

THE IMPACT OF COMMON BEVERAGES ON DENTAL ESTHETICS: COLOUR STABILITY IN DIFFERENT RESIN COMPOSITES

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ABSTRACT

Aim of the study: This study aimed to evaluate the impact of common dietary beverages on the color stability of various resin composites over time, assessing their esthetic durability in clinical settings. **Materials and methods:** The study involved 60 disk-shaped specimens from three types of resin composites (Herculite Ultra XRV, G-aenial A'CHORD, and Omnichroma), each grouped into different subcategories. Specimens were exposed to coffee, wine, and Coca-Cola to simulate dietary staining, with a control group for baseline comparison. Color changes were measured at intervals using a spectrophotometer, employing the CIELAB color system to quantify color shifts. Statistical analysis was performed using the Kruskal-Wallis test to compare color stability across the composites, followed by Dunn's post-hoc test for detailed pairwise comparisons. **Results:** The results indicated statistically significant differences in color stability across the composites, with Herculite and Omnichroma showing better resistance to staining compared to G-aenial. Each composite exhibited unique color stability patterns depending on the type of beverage exposure and duration, with coffee and wine producing more pronounced color changes than Coca-Cola. **Conclusions:** The study concludes that the composition of resin composites plays a critical role in color stability when exposed to common staining agents. Omnichroma demonstrated the highest resistance to discoloration, making it suitable for patients with high aesthetic demands. The findings underscore the importance of selecting composite materials based on patient dietary habits to ensure long-term color consistency in restorations.

Key words: Color stability, Resin composites, Dental aesthetics, Staining agents, Spectrophotometric analysis.

INTRODUCTION

In recent years, dentists have increasingly opted for resin-based restorative materials to meet patients' aesthetic demands, as they harmonize well with the natural tooth color(1).

Resin composite is a highly versatile material with a wide range of clinical applications, offering good aesthetics, a reasonable cost, and excellent adhesion to dental structures, making it suitable for both

direct and indirect restorations(2). Due to these advantages, resin composites have become a popular choice for cavity restoration, valued for their suitability for direct filling, aesthetic appeal, low toxicity, and enhanced durability. Ensuring the longevity of these restorations is a key priority for both patients and dental professionals alike(3).

Currently, resin-matrix composites allow for a more conservative approach to

biomimetic restoration, making them the preferred choice for chairside restorative materials(4).

When consenting to restorative treatment, patients anticipate a colour match with their natural dental structure. The selected composite colour is determined by a triad of factors: hue, chroma, and value. These allow the restoration to replicate optical properties like translucency, opalescence, and fluorescence, which are crucial for achieving esthetic success, particularly in the anterior region(5).

In recent years, single-shade (monochromatic) composites have been developed to enhance efficiency and simplify the restorative process by reducing the need for precise colour matching, thereby minimizing treatment complexity for clinicians. Unlike traditional methods that rely on multiple pigments, these composites offer a single-shade solution capable of blending with various tooth shades, thanks to the "chameleon effect." The integration of nanotechnology in dentistry has further advanced this approach, with composite resins incorporating nanofillers and nanoclusters that improve colour harmony with dental tissues. This one-shade system allows for quick and consistent aesthetic restorations without the need for extensive shade matching, making it an appealing option for both dentists and patients(6).

Several factors can affect the colour stability of dental materials, with discoloration arising from both intrinsic and extrinsic sources. Intrinsic factors involve chemical changes within the material, such as the oxidation of amine accelerators, where tertiary amines can cause a shift in colour from white to yellow. Extrinsic factors include staining from external substances like coffee, tea, and nicotine, which adhere to or infiltrate the material. It is important to

recognize that either individual factors or a combination of both can result in noticeable or aesthetically undesirable colour changes in dental materials(5).

Discoloration remains a considerable challenge, especially when restorations are exposed to the oral environment over prolonged periods. Such discoloration affects the colour harmony of the restoration, often resulting in patient dissatisfaction and the added cost of replacement(7,8).

