IDR International Dental Research

Original Article

The effect of different herbal teas on the color stability of nanohybrid and bulk-fill composites

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Received: 13 October 2022
Accepted: 14 December 2022

Access Online

DOI:
https://doi.org/10.5577/intdentres.445

Abstract

Aim: The aim of this study is to investigate the effects of green tea and rosehip tea, on the color stability of nanohybrid and bulk-fill composite resins.

Methodology: A total of 60 disc-shaped samples were made from two types of A2 resin with nanohybrid (Tetric N Ceram, Ivoclar Vivadent, Schaan, Liechtenstein) and bulk-fill (Filtek Bulk-Fill, 3M ESPE, MN, USA) structure with the help of 10 mm diameter and 2 mm thick Teflon molds in this study. All samples were finished and polished with 4-stage (thick, medium, fine, superfine) polishing discs (Sof-lex, 3M ESPE, MN, USA) and kept in an oven at 37 °C for 24 hours. The samples, whose initial color measurements were made by spectrophotometer, were divided into subgroups for the control group and two different herbal teas (Green tea, Rosehip) (n=10). Color measurements were repeated, and ΔE values were calculated. Wilcoxon, Kruskal-Wallis, and Bonferroni tests were used to analyze the data ($p < 0.05$).

Results: There was no statistically significant difference in color change between the composite resins ($p > 0.05$). No significant color change was found for either the Tetric N-Ceram or Filtek Bulk-Fill composite resin samples immersed in distilled water ($p > 0.05$, $\Delta E<3.3$).

Conclusion: Rosehip and green tea affect the color stability of composite resin restorations. Whereas the color change caused by green tea is at a clinically acceptable level, that stemming from rosehip tea falls within clinically unacceptable levels.

Keywords: Herbal tea, green tea, rosehip tea, nanohybrid, bulk-fill composite resin, color stability

How to cite this article: Tunçdemir MT, Dereli Z, Bahar A. The effect of different herbal teas on the color stability of nanohybrid and bulk-fill composites. Int Dent Res 2022;12(Suppl.1):103-7. https://doi.org/10.5577/intdentres.445

Introduction

Composite resin is one of the first choices among direct restorative materials due to its superior aesthetic properties, adhesion to the tooth structure, and conservative tooth preparation (1). Composite resins also have some disadvantages, such as polymerization shrinkage, change in surface hardness over time, water absorption, water solubility, low mechanical properties, and short clinical life (2). Studies to extend the survival of composite resins are carried out by modifying the inorganic, organic, and silane phases (3). The most preferred dental composites for restorative purposes are hybrid and microfilled composites. Hybrid composites offer moderate aesthetic properties and excellent mechanical properties by incorporating fillers with different average particle sizes (15-20 µm ve 0.01-0.05 µm) (4). The performance of composite resins also depends on the type and size of the filler. Generally, composites containing smaller filler particles provide better surface quality than those containing larger filler particles. Nanohybrid composites, which are accepted as universal composites, have been produced with advanced grinding techniques and particle size reduction (0.4-1 µm). They can generally be used in

most anterior and posterior restorations due to their excellent strength and polishing ability (5). Nanohybrid composites contain finely ground glass filler and nano filler in the form of prepolymerized filler (6).

Bulk-fill formulations are currently very popular composite resin formulations. These composites contain more sensitive photoinitiators that allow the depth of polymerization to reach up to 5 mm, unlike conventional composites that require layered placement (7). It has been placed in a single layer in deep lesions, accelerating dentists' restorative procedures (8).

One of the most important aesthetic components in dentistry is color (9). Patients expect restorations with good color compatibility with their natural teeth (10). The color match of the restoration with the adjacent tooth is important not only when it is done but also over a long period of time. The success of composite restorations depends on color stability over time. In addition, color stability is an important criterion in the selection of composites (11). The color stability of composite resins depends on the components and surface properties (12). It is also affected by the initiator system, polymerization time, resin matrix composition, degree of monomer conversion, and oxidation of the carbon pair (13). Studies have reported that colored beverages such as tea and coffee cause color changes in composite resins (14).

In recent years, the pursuit of healthy life has increased the popularity of herbal teas (15). Some people have started to prefer green tea, which is beneficial for health, to traditional tea given the increasing awareness of health (16). It is known that herbal teas are beneficial for health, and their consumption is increasing (17). Green tea and rosehip provide many health benefits and are among the herbal teas frequently consumed in Turkey (15, 18). Green tea is an herbal tea obtained by collecting and drying the leaves of Camellia sinensis and not allowing them to react with oxygen while drying. It has been shown to have various pharmacological effects, such as antioxidant, anti-inflammatory, antimutagenic, anticarcinogenic, antiangiogenic, apoptotic, antiobesity, hypocholesterolemic, antiatherosclerotic, antidiabetic, antibacterial, antiviral, and anti-aging effects (19). Green tea has powerful effects on the body due to the antioxidants it contains (20).

