Impact of pediatric nutritional syrups on the color stability of glass ionomer restorations

Pediatrik besin takviye şuruplarının cam iyonomer restorasyonların renk stabilitesine etkisi

Mustafa Duzyol[1], Esra Duzyol[2], Burak Carikcioglu[3]

[1] Department of Restorative Dentistry, Faculty of Dentistry, Istanbul Medeniyet University

[2] Department of Pediatric Dentistry, Faculty of Dentistry, Istanbul Medeniyet University

[3] Department of Pediatric Dentistry, Faculty of Dentistry, Çanakkale Onsekiz Mart University

Abstract

Aim: The purpose of this study was to evaluate the effects of different pediatric nutritional syrups' formulations on the color changes of glass ionomer-based restorative materials (GICs) used in pediatric dentistry.

Methods: Three types of GICs—compomer (Dyract XP, Dentsply), conventional glass ionomer (Equia Forte, GC), and glass carbomer (Glass Fill, GCP Dental)—were tested. 120 disc-shaped specimens (5 mm diameter, 2 mm deep) were prepared. Each type was divided into four groups (n=30). Specimens were stored in distilled water for 24 hours, then immersed in three different pediatric pediatric nutritional syrups (iron-Fe+3 [Ferifer, Berko], iron-Fe+2 [Ferro Sanol B, Adeka], and multivitamin [Polivit, Abdi İbrahim]) and distilled water. Color measurements were taken before and after immersion using a spectrophotometer (VITA Easyshade V, VITA Zahnfabrik). Color changes (ΔE00) were calculated at 30 and 90 days using the CIEDE2000 formula. Data were analyzed using two-way ANOVA and post-hoc Tukey's test ($p < 0.05$).

Results: After 30 days, the highest ΔE00 was observed in the glass carbomer group immersed in multivitamins (7.13 ± 0.77), while the lowest was in the compomer group immersed in distilled water (0.26 ± 0.13). ΔE00 values were significantly higher in the glass carbomer groups compared to the conventional glass ionomer and compomer groups ($p < 0.05$). At 90 days, no significant differences were found between the conventional glass ionomer and compomer groups ($p > 0.05$). The highest ΔE00 at 90 days was in the glass carbomer group immersed in multivitamins (9.15 ± 0.93), and the lowest was in the compomer group immersed in distilled water (0.38 ± 0.11).

Conclusion: Pediatric syrups, frequently used to treat malnutrition, caused more color changes in glass carbomers. Results indicated that as the resin content increased, the amount of coloration decreased.

Keywords: Color; discoloration; glass ionomer; iron; staining

Öz

Amaç: Bu çalışmanın amacı, pediatrik diş hekimliğinde kullanılan cam iyonomer bazlı restoratif materyallerin (GIC'ler) renk değişiklikleri üzerindeki farklı pediatrik besleyici şurup formülasyonlarının etkilerini değerlendirmekti.

Yöntemler: Üç tür GIC—kompomer (Dyract XP, Dentsply), konvansiyonel cam iyonomer (Equia Forte, GC) ve cam karbomer (Glass Fill, GCP Dental)—test edildi. 120 disk şeklinde örnek (5 mm çapında, 2 mm derinliğinde) hazırlandı. Her tür dört gruba ayrıldı (n=30). Örnekler 24 saat boyunca distile suda bekletildikten sonra üç farklı pediatrik ilaç (demir-Fe+3 [Ferifer, Berko], demir-Fe+2 [Ferro Sanol B, Adeka] ve multivitamin [Polivit, Abdi İbrahim]) ve distile suya daldırıldı. Renk ölçümleri, daldırma öncesi ve sonrası bir spektrofotometre (VITA Easyshade V, VITA Zahnfabrik) kullanılarak alındı. Renk değişiklikleri (ΔE00) CIEDE2000 formülü kullanılarak 30 ve 90 günün sonunda hesaplandı. Veriler two-way ANOVA ve post-hoc Tukey testi ile analiz edildi ($p < 0.05$).