Numerous studies have demonstrated that beverages commonly consumed as part of dietary habits contribute to colour changes in restorative materials and impact surface hardness at varying degrees(9).

The aim of this study was to evaluate the impact of common dietary beverages on the colour stability of different types of resin composites over time, thereby providing insights into the material's long-term aesthetic performance. By comparing discoloration levels in various composite formulations when exposed to staining agents such as coffee, wine, and cola, this research seeks to guide clinicians in selecting materials best suited for achieving enduring aesthetic outcomes in patients with varying dietary habits.

MATERIALS AND METHODS

A total of 60 disk-shaped specimens were prepared from three distinct resin composites. Each composite group consisted of 20 specimens, which were further divided into subgroups. Five specimens from each group were designated as controls, while the remaining 15 were distributed into three subgroups, with 5 specimens immersed in coffee, 5 in wine, and 5 in Coca-Cola.

To ensure uniformity, metallic molds measuring 8 mm in diameter and 2 mm in thickness were used to shape the specimens, aligning with the dimensions required for polymerization. Each specimen was

polymerized using a wireless LED curing light (3M Espe Elipar S10, 1200 mW, St. Paul, MN, USA), positioned at a distance of approximately 1 mm from the surface to ensure consistent light exposure from the top. Once polymerization was finished, both sides of each sample were polished for 60 seconds using polishing discs (Optidisc Polishing Discs, Sds Kerr, Danbury, CT, USA). The polishing was performed at a low speed, applying light pressure with a clinical contra-angle handpiece and micromotor.

The specimens were categorized based on the type of dental resin composite used, which were selected due to their widespread use among dental practitioners. Each composite represents a different class: nanohybrid, hybrid, and supra-nano composites.

Group 1 consisted of **Herculite Ultra XRV (Kerr)**, a universal nanohybrid composite featuring a filler system composed of barium glass fillers with an average particle size of 0.4 μm and silica nanoparticles ranging from 20 to 50 nm (10).

Group 2 included **G-aenial A'CHORD (GC)**, a hybrid composite combining two types of pre-polymerized resin fillers. These fillers incorporate microfillers into a resin matrix, which are then milled into particles averaging 16 to 17 μm in size, providing both radiopacity and aesthetic advantages in clinical settings (11).

Group 3 featured **Omnichroma (Tokuyama)**, a universal supra-nano composite used in a wide range of direct restorative cases. It is composed of UDMA and TEGDMA, along with supra-nano spherical fillers consisting of silica-zirconia particles with an average size of 0.3 μm , ranging from 0.2 to 0.6 μm (12).

To assess color changes in different beverages, samples from each composite resin group ($n = 15$ per group) were submerged in coffee, wine, and cola.

Additionally, a control group ($n = 5$) was included. All specimens were stored in an incubator set at 37°C for a period of 10 days, with the staining solutions being refreshed daily to avoid bacterial or yeast contamination. The samples were immersed in black coffee (prepared by dissolving 5 grams of coffee in 150 ml of boiled water, Lavazza Qualità Oro), red wine (Domeniul Coroanei Segarcea, Marama Feteasca Neagra, Romania), and Coca-Cola for 30 minutes each day over the 10-day period.

A spectrophotometer (Vita Easyshade®V Compact, Vita Zahnfabrik, Bad Säckingen, Germany) was utilized to perform colorimetric assessments of the specimens. Calibration of the device was conducted in accordance with the National Institute of Standards and Technology (NIST) reference tiles(13). Measurements were taken with a wavelength interval of 10 nm, covering a spectral range from 360 to 750 nm, and using a reflectance angle of 45°. The background during testing was standardized to black, and each specimen was subjected to three consecutive scans to ensure accuracy.

The CIELAB color space was employed for color quantification, with parameters L^* , a^* , and b^* representing lightness (L^* : 0 to 100), the red-green axis (a^* : 90 to -70), and the yellow-blue axis (b^* : 80 to -100), respectively. Color differences (ΔE) were computed using the following formula: $\Delta E = (\Delta L^2 + \Delta a^2 + \Delta b^2)^{0.5}$

where ΔL , Δa , and Δb represent changes in the respective CIELAB values. According to established thresholds, a ΔE value greater than 2.7 denotes a "very distinct" color change, values between 1.2 and 2.7 indicate "distinct" changes, and values below 1.2 reflect "non-distinct" changes(14–16).