Rosehip is a very useful food in terms of nutritional value and human health. Rosehip is among the most popular medicinal plants in the treatment of several diseases. Rosehip berries contain vitamins C, P, A, B1, B2, E, and K. Products such as jam, marmalade, fruit juice, and tea are produced with rosehip fruit, providing income to people who work with this plant. In addition to being anti-inflammatory, rosehip is a good source of phytonutrients that also contain vitamin C and lycopene. Due to its nutritious composition, rosehip supplements have very positive effects on certain chronic diseases, including osteoarthritis, rheumatoid arthritis, and cancer (21).

The aim of this study is to investigate the effects of green tea and rosehip tea, which are frequently consumed today, on the color stability of nanohybrid and bulk-fill composite resins. The null hypothesis is that immersion in different herbal teas will not significantly change the color of the tested bulk-fill and nanofill composite groups.

Materials and Methods

Two types of composite resins nanohybrid Tetric N Ceram (Ivoclar Vivadent, A2) and bulk-fill Filtek Bulk-Fill, (3M ESPE, A2) were used in this study (Table 1). A total of 60 disc-shaped samples, 30 of each composite material, were prepared with the help of Teflon molds with a diameter of 10 mm and a height of 2 mm. The composite material was placed in the Teflon mold with the help of a spatula, a transparent tape was applied to it, and each sample was polymerized for 20 seconds with an LED light device. All samples were finished and polished with 4-stage (coarse, medium, fine, superfine) polishing discs (Sof-lex, 3M ESPE). The samples were kept in an oven at 37°C for 24 hours in distilled water. After 24 hours, the samples were fixed on a standard white background with the help of cement glass, the initial color measurements were repeated 3 times with a spectrophotometer (VITA Easyshade, Bad Säckingen, Germany), and the average L, a, and b values were recorded. The device was calibrated in accordance with the manufacturer's recommendations before each measurement. The samples were divided into subgroups to be kept in two different herbal teas (green tea and rosehip, Doğus, Turkey, infused for 10 minutes) or in distilled water (the control group) (n=10). The liquids in which the samples were kept were renewed every 24 hours at 37°C for 6 days. Color measurements were repeated, and ΔE values were calculated.

Statistical analysis

All analyses and graphs were prepared using SPSS 21 (IBM SPSS Inc., Armonk, NY, USA). Wilcoxon, Kruskal-Wallis, and Bonferroni tests were used to analyze the data. A p-value < 0.05 was considered statistically significant.

Results

There was no statistically significant difference in color change between the composite resins ($p>0.05$). No significant color change was found for either the Tetric N Ceram or Filtek Bulk-Fill composite resin samples immersed in distilled water ($p > 0.05$, $\Delta E<3.3$). A ΔE greater than 3.3 was also found for both composite resin samples after immersion in rosehip tea, and color change was within clinically unacceptable limits. The samples submerged in green tea changed color to a greater extent than those in the control group, but this difference fell within clinically acceptable limits and was not statistically significant ($\Delta E>3.3$) (Table 2).

Table 1. Composite materials and contents

Product	Manufacturer	Inorganic filler content	Inorganic filler by volume	Inorganic filler by weight	Color
Tetric N-Ceram	Ivoclar Vivadent, Schaan, Lichtenstein	Barium glass Ytterbium trifluoride Mixed oxide Copolymer	%55-57	%80-81	A2
Filtek Bulk-Fill	3M ESPE, MN, USA	Non-aglomerated 20 nm silica, Non-aglomerated 4-11 nm zirconia, Agrage zirconia-silica, Ytterbium trifluoride	%58,4	%76,5	A2

Table 2. ΔE and *p*-values of the bulk-fill and nanohybrid composite resins after immersion in herbal teas

	Bulk-fill	Nanofill	*p*-value
Control	1.03 ± 0.52	1.38 ± 0.95	0.771
Green tea	2.84 ± 1.03	3.2 ± 1.10	0.621
Roseship tea	4,25 ± 1.13	4.87 ± 0.92	0.533
p-value	0.004	0.011	

Discussion

This study investigated color changes in nanohybrid and bulk-fill composite resins after immersion in different herbal teas. Unlike green tea, rosehip tea caused a significant color change in both composite resins, thereby prompting the rejection of the null hypothesis (i.e., Two herbal teas will not change the color of different composites.). Color harmony between a tooth and a restoration is aesthetically critical, and low color stability in composite resin restorations is a major aesthetic failure (22). Discoloration occurs as the hydrophilic monomers in a composite resin material absorb water. By contrast, fillers in composite resin adsorb water toward the surface (23). Other factors that are important in color stability are the resin matrix structure of a composite, chemical differences among resin monomers, filler sizes and concentrations, polymerization initiators, and the oxidation of unreacted monomers (24).