Bulgular: 30 gün sonra, en yüksek ΔE00 multivitamin içine daldırılan cam karbomer grubunda (7.13 ± 0.77) gözlenirken, en düşük kompomer grubunda distile suya daldırıldığında (0.26 ± 0.13) gözlendi. ΔE00 değerleri cam karbomer gruplarında konvansiyonel cam iyonomer ve kompomer gruplarına göre anlamlı derecede yüksekti ($p < 0.05$). 90 gün sonunda, konvansiyonel cam iyonomer ve kompomer grupları arasında anlamlı bir fark bulunamadı ($p > 0.05$). 90 gün sonunda en yüksek ΔE00 multivitamin içine daldırılan cam karbomer grubunda (9.15 ± 0.93), en düşük ise distile suya daldırılan kompomer grubunda (0.38 ± 0.11) bulundu.

Sonuç: Malnütrisyon tedavisinde sıkça kullanılan pediatrik şuruplar, cam karbomerlerde daha fazla renk değişikliğine neden oldu. Sonuçlar, reçine içeriği arttıkça renklenmenin azaldığını gösterdi.

Anahtar Sözcükler: Cam iyonomer; demir; renk; renklenme; renk değişimi

Received/*Geliş* : 17.07.2024
Accepted/*Kabul*: 29.08.2024

DOI: 10.21673/anadoluklin.1517503

Corresponding author/*Yazışma yazarı*

Mustafa Düzyol
İstanbul Medeniyet Üniversitesi, Diş Hekimliği Fakültesi, Restoratif Diş Hekimliği Anabilim Dalı, İstanbul, Türkiye.
E-mail: mustfadzyl@gmail.com

ORCID
Mustafa Düzyol: 0000-0002-8438-1423
Esra Düzyol: 0000-0002-5674-6990
Burak Çarıkçıoğlu: 0000-0001-5951-8179

INTRODUCTION

Pediatric dentistry, a specialized field focused on the oral health and well-being of young patients, demands meticulous consideration of various factors, including the choice of restorative dental materials. Among these critical aspects is the impact of pediatric nutritional syrups, often administered in syrup form, on the color stability of dental restorations. Children with malnutrition or specific health conditions frequently require prolonged exposure to these medications, potentially leading to unintended consequences such as alterations in tooth color and the appearance of dental restorative materials (1).

Glass ionomer-based restorative materials (GICs) are widely used in pediatric dentistry due to their favorable characteristics, including adhesion to tooth structure, fluoride release, and biocompatibility (2). However, concerns exist within the dental community regarding the susceptibility of these materials to color changes when exposed to various environmental factors, especially pediatric nutritional syrups. This study aims to comprehensively evaluate the effects of different pediatric drug formulations on the color stability of three distinct GICs: compomer (Dyract XP, Dentsply), conventional glass ionomer (Equia Forte, GC), and glass carbomer (Glass Fill, GCP Dental).

Iron, a substantial nutrient for the human body, plays a significant role in many metabolic processes, such as electron transport, oxygen transport, and DNA synthesis. Iron deficiency is a major global public health problem and is commonly seen as a nutritional deficiency worldwide (3). Treatment typically includes nutritional improvement, iron supplementation, and enhancing awareness of the patient and family. Children often consume iron supplements in drop or syrup form (4). One basic drawback of these supplements is the potential for black discoloration on teeth, due to an insoluble ferric compound formed by the interaction between iron ions or gingival fluid composition and hydrogen sulfide produced by bacteria (5).

Previous research has shown that iron syrups can significantly stain primary teeth. There is limited literature on the staining effects of pediatric nutritional syrups, including iron syrups, on restorative materials. The highest color change values have been reported in iron syrups, often exceeding acceptable thresholds. Surface sealants have been suggested as a means to minimize color changes related to pediatric liquid nutritional syrups on restorative materials by saturating the material surface, correcting irregularities, and increasing stain resistance (6-8).

This study extends beyond restorative materials to consider the staining effects of pediatric nutritional syrups, including iron syrup, and the potential benefits of surface sealants on color stability. This study aims to investigate whether the use of surface sealant can mitigate the susceptibility of restorative materials to staining, whether exposure to different forms of iron syrups and the duration of exposure impact the staining resistance of restorative materials, and whether the type of restorative material affects staining resistance. In our study, two null hypotheses were determined, respectively: 'The waiting time of the restorations in solutions and in the control group should not affect the color change.' and 'The nutritional supplement syrups used should not cause color change in the restorations.'