Color measurements were conducted on days 4 and 10 of the study. Prior to each measurement, the specimens were thoroughly

rinsed with distilled water and air-dried to eliminate any residual beverage, ensuring that the recorded color variations corresponded to changes within the composite material itself rather than superficial staining.

Statistical analysis was performed using SPSS software. To identify significant differences in colour stability among the composite groups exposed to various staining agents, the Kruskal-Wallis test was applied with a significance threshold of $p < 0.05$. When significant results were detected, Dunn's post-hoc test was used for pairwise comparisons.

RESULTS AND DISCUSSIONS

The statistical results indicate significant differences between the three types of composites (Herculite, G-ænial, and Omnicroma) regarding colour stability, as demonstrated by the Kruskal-Wallis test (with a chi-square value of 346.02 and a $p < 0.05$). A Dunn post-hoc test further details these pairwise differences, showing that each composite responds differently to staining sources (coffee, cola, wine) at various time points (1 day and 4 days). Herculite and Omnicroma display lower susceptibility to discoloration compared to G-ænial, as indicated by the distinct letters assigned to each group, reflecting significant differences. This analysis also included initial and four-day time points for each composite, highlighting that G-ænial exhibits the greatest tendency for discoloration, while Omnicroma and Herculite demonstrate greater color stability over time.

The figure illustrates the color stability of Herculite (1), G-ænial (2), and Omnicroma (3) composites after immersion in different staining solutions (coffee, cola, wine) over 4 and 10 days. Letters above each bar correspond to Dunn's post-hoc test results, denoting significant differences among

groups. Notably, G-ænial (2) exhibits the highest degree of colour change, especially in coffee at 10 days, reaching its peak discoloration ("e"), suggesting a greater susceptibility to prolonged staining. Conversely, Herculite (1) and Omnicroma (3) maintain relatively stable colour profiles, with fewer variations, particularly in the control and cola groups. Omnicroma, in particular, shows the greatest resistance to discoloration across all tested beverages, with consistent values at both time points. Overall, the graph indicates that G-ænial is most affected by staining agents, particularly over extended exposure periods, whereas Herculite and Omnicroma exhibit superior colour stability in similar conditions (Figure 1).

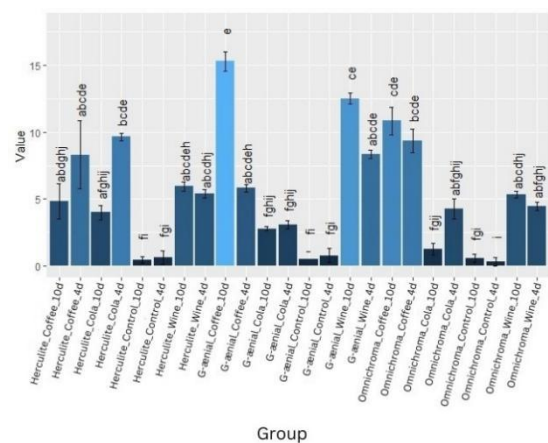


Figure 1. Color Stability of Resin Composites (Herculite, G-ænial, Omnicroma) after Exposure to Different Staining Agents over 4 and 10 Days

The Kruskal-Wallis test revealed significant differences in color stability across the composite groups exposed to coffee ($\chi^2 = 77.846$, $df = 5$, $p < 0.00001$). Subsequent Dunn's post-hoc analysis highlighted specific pairwise differences, with notable color changes observed between certain groups, particularly after 10 days of exposure. Herculite, G-ænial, and Omnicroma composites responded differently to staining, with G-ænial showing the most significant discoloration over time.

