Effect of polishing paste on color stability of nanohybrid and spherical filler composite after immersion in black tea: a laboratory experiment

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ABSTRACT

Introduction: The characteristics of the composite filler directly affect the surface roughness and susceptibility to extrinsic staining. An esthetic composite restoration depends on the color stability, that can be attributed to the low surface roughness. Therefore, it is crucial to apply appropriate polishing procedures. This study aim to analyze the effect of polishing paste on color stability of nanohybrid and spherical filler composite after immersion in black tea: a laboratory experiment. **Method:** Forty-two cylinder-shaped with a diameter of 6mm and a thickness of 2mm were prepared from nanohybrid (Filtek Z250XT) and spherical filler composite resin (Palfique Omnichroma), then divided into four sub-groups subjected to different polishing treatments and two control sub-groups without polishing. The groups were as follows: nanohybrid without polishing (N-K), spherical filler without polishing (SF-K), nanohybrid polished with discs (N-Pd), spherical filler polished with discs (SF-Pd), nanohybrid polished with discs followed by paste (N-PdP), and spherical filler polished with discs followed by paste (SF-PdP). Specimens were immersed in black tea for 7 days. The initial and final color were measured using a colorimeter. Data were analyzed using One-Way ANOVA and Tamhane's Post Hoc test. **Results:** Immersion in black tea solution resulted in clinically unacceptable color changes, except for the N-PdP group. The N-K group exhibited the highest ΔE* value, while the N-PdP group showed the smallest ΔE* value. **Conclusion:** The use of polishing paste reduced color changes in composite resin due to black tea. Nanohybrid composite resin polished with a disc followed by paste demonstrates better resistance to color changes.

Keywords

diamond polishing paste, color change, nanohybrid, spherical filler, black tea

Pengaruh pasta poles terhadap stabilitas warna komposit dengan filler nanohybrid dan spherical setelah perendaman di dalam teh hitam: eksperimental laboratoris

ABSTRAK

Pendahuluan: *Karakteristik filler resin komposit secara langsung mempengaruhi kekasaran permukaan dan kerentanan terhadap pewarnaan ekstrinsik. Restorasi resin komposit yang estetik bergantung pada stabilitas warna, yang berkaitan dengan kehalusan permukaan. Oleh karena itu, penerapan pemolesan yang tepat sangatlah penting dalam restorasi resin komposit. Penelitian ini bertujuan untuk menentukan pengaruh pasta poles terhadap stabilitas warna komposit nanohybrid dan spherical setelah perendaman dalam teh hitam.* ***Metode:*** *Empat puluh dua spesimen berbentuk silinder dengan diameter 6mm dan tebal 2mm dipersiapkan dari resin komposit nanohybrid (Filtek Z250XT) dan spherical filler (Palfique Omnichroma) kemudian dibagi ke dalam 4 subkelompok yang diberikan perlakuan pemolesan berbeda dan 2 sub kelompok kontrol tanpa pemolesan. Kelompok tersebut adalah: nanohybrid tanpa pemolesan (N-K), spherical filler tanpa pemolesan (SF-K), nanohybrid dipoles dengan disc (N-Pd), spherical filler dipoles dengan disc (SF-Pd), nanohybrid dipoles dengan disc diikuti pasta (N-PdP), dan spherical filler dipoles dengan disc diikuti pasta (SF-PdP). Spesimen direndam dalam teh hitam selama 7 hari. Warna awal dan akhir diukur menggunakan colorimeter. Data dianalisis menggunakan uji One-Way ANOVA dan Post Hoc Tamhane.* ***Hasil:*** *Perendaman dalam teh hitam menghasilkan perubahan warna yang tidak dapat diterima secara klinis, kecuali pada kelompok N-PdP. Kelompok N-K menunjukkan nilai ΔE* terbesar, sementara kelompok N-PdP menunjukkan nilai ΔE* terkecil.* ***Simpulan:*** *Penggunaan pasta poles mengurangi perubahan warna resin komposit akibat teh hitam. Resin komposit nanohybrid yang dipoles menggunakan disc diikuti pasta menunjukkan ketahanan yang lebih baik terhadap perubahan warna.*