MATERIAL AND METHODS

Specimen Preparation

In this study, no materials derived from animals or humans were used. The solutions applied in the experimental groups were also not derived from any animal or human materials. In our study, where we evaluated the potential color changes of restorative materials used in dentistry when immersed in tea, coffee, and water, ethical committee approval is not required.

Sample size calculation was performed with the G*Power 3.1 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) and the sample size was calculated as 10 per group with alpha-type error of 0.05, a power (1-beta) of 0.95, an effect size of 0.712 obtained from a previous study (9). A total of 120 specimens (n=40) were prepared according to the manufacturer's recommendations. (Table 1.)

Restorative material resins were placed in stainless steel molds with dimensions of 2 mm in depth and 5 mm in diameter. To avoid air bubbles and achieve a smooth surface, Mylar strips and glass slides were placed on each specimen, and pressure was applied to remove any excess material. The specimens were then polymerized for 20 seconds using an LED light source (Elipar Freelight II, 3M ESPE, AG, Germany, 1150 mW/cm²). The power of the light source was verified to be above 1000 mW/cm² before polymerizing every five specimens. After curing, the specimens were removed from the molds, and their thickness was standardized using a digital caliper (Ultra-Cal V, Fowler Corp., Sylvac, Switzerland). Finally, the surfaces of the polymerized specimens were polished with aluminum oxide-coated discs (Sof-Lex XT; 3M/ESPE, St. Paul, MN, USA).

Color measurements

In this study, color values were measured using the Commission International de l'Eclairage (CIE) L*a*b* system with a spectrophotometer (VitaEasyshade V, Vita Zahnfabrik, Bad Sackingen, Germany) against a neutral gray background (L*=64.1; a*=0.3; b*=−3.4). Measurements were conducted under D65 standard lighting conditions, and the spectrophotometer was calibrated according to the manufacturer's instructions before each measurement. Specimens were dried with tissue paper, and three measurements were taken on each surface, with the average L, a, and b values calculated.

The CIELAB system is based on the sensitivities of three types of cone cells in the eye to red, green, and blue light. Each color is represented by L* (lightness), a* (red-green axis), and b* (blue-yellow axis). The L* value ranges from 0 to 100, indicating lightness or darkness, while a* and b* represent the color's hue.

Initial color measurements (L0, a0, b0) of the specimens were taken after they were stored in distilled water at 37°C for 24 hours. The specimens were divided into four groups based on the type of restorative materials (n=40). Ten randomly selected specimens were immersed in iron syrup (Ferifer, Berko), ten in Iron + Multivitamin Syrup (Ferro Sanol B, Adeka), and ten in Multivitamin Syrup (Polivit, Abdi İbrahim). The control group consisted of ten specimens immersed in distilled water and kept in an incubator at 37°C for 90 days. The samples were immersed in the test solutions for 2 minutes daily, then removed, dried, and stored in distilled water. The second color measurement was taken on the 30th day, and the final measurement on the 90th day.

The color change levels in the specimens were calculated using the CIEDE2000 formula as follows: (Figure 1)

- $\Delta L'$ is the lightness difference
- $\Delta C'$ is the chroma difference
- $\Delta H'$ is the hue difference
- R_T is the rotation term that accounts for the interaction between chroma and hue differences
- S_L, S_C, and S_H are the weighting functions for the lightness, chroma, and hue components, respectively
- K_L, K_C, and K_H are the parametric factors for the lightness, chroma, and hue components, respectively

$$\Delta E_{00} = \left[\left(\frac{\Delta L'}{K_L S_L}\right)^2 + \left(\frac{\Delta C'}{K_C S_C}\right)^2 + \left(\frac{\Delta H'}{K_H S_H}\right)^2 + R_T \left(\frac{\Delta C'}{K_C S_C}\right)\left(\frac{\Delta H'}{K_H S_H}\right) \right]^{\frac{1}{2}}$$

Figure 1. CIEDE2000 formula used to determine color change in our study

The ΔE00 (color change value) value measured 0.8, referencing perceptibility (PT) and acceptability (AT) threshold values of 1.8. These thresholds serve as benchmarks to assess whether the color change is noticeable or acceptable based on perceptual sensitivity (10).

Statistical analyses

Statistical Package for the Social Sciences package program version 26.0 (SPSS Inc., Chicago, IL, USA) was employed for statistical analyses. A paired-sample t-test ($p<0.05$) was utilized to assess significant differences. The effects of composites and solutions on ΔE00 over time were analyzed using two-way ANOVA., followed by post-hoc Tukey tests for multiple comparisons. Changes in ΔE00, values within the same solution over time were analyzed using paired-sample t-tests.