In the figure 2 is presented, the color stability of three resin composites—Herculite (1), G-ænial (2), and Omnicroma (3)—after exposure to coffee for 4 and 10 days is displayed. Groups with different letters indicate significant differences in color stability. G-ænial (2) at 10 days exhibits the highest discoloration, marked by "c," highlighting a substantial color change compared to other groups. Herculite (1) shows relatively stable color values with lower discoloration over both time points, as indicated by "d" and "ab." Omnicroma (3) displays moderate discoloration, with differences between the 4-day ("b") and 10-day ("bc") measurements. Overall, G-ænial is the most susceptible to staining, Herculite demonstrates the highest color stability, and Omnicroma shows intermediate stability under coffee exposure.

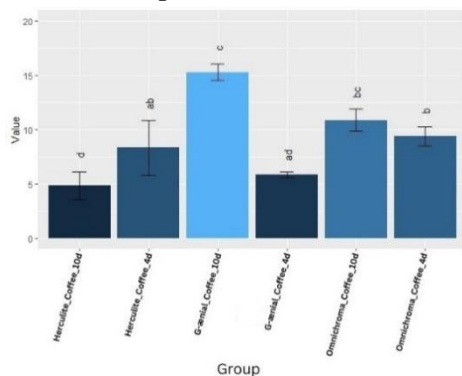


Figure 2. Color Stability of Resin Composites (Herculite, G-ænial, Omnicroma) after Coffee Exposure over 4 and 10 Days

The Kruskal-Wallis test assessing color stability under wine exposure across the three resin composites (Herculite, G-ænial, and Omnicroma) reveals significant differences ($\chi^2 = 82.135$, $df = 5$, $p < 0.00001$). Dunn's post-hoc test provides further insight through specific pairwise comparisons, highlighting significant differences between several groups, particularly at the 10-day mark. G-ænial at 10 days exhibits substantial

discoloration, showing statistically significant differences compared to both Herculite and Omnicroma. Herculite, in contrast, displays less pronounced color changes, with minor variations over time that remain generally lower than those observed in G-ænial. Omnicroma shows moderate stability, with its color changes under wine exposure being less severe than those in G-ænial. This analysis emphasizes that wine exposure markedly stains G-ænial, whereas Herculite and Omnicroma maintain relatively better color stability over time.

The figure displays the color stability of three resin composites after 4 and 10 days of exposure to wine. Significant differences in color stability between the groups are denoted by different letters. G-ænial at 10 days demonstrates the highest degree of discoloration, marked by the letter "c," indicating a more pronounced color change than in the other groups. Herculite experiences moderate discoloration across both time points, marked by the letters "ab" and "bd," reflecting some stability but with noticeable color shifts. Omnicroma shows the least discoloration, with the letter "a" indicating minimal color change over time. In summary, G-ænial is the most susceptible to staining from wine, Omnicroma exhibits the greatest color stability, and Herculite shows an intermediate level of resistance.(Figure 3)

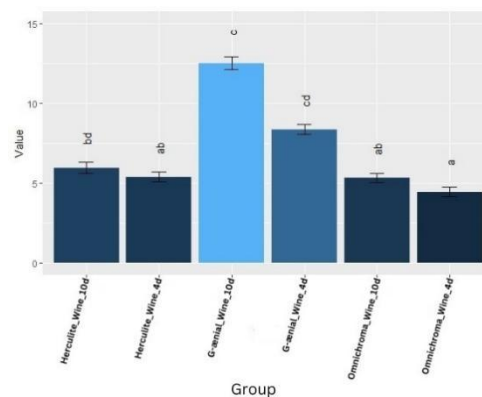


Figure 3. Color Stability of Resin Composites (Herculite, G-ænial, Omnicroma) after Wine Exposure over 4 and 10 Days

Composites (Herculite, G-ænial, Omnicroma) after Wine Exposure over 4 and 10 Days

The Kruskal-Wallis test for color stability among three resin composites exposed to cola for 4 and 10 days shows statistically significant differences ($\chi^2 = 81.132$, $df = 5$, $p < 0.00001$). Dunn's post-hoc test highlights specific group differences, with notable statistical significance observed in multiple pairwise comparisons, particularly involving G-ænial (2_COLA) at 10 days. G-ænial exhibits marked discoloration compared to other groups.