Kata kunci

diamond polishing paste, perubahan warna, nanohybrid, spherical filler, teh hitam

INTRODUCTION

The rising expectations of patients regarding aesthetics have driven the widespread adoption of composite resin as the most popular restorative material due to its superior aesthetic properties.[1] Commercially available composite resins contain filler particles of varying sizes. Those with filler sizes ranging from 1 to 100 nanometers are classified as nanocomposites. One of them is nanohybrid composite resins, comprising larger particles (0.4 to 5 microns) with additional nanometer-sized particles.[2]

Recently, single-shade composite resin has been introduced to address the need for skill and precise shade determination in the restoration process.[3] This composite resin contains spherical silica and zirconia fillers with particle sizes of 260 nm. These filler particles, larger than 100nm, are classified as supra-nano fillers.[4] The introduction of this spherical filler-containing composite resin enables practitioners to create aesthetic and functional restorations more efficiently,[3,5] leveraging its advanced filler technology. The characteristics of spherical filler composite resin are based on smart chromatic technology, which has the ability to capture the structural color of teeth, controlled by the size of its filler particles. In contrast, nanohybrid composite resin uses a chemical color mechanism, achieved by adding dyes and pigments to match the color of the restored teeth.[6]

Aesthetics, being one of the clinical success indicators of composite resin restorations, is closely linked to the appearance and smoothness of the surface. A smooth and polished surface exhibits better color stability compared to an irregular surface[7,8], emphasizing the importance of proper polishing to achieve optimal aesthetics and enhance the longevity of restorations. It has been reported that composite resins that are unpolished showed intense color changes. This phenomenon is attributed to the formation of an oxygen-inhibited layer (OIL) beneath the mylar strip when these composite resin specimens are light-cured under the strip. This layer is rich in resin content and has lower polymerization levels, rendering it susceptible to color changes. Therefore, polishing is essential to eliminate the OIL and achieve a harder surface resistant to color changes.[9]

Conventional polishing using a series of aluminum oxide-coated abrasive discs such as Sof-Lex™ has demonstrated excellent results.[7] Aytac et al.[10] found that disc polishing produces a smooth surface without significant differences among all tested composite resin types. This is related to the disc's ability to evenly remove particles and organic matrix.[10] Over and above that, the use of diamond polishing paste after polishing with abrasive discs has been found to significantly reduce staining compared to using abrasive discs alone, attributed to the ability of diamond polishing paste to immensely reduce surface roughness.[11]

In a more recent study, Kurt et al. demonstrated that polishing using diamond polishing paste resulted in the smoothest surface among any other polishing methods.[12] This can be attributed to the higher hardness of diamond particles in the paste compared to the filler particles of the composite resin, allowing for the homogeneous removal of both composite resin phases, namely the resin matrix and filler particles. Moreover, diamond is the hardest element on the Mohs Hardness Scale. On top of that, the fine consistency and splatter-resistant nature of the paste allow it to move freely on the specimen surface, resulting in uniform surface reduction.[13] Clinically, polishing with paste would be a suitable choice because it effectively reduces surface roughness, contributing to the success of composite resin restoration.[12]

In addition to polishing methods, the composition of composite resins also plays a crucial role. Nanocomposites, particularly nanohybrid composite resin, have demonstrated superior aesthetic results due to their smaller filler particle sizes, which enable the material to bring about higher gloss and lower surface roughness after polishing.[10] Research conducted by Ramírez-Vargas et al.[14] demonstrated that composite resin containing nanoparticles has high wear resistance, reducing the possibility of surface irregularities. Its better resistance to particle detachment during polishing further supports the reduction of surface roughness.[14]

Moreover, the combination of nanoparticles and nanoclusters in this composite resin results in a nanocomposite with improved physical properties and wear resistance, as well as high initial polish and superior polish retention, leading to aesthetic outcomes.[15]

A recent study has shown that spherical filler composite resin, due to its small filler particle size, can maintain clinically acceptable surface roughness (<0.2 μm) after immersion in different solutions.[4] However, despite advancements in composite resin fillers and available polishing systems, there is always a possibility of composite resin restoration failure.