RESULTS

A two-way ANOVA test was applied to compare the 30-day groups, revealing a significant difference in the color change of restorative materials in pediatric nutritional syrup groups after 30 days ($p<0.05$). Table 2 presents the mean and standard deviation (Std. Dev.) of color changes across different time points. At both 30 and 90 days, the control group exhibited the lowest color change in all restorative materials. Among the

Table 1. Materials used in the study.

	Product Name	Type	Ingredients	Manufacturer
Restorative Materials	Dyract XP	Polyacid Modified Glass Ionomer	Strontium-fluoro-silicate glass, strontium fluoride, TCB resin, UDMA, photoinitiator and stabilizers	Dentsply DeTrey, GmbH, Germany
	GCP Glass Fill	Glass Carbomer	Fluoroaluminosilicate glass, nano fluoro/ hydroxyapatite, olyacids	GCP Dental, Vianen,Holland
	Equia Forte	Glass Hybrid	Strontium fluoroaluminosilicate glass, polyacrylic acid and aqueous polyacrylic acid	GC Corporation, Tokyo, Japan
Pediatric Nutritional Syrups	Ferifer	Iron syrup	100 mg iron (ferrous III hydroxide polymaltose complex), Sorbitol (E420), methyl paraben sodium (E219), propyl paraben sodium (E217), citric acid monohydrate, vanilla flavor, glycerin, propylene glycol and deionized water.	Berko İlaç ve Kimya Sanayi Anonim Şirketi, İstanbul, Türkiye
	Ferro Sanol B	Iron + Multivitamin Syrup	112.50 mg iron (II)-glycine-sulfate-complex (equivalent to 20 mg Fe^{+2}), 0.43 mg riboflavin -5-sodium phosphate, 0.32 mg vitamin B1 (thiamine hydrochloride), 0.63 mg vitamin B6 (pyridoxine hydrochloride), Ascorbic acid , once refined sugar, glucose monohydrate, sorbitol, sulfuric acid 95-98%, orange essence, pear essence, deionized water	ADEKA İlaç Sanayi ve Ticaret Anonim Şirketi, Samsun, Türkiye
	Polivit	Multivitamin Syrup	1500 IU Vitamin A, 1 mg Vitamin B, 1.2 mg Vitamin B2, 2 mg Vitamin B6, 7 mg Nicotinamide (PP), 3 mg D-Panthenol, 25 mg Vitamin C, 400 IU Vitamin D3, 5 mg Vitamin E, : 3.75 mg Sodium saccharin, 5.00 mg Sodium benzoate	Abdi İbrahim İlaç Sanayi ve Ticaret Anonim Şirketi, İstanbul, Türkiye

TCB: A reaction product of butane tetracarboxylic acid and hydroxymethyl methacrylate, UDMA: Urethane dimethacrylate, Fe+2: Ferrous ion, San: Sanayi, Tic: Ticaret, A.Ş: Anonim şirketi, mg: Miligram, %: Percentage, IU: International unit

Table 2. Mean ΔE00 values ± standard deviations of composites after 30 days and 90 days of immersion in solutions.

Restorative Materials	Time	Ferifer (Mean±Std.Dev.)	Ferro Sanol (Mean±Std.Dev.)	Polivit (Mean±Std.Dev.)	Distillized Water (Mean±Std.Dev.)
Glass Carbomer	30 day	4.063±1.8021 aA	6.09±1.0938 bF	7.134±0.7732 bJ	0.561±0.3212 cN
	90 day	4.83±2.3739 dC	8.655±1.348 eH	9.149±0.9302 eL	0.773±0.4222 fP
Glass Hybrid	30 day	0.818±0.3823 gB	0.744±0.42 g,hF	0.577±0.4482 g,hK	0.349±0.2643 hN,O
	90 day	1.046±0.4647 ıD	1.221±0.8193 ı,iI	0.594±0.4237 iM	0.413±0.2717 iR
Polyacid Modified Glass Ionomer	30 day	0.753±0.2891 j,kB	1.238±0.3706 jG	0.658±0.2203 k,lK	0.264±0.1318 lO
	90 day	0.914±0.5612 mD	1.728±0.3706 nI	1.148±0.2957 oM	0.383±0.1049 pR

*Lowercase letters indicate differences in rows, uppercase letters indicate differences in columns. ($p < 0.05$) Std. Dev.: standard deviation

experimental groups, Ferifer showed the least color change, while Polivit showed the most.