Significant differences in color stability are denoted by distinct letters above each bar. Herculite at 4 days (1_COLA_4d) shows the highest discoloration, marked with "a," indicating a considerable color change compared to other groups. G-ænial at both time points (2_COLA_4d and 2_COLA_10d) demonstrates moderate discoloration, marked by "bc" and "bd," suggesting a relatively stable but noticeable change. Omnicroma (3_COLA), particularly at 10 days (3_COLA_10d), shows the least discoloration, marked by "c," highlighting superior color stability in cola exposure. Overall, Herculite exhibits the most discoloration after 4 days, G-ænial shows intermediate stability, and Omnicroma provides the best resistance to cola-induced staining.(Figure 4)

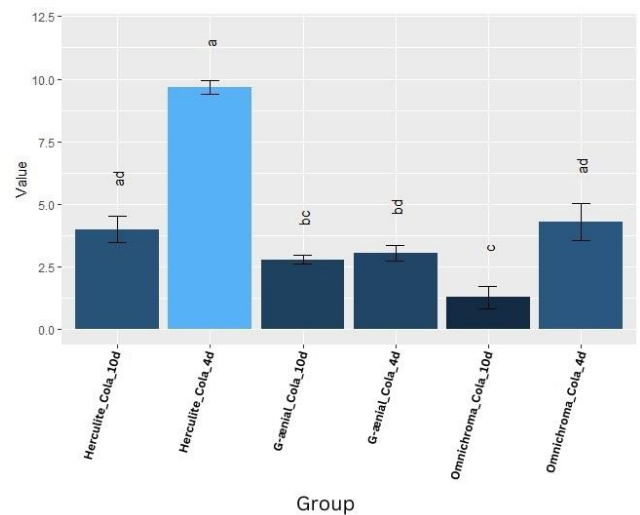


Figure 4. Color Stability of Resin Composites (Herculite, G-ænial, Omnicroma) after Cola Exposure over 4 and 10 Days

The results of this study highlight the differing responses of resin composites—Herculite, G-ænial, and Omnicroma—to various staining agents (coffee, wine, and cola), underscoring the significance of material composition in color stability. Across all staining solutions, G-ænial exhibited the highest tendency for discoloration, particularly after prolonged exposure, as confirmed by statistical tests. The Kruskal-Wallis and Dunn post-hoc tests showed that G-ænial consistently demonstrated the most pronounced color changes, especially in coffee and wine exposures over 10 days. In contrast, Herculite and Omnicroma showed better color retention, with Omnicroma displaying the least discoloration across all time points and solutions. These findings align with previous research, which has identified that composites with specific material formulations, such as nanofillers in Omnicroma, tend to exhibit better color stability due to improved resistance to pigment infiltration.

The implications of these results are clinically relevant, particularly for aesthetic

restorations where patients have high expectations regarding the longevity of color match with natural dentition. Given the observed performance, Omnicroma may be a preferable choice for patients with diets high in staining substances, as its stability in the face of coffee, cola, and wine exposure was superior. Meanwhile, G-aenial, despite offering certain aesthetic advantages, may require more frequent monitoring and potential replacements in patients frequently consuming staining agents. This study emphasizes the need for clinicians to consider patient dietary habits when selecting composite materials to ensure long-lasting aesthetic results. Further research may focus on developing composite formulations with enhanced resistance to discoloration while maintaining the other desirable properties of resin-based restorations.

The findings of this study are consistent with those of Barutçigil et al. (2017), who similarly found that composite resins, particularly bulk-fill types, demonstrate varying levels of color stability when exposed to typical staining agents like coffee and wine. In line with our observations, Barutçigil et al. noted that bulk-fill composites tend to discolor more readily, likely due to factors such as higher translucency and the strong initiators needed for deeper polymerization. Both studies highlight the significant role of composite formulation in color stability and emphasize the importance of selecting materials that consider patients' dietary habits and esthetic preferences. Unlike Barutçigil et al., who evaluated color stability over a shorter immersion period, this study's extended observation period of 10 days offers additional insights into the effects of prolonged exposure (17).

