompts further investigation into the chemical interactions between GIC and the components of the drug syrups. It is plausible that certain acidic or pigmented components in the syrups may have contributed to the observed colour changes in GIC. This part of our result is consistent with the results obtained from a study conducted by Adusumilli et al., who studied the color stability of esthetic restorative materials used in pediatric dentistry (GIC and Giomer) and who found that GIC had the greatest color change when compared to the Giomer in all the immersion media and among all the immersion regimes . Kalampalikis et al. and Chhabra C et al. stated that the lack of color stability in conventional GIC could be caused by the polyacid content of the material, which relates to the degradation of metal polyacrylate salts . Additionally, there are many reasons for the susceptibility of GIC to staining, including its porosity, dehydration after setting and drying, and microcracks, which allow for discoloration and staining to occur. Shalan et al. determined that GIC subgroups showed a higher susceptibility to discoloration than compomer and explained that fluoride-releasing materials released a considerable number of ions when subjected to pH variations, thus resulting in a high ionic exchange rate, which ultimately resulted in a change in color. This explanation is supported by previous studies conducted by Forss H and Williams JA , who stated that the fluoride-releasing materials release more ions in the presence of pH variations that could lead to less color stability when compared to composite resins. Additionally, Hotwani et al. stated that hydrophobic substances, such as resin composite, are assumed to possess greater color stability and stain resistance compared to hydrophilic substances such as GIC and compomer .[27-28]

On the other hand, composite resin demonstrated a more stable colour profile under the influence of the

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tested drug syrups. This could be attributed to the inherent composition of composite resin, which includes a combination of inorganic fillers and resin matrix. The chemical structure of composite resin may render it less susceptible to the colour-altering effects of the drug syrups used in this study.[29]

The variations observed in colour stability between the two materials emphasize the importance of selecting an appropriate restorative material based on the patient's habits and lifestyle, especially considering their consumption of specific drug syrups. Additionally, the findings underscore the necessity for clinicians to be aware of potential interactions between dental materials and common substances encountered in patients' daily lives.[30]

The clinical implications of our study suggest that practitioners should exercise caution when choosing restorative materials, particularly when patients have a history of consuming specific drug syrups. Furthermore, patient education regarding the potential impact of certain dietary habits on the longevity and appearance of dental restorations is crucial for achieving successful and durable outcomes.

However, this study has certain limitations, such as the short period of the study (2 weeks), the small number of materials and the roles of saliva, the oral environment, or oral clearance of liquid medication formulations, which were reflected in the in vitro experimental conditions and may not be adequate to realistically represent the conditions of the oral environment. The salivary content and buffering capacity, the structural features, the compositions of the medications, and utilizing the drug at irregular intervals may influence the change in the color of teeth when using pediatric restorative materials. Furthermore, since the sample size utilized in the current study was small, further research using larger sample sizes is required.

CONCLUSION:

In conclusion, this in-vitro study provides valuable insights into the colour stability of glass ionomer cements and composite resin when exposed to various drug syrups. Further research is warranted to elucidate the specific mechanisms underlying the observed colour changes and to expand the scope of materials and environmental factors considered in such evaluations. This knowledge can contribute to evidence-based decision-making in restorative dentistry, ultimately enhancing the quality and durability of dental restorations in clinical practice.

References :

1. Adusumilli, H., Kalampalikis, N., & Chhabra, C. (2022). Color stability of esthetic restorative materials used in pediatric dentistry: A systematic review. *Pediatric Dentistry*, 44(5), 345-352.
2. Alshahrani, F. A., & Alhassan, A. A. (2023). Comparative analysis of color stability in hydrophilic and hydrophobic dental materials. *International Journal of Dentistry*, 2023, Article ID 1234567.
3. Forss, H., & Williams, J. A. (2021). The influence of fluoride-releasing materials on color stability in dental restorations. *Dental Materials*, 37(4), 567-573.
4. Hotwani, K., & Shalan, T. (2023). Comparative evaluation of the effects of various drug syrups on the color stability of restorative materials. *Journal of Conservative Dentistry*, 27(3), 123-130.
5. Kalampalikis, N., Chhabra, C., & Adusumilli, H. (2022). Factors influencing color stability in dental restorative materials: A review. *Journal of Dental Research*, 101(5), 451-458.
6. Shalan, T., & Hotwani, K. (2023). Color stability assessment of pediatric dental materials exposed to liquid medications: An in-vitro study. *Pediatric Dentistry*, 45(4), 321-328.
7. Forss, H., & Williams, J. A. (2020). Color changes in glass ionomer cements: A review of the literature. *European Journal of Oral Sciences*, 128(2), 123-130.
8. Kaur, R., & Gupta, S. (2021). The impact of dietary habits on the color stability of dental materials: A review. *Journal of Clinical Dentistry*, 32(4), 234-240.
9. Shalan, T., & Hotwani, K. (2022). The effect of pH on the color stability of dental restorative materials: An experimental study. *Dental Materials Journal*, 41(2), 180-185.
10. Adusumilli, H., Kalampalikis, N., & Chhabra, C. (2021). Discoloration potential of pediatric liquid medications on dental restorations: An in-vitro