On the 30th day, the control group again exhibited the least color change. When comparing the 30- and 90-day immersion periods in terms of ΔE00, polyacid-modified glass ionomer specimens immersed in water showed the lowest color change, while the highest color change was observed in glass carbomer specimens kept in multivitamin syrup (Figures 2 and 3). The mean (SD) color change of restorative materials indicated that the color in the control group remained within acceptable limits at all time points.

The results demonstrated that prolonged use of pediatric nutritional supplements led to a greater color change in the Ferifer, Ferro Sanol, and Polivit groups at all time points, considering the normal data distribution and mean color change over time (Table 2). The two-way ANOVA indicated a significant color difference at 30 and 90 days in the Ferifer, Ferro Sanol, and Polivit groups ($P<0.05$). Additionally, pairwise comparisons using the LSD test showed significant differences at different time points ($P=0.0001$).

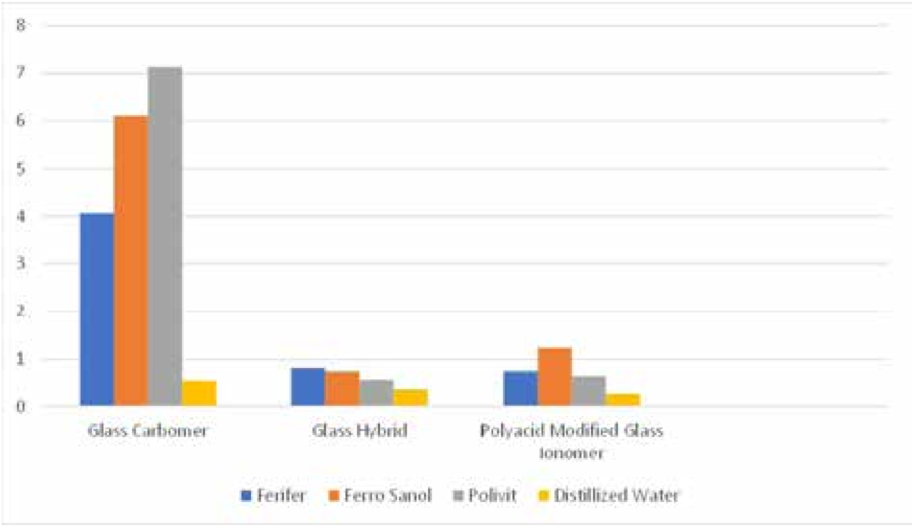

Figure 2. Changes in ΔE00 color difference values of the restorative materials used in our study after 30 days

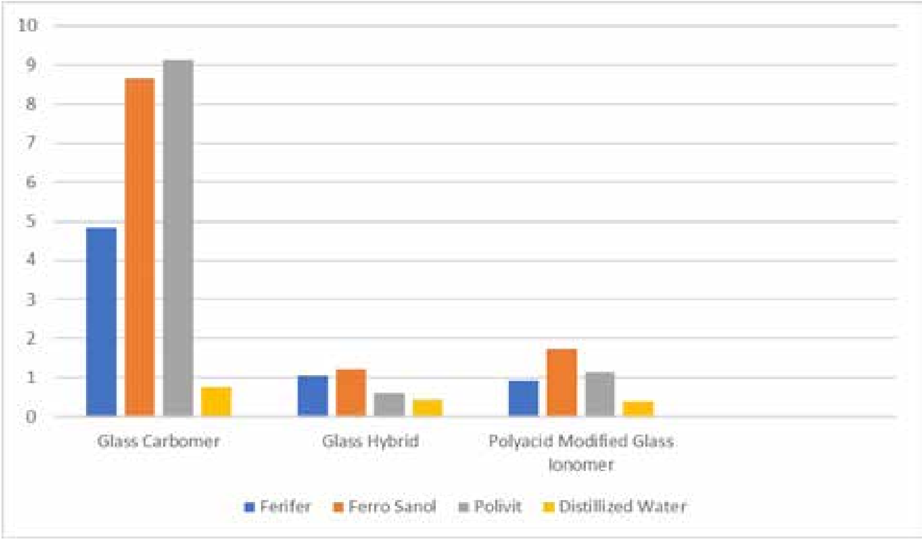

Figure 3. Changes in ΔE00 color difference values of the restorative materials used in our study after 90 days.