Similarly, our findings align with those of Faris et al. (2023), who also examined color stability in restorative materials subjected to different beverages. Both studies highlight the susceptibility of resin-based composites to discoloration from common beverages, such as coffee and cola. Faris et al. observed substantial color shifts, particularly in micro-hybrid composites exposed to tea-milk solutions and cola, mirroring our findings on color instability linked to composite composition and staining agent type. However, whereas Faris et al. employed a 30-day immersion period, our study reveals that even a shorter 10-day exposure can lead to noticeable color changes, suggesting that shorter-term exposure remains significant for clinical color stability. Together, these studies emphasize the importance of choosing appropriate materials for patients frequently consuming staining beverages(18).

In line with these observations, our results also correlate with those of Oliveira et al. (2024), who investigated the impact of different beverages on resin composites, focusing on color stability and fluorescence, particularly with acidic and alcoholic drinks. Both studies confirm that high-pigment, acidic beverages like red wine and cola significantly affect color stability, especially in composites with less resistance to staining. Oliveira et al. noted that acidic drinks, especially those containing alcohol, contribute to surface degradation and increased pigment absorption, findings that align with our observation of pronounced discoloration in G-aenial when exposed to wine. While Oliveira et al. used an in situ design to simulate oral conditions, our 10-day in vitro immersion setup intensifies the staining

effects, offering further insights into potential long-term outcomes(19).

Although this study sheds light on the effects of popular beverages on dental composites, certain limitations are present. First, the in vitro setup does not entirely mimic the intricate oral environment, where variables like saliva flow, temperature shifts, pH fluctuations, and chewing forces could impact the degradation and discoloration of composites. Moreover, the study focused on only three composite resin types and three beverages, which may not fully represent the range of materials and dietary habits observed in clinical settings. The 10-day immersion period, while helpful for assessing immediate effects, does not reflect the long-term changes that might develop over months or years. Additionally, the standardized shape of the specimens does not accurately simulate real dental restorations. The study also did not account for brushing or other oral hygiene practices that could potentially reduce staining and degradation. Future studies should incorporate these factors to better understand how dietary and hygiene habits, including pH fluctuations, impact the

durability and aesthetics of composite dental restorations.

CONCLUSIONS

The study concludes that the aesthetic integrity of resin composites is highly dependent on their color stability when exposed to common staining agents. Omnichroma proved to be the most resistant to discoloration, maintaining its original shade across exposures to coffee, cola, and wine, thus ensuring consistent aesthetic appeal. In contrast, G-aenial showed significant color changes, particularly in response to coffee and wine, suggesting it may be less suited for patients with high aesthetic demands.

From an aesthetic perspective, these findings highlight the importance of choosing composites with robust color stability to meet patients' expectations for natural-looking, long-lasting restorations. The results underline the critical role of composite formulation, including filler type and matrix design, in preserving the visual harmony of restorations over time.

REFERENCES

1. Altıparmak ET, Oktay EA, Karaoğlu S, Aydın N, Ersöz B, Özarslantürk S. The effect of cold drinks on the coloration of resin-containing restorative materials. *Int Dent Res.* 2022 Apr 30;12(1):14–20.
2. De Souza Oliveira LP, Silva JDS, Silva LDME, Leal CMB, Regalado DF, Toda C, et al. Effects of different beverages on the color stability and fluorescence of resin composites: in situ study. *Clin Oral Invest.* 2024 Sep 19;28(10):532.
3. Hajdu AI, Dumitrescu R, Balean O, Lalescu DV, Buzatu BLR, Bolchis V, et al. Enhancing Esthetics in Direct Dental Resin Composite: Investigating Surface Roughness and Color Stability. *JFB.* 2024 Jul 25;15(8):208.
4. Hajdu AI, Dumitrescu R, Balean O, Jumanca D, Sava-Rosianu R, Floare L, et al. Microscopic and Color Changes in Direct Dental Restorative Composite Resins upon Immersion in