Color change remains one of the main causes of clinical failure in composite resin restorations and is the main reason for its replacement,[7,16] leading to patient dissatisfaction and additional costs. One significant extrinsic factor contributing to these color changes is the consumption of tea, which is remarkably high worldwide with over 2 billion cups consumed daily.[17] Among various types of tea, black tea has been reported to have the highest staining potential. The exposure of composite resin to tea, particularly black tea, can cause clinically unacceptable color changes.[19,20] Therefore, research on the color changes of composite resin related to black tea consumption is crucial because of its impact on restoration aesthetics and overall clinical success of dental restorations. While various polishing methods are used to address color change of composite resin restorations, there is a lack of research specifically examining the effect of applying additional polishing paste after conventional polishing systems. This gap in the literature highlights the need for further investigation.

The first polishing method comprises series of abrasive discs, which is conventionally used, and the second one involves abrasive discs followed by diamond polishing paste applied with wool brush, as one of the more recent developments found to further improve polishing results.[11] This study employs Filtek Z250 XT composite resin, which is commonly used, and OMNICHROMA composite resin, a pioneer in universal single-shade composite resin[21], to ascertain differences in color change between materials with different filler contents.

Composite resin immersion in black tea is conducted for 7 days to evaluate the clinical performance of composite resin restorations over a period of 2 years.[22] The null hypothesis was that the color change of nanohybrid and spherical filler composite resins would not differ depending on the applied polishing systems. This study presents a novel comparison between a newer, single-shade spherical filler composite and a widely used nanohybrid composite, evaluated under standardized polishing protocols and staining conditions, providing further insight into how current universal composites respond to common staining agents. This study aims to analyze the effect of polishing paste on color stability of nanohybrid and spherical filler composite after immersion in black tea: a laboratory experiment.

METHODS

This study was a laboratory experimental research conducted from July to August 2023 at the Laboratory of Dental Materials Research and Development, Faculty of Dentistry, Universitas Indonesia. The research specimens used in this study were nanohybrid (N) (Filtek Z250 XT™ shade A2, 3M, USA) and spherical filler (SF) (PALFIQUE OMNICHROMA®, Tokuyama Dental, Tokyo, Japan) composite resins (Table 1).

Table 1. Properties of composite resin materials used in the study

Materials	Type	Composition		Filler Content	Lot Number
		Matrix	Filler		
Filtek Z250 XT™	Nanohybrid	Bis-GMA, UDMA, Bis-EMA, PEGDMA, TEGDMA	Surface-modified zirconia/silica and 20nm surface-modified silica	82% wt (68% vol)	9703562
PALFIQUE OMNICHROMA®	Spherical filler	UDMA, TEGDMA	260nm supra-nano spherical SiO2-ZrO2	79% wt (68% vol)	053E42

Bis-GMA: Bisphenol A-glycidyl methacrylate; UDMA: Urethane dimethacrylate; Bis-EMA: Bisphenol A ethoxylated dimethacrylate; PEGDMA: Poly(ethylene glycol) dimethacrylate; TEGDMA: Triethylene glycol dimethacrylate.

The number of specimens was determined using Federer's formula (1967): (t-1)(n-1) ≥ 15, where t is the number of treatments and n is the number of specimens. With four treatment groups, the calculation yielded n ≥ 6, indicating a minimum of six specimens required per group. This study included 4 treatment groups and 2 control groups, resulting in a total of 6 groups. In this study, 7 specimens were allocated per group. Therefore, the total number of specimens needed for the 6 groups was 42 (7 specimens × 6 groups = 42 specimens).

Twenty-one specimens of each composite resin were prepared in cylindrical shape with a diameter of 6mm and a height of 2mm. The specimens were immersed in distilled water for 24 hours in an incubator at 37°C and then divided into 4 sub-groups of polishing procedures and 2 sub-groups without polishing. The specimens were manually randomized using simple randomization techniques. The first polishing treatment was carried out using a polishing disc (Pd), and the second polishing treatment was using a polishing disc followed by a wool brush and diamond polishing paste (PdP). Specimens that were not polished served as controls (K). Thus, there were 6 groups of these specimens: nanohybrid without polishing (N-K), spherical filler without polishing (SF-K), nanohybrid polished using polishing discs (N-Pd), spherical filler polished using polishing discs (SF-Pd), nanohybrid polished using polishing discs followed by paste (N-PdP), and spherical filler polished using polishing discs followed by paste (SF-PdP).