DISCUSSION AND CONCLUSION

The findings of this study provide valuable insights into how pediatric nutritional syrups impact the color stability of glass ionomer-based restorative materials (GICs) in pediatric dentistry. Understanding these effects is crucial for clinicians when selecting appropriate restorative materials and managing the oral health of their patients. According to the data obtained in our study, our first hypothesis, 'The waiting time of the restorations in solutions and in the control group should not affect the color change.' was rejected. Additionally, our second hypothesis, 'The nutritional supplement syrups used should not cause color change in the restorations', was rejected.

Yıldırım and Uslu (11) did not find a correlation between the degree of color change in glass carbomer and glass hybrid restorations after immersion in nutritional syrups and subsequent tooth brushing. In our study, after removing the samples from the syrups, they were rinsed and measured.

Pani et al. (6) and Yıldırım and Kaya (12) demonstrated in their studies that iron syrups cause significant discoloration in teeth and restorations over time. In our research, a noticeable increase in color change was observed in all groups during the 90-day period compared to the 30-day period. Color change (ΔE00) was assessed at two intervals (30 days and 90 days) after immersion in various pediatric drug formulations and distilled water. The results revealed that the glass carbomer group exhibited the highest ΔE00 values when immersed in multivitamin syrup at both time points, suggesting greater susceptibility to color changes compared to compomers and conventional glass ionomers. Interestingly, no significant differences in color change were found between compomers and conventional glass ionomers after 90 days of immersion. However, at 30 days, compomers exhibited significantly lower ΔE00 values than conventional glass ionomers, particularly when immersed in distilled water, indicating superior initial color stability.

Numerous studies have reported that nutritional syrups and nutritional supplements in syrup form can induce color changes in restorations. (13 -15) The amount of discoloration may vary depending on the iron composition present in iron syrups. Tayebi et al. (16) demonstrated that Vitamin C, found in multivitamins, can cause considerable color change. In our study, the greatest color change was observed in glass carbomer specimens immersed in multivitamin syrup. However, the most significant color changes were observed in the groups immersed in Ferifer (containing iron III hydroxide polymaltose) after 30 days for Cam hybrid and in Ferro Sanol B (containing iron (II)-glycine-sulfate and a multivitamin complex) after 90 days. In the compomer group, the most pronounced color change occurred with Ferro Sanol B. These differences in color stability among GICs can be attributed to their distinct compositions. Compomers, which contain resin components, exhibited greater resistance to color change, especially in the absence of pediatric nutritional syrups, suggesting that resin content may enhance color stability. (17) Conversely, the composition of glass carbomers made them more susceptible to coloration induced by pediatric nutritional syrups.

These findings underscore the importance of carefully selecting GIC materials in pediatric dentistry, particularly considering potential long-term exposure to pediatric nutritional syrups. Clinicians are advised to choose restorative materials that offer optimal color stability alongside other desirable clinical properties. In their study, Yıldırım and Uslu (11) found that glass carbomers demonstrated superior color stability under the influence of pediatric nutritional syrups. According to Tüzüner et al. (18), glass ionomer cements exhibit superior resistance to color change. In our research, the least color change occurred in the compomer group immersed in distilled water. Its UDMA content provided greater color stability compared to TEDGMA and Bis-GMA. Conversely, glass carbomers exhibited the most significant color change across all groups, while glass hybrid materials showed resistance to color change.

In conclusion, this study highlights that pediatric nutritional supplements in syrup form can lead to color changes in GIC-based restorative materials, with glass carbomers being particularly susceptible. It also emphasizes the role of resin content in mitigating color change, with compomers demonstrating better initial color stability. These insights can assist clinicians in making informed decisions regarding restorative materials for pediatric patients and advocate for further research to enhance GIC color stability in pediatric dentistry. However, our study could be further improved by comparing syrup and drop forms through in vivo experiments.

Acknowledgement

The abstract of this study was presented as an oral presentation at the 27th International Turkish Pedodontic Association Congress, 26-29 October 2023, Ankara, Türkiye .