In dentistry, color can be selected with the naked eye or through the use of digital devices. An example is a spectrophotometer, which is a sensitive device that can measure small color differences and generate reproducible, objective, and universal results (25). It determines color changes as numerical values without the need for the natural subjectivity of people (26). An acceptable color change value is $\Delta E \leq 3.3$ (27), which was also adopted in the current research.

The materials used in this study were Tetric N Ceram and Filtek Bulk-Fill. Different results were reported in studies comparing the coloration of bulk-fill and conventional composites. Bulk-fill composites contain fillers with different optical properties that increase the depth of polymerization, enabling their application as a single layer (28). These materials have a reduced amount of filler particles with increased sizes, thus preventing light scattering and elevating deep penetration into teeth (29). Meanwhile, nanohybrid composites contain small inorganic fillers at the submicron level. They are suitable for use in the anterior region, as they can be satisfactorily polished, and in the posterior region because of their durability and abrasion resistance (30). The polished samples in the present work were immersed in herbal teas for six days, but no significant difference in coloration was found between the composite resins, which are frequently preferred in routine clinical applications.

This finding contrasts with that of Bahbishi et al., who immersed five composite materials in tea, coffee, fruit juice, and distilled water and reported that bulk-fill resins show greater color stability than universal resins (31). The discrepancy in the results may be due to differences in immersion times.

The pursuit of a healthy life has increased the popularity of herbal teas (15). The teas investigated in the current work were chosen because these are among the herbal products frequently consumed in Turkey. As a dye, rosehip fruit contains carotenoids at a ratio of 3.8 mg/100 g (32). Researchers reported that color change within clinically acceptable limits occurs in supranano-filled composite material submerged in clove and green tea for 48 hours (17). Abdelaziz and Malky reported that Filtek Z250 XT composite material with nanohybrid filler shows low sensitivity to staining by herbal beverages and concluded that hibiscus herbal tea has more coloring potential than anise (33). In the present study, both the Tetric N Ceram and Filtek Bulk-Fill samples showed color change falling within clinically acceptable limits when immersed in green tea, which has a color similar to anise tea. More intense color changes occur in composite resin samples with nanoparticles immersed in black tea than in those treated with green tea (34). Patil et al. stated that the coloring effect of herbal teas increases over time (35). Similar to other studies, the current work immersed composite resin samples in herbal teas for six days. An immersion time lasting this long is equivalent to an estimated six months of consumption (36). Kwon et al. immersed Ceram X, Grandio, and Filtek Z350 composite resin materials in green tea, ethanol, coffee, and distilled water seven hours a day for three weeks. An acceptable color change occurs in composites immersed in distilled water, green tea, and ethanol, but unacceptable alterations occur in materials exposed to coffee (37). In our research, color change falling within clinically unacceptable limits occurred in both composite materials when immersed in rosehip tea. Similarly, Dinç Ata et al. immersed three composite resins in different coloring solutions and reported that the greatest color change occurred in the samples immersed in rosehip tea (38). Rosehip extract obtained by boiling rosehip fruit in pure water is used to dye fabric. We believe that more remarkable coloration occurred in the composite samples submerged in rosehip tea because of the presence of a dyestuff called carotoneid in rosehip.

Conclusions

Rosehip and green tea affect the color stability of composite resin restorations. Whereas the color change caused by green tea is at a clinically acceptable level, that stemming from rosehip tea falls within clinically unacceptable levels. Informing patients about this issue may contribute to ensuring the color stability of restorations.

Acknowledgments: This study has been presented at the Necmettin Erbakan University 2nd International Dentistry Congress in Konya, Turkey held between October 1-3, 2022.

Peer-review: Externally peer-reviewed.

Author Contributions: Conception – M.T.T.; Design – M.T.T., Z.D.; Supervision – Z.D.; Materials – M.T.T.; Data Collection and/or Processing – M.T.T., A.B.; Analysis and/or Interpretation – M.T.T.; Literature Review – M.T.T., Z.D., A.B.; Writer – M.T.T.; Critical Review – M.T.T.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

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