- Beverages: Characterization by Scanning Electron Microscopy (SEM) and Energy-Dispersive X-ray Spectroscopy (EDS). *Biomedicines*. 2024 Aug 2;12(8):1740.
5. Fathima JN, Hashir MMJ, Padmanabhan K. Spectrophotometric evaluation of color stability of composite resin after exposure to cold drinks: An in vitro study. *Journal of Conservative Dentistry and Endodontics*. 2024 Feb;27(2):195–9.
 6. Duzyol M, Duzyol E, Çarıkçıoğlu B. Assessing one-shade composite resin color stability in response to everyday drinks. *BMC Oral Health*. 2024 Jul 20;24(1):821.
 7. Al-Asmar AA, HA Sabrah A, Abd-Raheem IM, Ismail NH, Oweis YG. Clinical evaluation of reasons for replacement of amalgam vs composite posterior restorations. *The Saudi Dental Journal*. 2023 Mar 1;35(3):275–81.
 8. Uctasli M, Garoushi S, Uctasli M, Vallittu P, Lassila L. A comparative assessment of color stability among various commercial resin composites. *BMC Oral Health*. 2023 Oct 24;23(1):789.
 9. Ozkanoglu S, Akin EGG. Evaluation of the Effect of Various Beverages on the Color Stability and Microhardness of Restorative Materials. *Nigerian Journal of Clinical Practice*. 2020 Mar;23(3):322.
 10. Kerr Dental [Internet]. 2015 [cited 2024 Jun 17]. Herculite™ Ultra. Available from: <https://www.kerrdental.com/kerr-restoratives/herculite-ultra-universal-nanohybrid-dental-composite>
 11. G-aenial A'CHORD | GC Europe N.V. [Internet]. 2020 [cited 2024 Jun 17]. Available from: <https://www.gc.dental/europe/en-LB/products/gaenialachord>
 12. Tokuyama Dental America Inc. [Internet]. [cited 2024 Jun 17]. OMNICHROMA Composite - Tokuyama Dental America. Available from: <https://www.tokuyama-us.com/omnichroma-dental-composite/>
 13. VITA Zahnfabrik [Internet]. [cited 2024 Jun 17]. VITA Easyshade® V. Available from: https://www.vita-zahnfabrik.com/pdb_GG2G50G200_en-US.html_us
 14. Westland S. Review of the CIE System of Colorimetry and Its Use in Dentistry. *Journal of Esthetic and Restorative Dentistry*. 2003;15(s1):S5–12.
 15. Thakkar R, Maini AP, Mogla S, Hussain Qadri SS, Varma PK, Dubey A. Effect of Staining Beverages on Color Stability of Composite: A Spectrophotometric Study. *Journal of Pharmacy and Bioallied Sciences*. 2024 Feb;16(Suppl 1):S389.
 16. Pérez M del M, Ghinea R, Rivas MJ, Yebra A, Ionescu AM, Paravina RD, et al. Development of a customized whiteness index for dentistry based on CIELAB color space. *Dental Materials*. 2016 Mar 1;32(3):461–7.
 17. Barutçigil Ç, Barutçigil K, Özarslan MM, Dündar A, Yilmaz B. Color of bulk-fill composite resin restorative materials. *J Esthet Restor Dent* [Internet]. 2018 Mar [cited 2024 Jun 19];30(2). Available from: <https://onlinelibrary.wiley.com/doi/10.1111/jerd.12340>
 18. Faris TM, Abdulrahim RH, Mahmood MA, Mhammed Dalloo GA, Gul SS. In vitro evaluation of dental color stability using various aesthetic restorative materials after immersion in different drinks. *BMC Oral Health*. 2023 Jan 29;23(1):49.
 19. De Souza Oliveira LP, Silva JDS, Silva LDME, Leal CMB, Regalado DF, Toda C, et al. Effects of different beverages on the color stability and fluorescence of resin composites: in situ study. *Clin Oral Invest*. 2024 Sep 19;28(10):532.