Conflict-of-interest and financial disclosure

The authors declare that they have no conflict of interest to disclose. The authors also declare that they did not receive any financial support for the study.

REFERENCES

1. Almutairi M, Moussa I, Alsaeri N, Alqahtani A, Alsulaiman S, Alhajri M. The Effects of Different Pediatric Drugs and Brushing on the Color Stability of Esthetic Restorative Materials Used in Pediatric Dentistry: An In Vitro Study. Children (Basel). 2022;9(7):1026.
2. Nouri S, El-Housseiny AA. Glass Ionomer Cements for

Restoration of Primary Molars: A Review. EC Dental Science. 2018;17:644-57.

3. Pasricha SR, Tye-Din J, Muckenthaler MU, Swinkels DW. Iron deficiency. Lancet. 2021;397(10270):233-48.
4. Mattiello V, Schmugge M, Hengartner H, von der Weid N, Renella R; SPOG Pediatric Hematology Working Group. Diagnosis and management of iron deficiency in children with or without anemia: consensus recommendations of the SPOG Pediatric Hematology Working Group. Eur J Pediatr. 2020;179(4):527-45.
5. Mutsaddi S, Kotrashetti VS, Nayak R, Pattanshetty S, Hosmani JV, Babji D. Association of dental caries in children with black stain and non-discolored dental plaque: A microbiological study. J Adv Clin Res Insights. 2018;5(3):59-64.
6. Pani SC, Alenazi FM, Alotain AM, Alanazi HD, Alasmari AS. Extrinsic tooth staining potential of high dose and sustained release iron syrups on primary teeth. BMC Oral Health. 2015;15:90.
7. Mukundan D, R V. Comparative Evaluation on the Effects of Three Pediatric Syrups on Microhardness, Roughness and Staining of the Primary Teeth Enamel: An In-Vitro Study. Cureus. 2023;15(7):e42764.
8. Arat Maden E, Eker İ, Erdem O. Evaluation of the effects of iron containing supplements on primary teeth of children. Int Dent Res. 2019;9(2):46-50.
9. Çarıkçıoğlu B. Influence of various mouthrinses on color stability and whiteness of resin-based restorative materials. Color Res Appl. 2021;46:1142-50.
10. Paravina RD, Pérez MM, Ghinea R. Acceptability and perceptibility thresholds in dentistry: A comprehensive review of clinical and research applications. J Esthet Restor Dent. 2019;31(2):103-12.
11. Yildirim S, Uslu YS. Effects of different pediatric drugs and toothbrushing on color change of restorative materials used in pediatric dentistry. Niger J Clin Pract. 2020;23(5):610-8.
12. Yıldırım S, Kaya E. Can the use of surface sealant on restorative materials prevent discoloration related to iron syrup supplements?. Eur Arch Paediatr Dent. 2021;22(4):739-50.
13. Alazmah A. Primary teeth stains and discoloration: a review. J Child Sci. 2021;11(01):e20-7.
14. Yılmaz N, Baygin O, Tüzüner T, Turgut SN, Erbek ŞM. Evaluation of the effect of pediatric drugs and an oral rinse on primary teeth discoloration. Dent Med Probl. 2022;59(2):225-31.
15. Güçyetmez Topal B, Yiğit T, Tıraş M, Gökçe Meydan E, Ünal M. Evaluation of the children with black tooth stain according to the severity of the stain and the number of affected primary teeth: A cross-sectional study. Turkiye Klinikleri J Dental Sci. 2023;29(2):277-85.
16. Tayebi S, Esmaeilzade M, Soufi Rezai L, Fotovat F, Najafi Vosogh R, Faregh N. Color Change of Primary Teeth Following Using 4 Types of Iron Supplements Available in the Iranian Pharmacopeia. Avicenna J Dent Res. 2019;11(2):66- 71.
17. Candan M, Ünal M. The effect of various inhaled asthma medications on the color stability of paediatric dental restorative materials. BMC Oral Health. 2024;24(1):384.
18. Tüzüner T, Turgut S, Baygin O, Yilmaz N, Tuna EB, Ozen B. Effects of Different Pediatric Drugs on the Color Stability of Various Restorative Materials Applicable in Pediatric Dentistry. Biomed Res Int. 2017;2017:9684193.