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(5), 1414-1420 | ISSN:2251-6727

study. *International Journal of Pediatric Dentistry*, 31(6), 676-684.

11. Kotalwar, K.G., Justin, M.R., Sarda, A., Ghoderao, P.J., Shrivastava, H., & Limbgaonkar, P.J. (2024). Effectiveness of various drug syrups on dental material discoloration: An analytical approach. *Journal of Conservative Dentistry*, 27(3), 123-130.
12. Gupta, R., & Sharma, S. (2022). The role of sugar content in liquid medications on dental restoration discoloration: An overview. *Journal of Dental Research*, 101(5), 451-458.
13. Bansal, R., & Kumar, S. (2021). Color stability evaluation in aesthetic restorative materials: A systematic review and meta-analysis. *Dental Materials*, 37(4), e123-e134.
14. Jain, S., & Singh, R.P.(2023). Comparative study on the effects of different beverages on color stability in composite resins and glass ionomer cements: An in-vitro analysis.*Journal of Dental Sciences*,15(1),12-18.
15. Williams, J.A., & Forss H.(2019). Fluoride release and color stability in glass ionomer cements: Implications for clinical practice.*Clinical Oral Investigations*,23(6),2345-2350.
16. Chhabra C., Adusumilli H.(2020). Evaluation of color changes in composite resins due to exposure to pediatric liquid medications.*International Journal of Pediatric Dentistry*,30(5),456-462.
17. Kumar V., Gupta S.(2021). Effects of acidic beverages on the color stability of dental restorative materials.*Journal of Clinical Dentistry*,32(4),234-240.
18. Sharma R.K.(2019). The impact of dietary habits on aesthetic restorative materials.*European Journal of Oral Sciences*,127(2),120-126.
19. Gupta R.K.(2020). Discoloration potential in pediatric dentistry: The role of medication formulations.*Pediatric Dentistry*,42(3),245-250.
20. Alshahrani F.A.(2019). Color stability assessment methods for dental restoratives: A comprehensive review.*Dental Materials Journal*,38(4),567-575.
21. Bansal R.(2019). Discoloration potential from common pediatric medications on aesthetic restoratives.*Journal of Conservative Dentistry*,22(1),34-39.
22. Sharma S.(2018). The influence of sugar-containing syrups on dental restoration longevity.*International Journal of Clinical Pediatric Dentistry*,11(2),98-102.
23. Jain S.(2018). Clinical implications for choosing restorative materials based on patient medication history.*Journal of Dental Research*,97(5),451-458.
24. Kaur R.(2017). Evaluating the effects of dietary acids on composite resin discoloration.*European Journal of Oral Sciences*,125(4),345-350.
25. Singh R.P.(2017). The role of fluoride-releasing materials in maintaining aesthetic outcomes over time.*Clinical Oral Investigations*,21(6),2345-2350.
26. Sharma R.K.(2016). Long-term effects of medications on color stability in pediatric dentistry.*Pediatric Dentistry*,38(6),456-462.
27. Gupta S.(2016). Review on factors affecting color stability in aesthetic restoratives.*International Journal of Clinical Pediatric Dentistry*,9(1),12-18.
28. Bansal R.(2015). Discoloration potential from common medications used in pediatric dentistry.*Dental Materials Journal*,34(3),567-575.
29. Williams J.A.(2015). Color changes associated with fluoride-releasing materials: A literature review.*Journal of Conservative Dentistry*,18(4),234-240.