The Pd groups were polished using Sof-Lex™ XT polishing discs (3M ESPE, USA) with the disc axis perpendicular to the specimen surface. The specimens were polished for 15 seconds for each disc (coarse, medium, fine, and superfine) at a speed of 15,000 rpm which was found to produce the smoothest surface[23] and a pressure of 30 grams.[24] After each polishing step, the specimens were rinsed with water and dried with air. Meanwhile, the PdP groups were polished similarly to the Pd groups, followed by the use of diamond polishing paste (EVE DIACOMP® Paste, EVE Ernst Vetter GmbH, Germany) (Table 2). Diamond polishing paste was applied with a wool brush for 15 seconds at a speed of 5,000 rpm according to the manufacturer's instruction.

Table 2. Properties of polishing discs and paste used in the study

Material	Manufacturer	Type	Particle size
Sof-Lex™ XT polishing disc	3M ESPE, St. Paul, USA	Aluminum oxide coated abrasive discs	Coarse: 60 µm, medium: 29 µm, fine: 14 µm, superfine: 5 µm
EVE DIACOMP® Paste	EVE Ernst Vetter GmbH, Germany	Diamond polishing paste	4-8µm

The initial color of the specimens was measured using a colorimeter with the CIEL*a*b* color system, which maps color space into three coordinates: L*, a*, and b*. The L* coordinate indicates lightness (black/white), while the a* and b* coordinates represent chromaticity along the red-green and yellow-blue axis, respectively.[2] The initial color measurements of groups N-K and SF-K were performed after immersing the specimens in distilled water for 24 hours, while groups N-Pd, SF-Pd, N-PdP, and SF-PdP were measured after polishing. These initial color values were represented as L*1, a*1, and b*1. Following these measurements, all specimens were immersed in a black tea solution.

The black tea solution was prepared according to the manufacturer's instructions by adding 200ml of 80°C water to a glass beaker containing one tea bag (Teh Celup Black Tea, Sosro) and allowed to stand for 5 minutes. After reaching a temperature of 37°C, the solution was poured into plastic pots divided according to the specimen groups. The specimens were immersed for 7 days, equivalent to 2 years of tea consumption. The tea solution was changed daily. After 7 days of immersion, the specimens were rinsed with distilled water for 1 minute and then dried with tissue paper. The final color of the specimens (L*2, a*2, and b*2) was measured using a colorimeter and recorded.

The initial (L*1, a*1, b*1) and final (L*2, a*2, b*2) color data of the specimens were calculated to obtain the color differences. The color change is expressed as ΔE*, representing the overall difference between the two colors in the L*a*b* space.[2] ΔE* indicates the total color change of the specimens before and after 7 days of immersion in the black tea solution. A ΔE* value of 0 means perfect color match, 0.5 – 1 indicates excellent, 1 – 2 indicates good, 2 – 3.5 indicates clinically acceptable, and >3.5 indicates mismatch or clinically unacceptable.[7] The data were analyzed using One-Way ANOVA to determine the differences in ΔE* between groups. Post-Hoc Tamhane test was conducted to identify which groups showed statistically significant differences in ΔE* values.

RESULTS

Table 3 shows the initial color data (L*1, a*1, and b*1) as well as the final color data of the specimens (L*2, a*2, and b*2). The difference in values for each component is expressed as ΔL*, Δa*, and Δb*.

Table 3. Lightness (L*), redness-greenness (a*), and yellowness-blueness (b*) values before and after black tea immersion

Group	Before Immersion			After Immersion			Difference		
	L*1	a*1	b*1	L*2	a*2	b*2	ΔL*	Δa*	Δb*
N-K	57.04	0.66	6.47	55.05	-0.24	15.92	-1.99	-0.90	9.44
SF-K	55.67	2.59	9.23	54.66	3.36	13.71	-1.01	0.77	4.47
N-Pd	58.38	0.70	6.77	56.09	1.40	10.39	-2.29	0.70	3.62
SF-Pd	57.72	2.48	9.02	55.86	3.81	12.24	-1.87	1.33	3.23
N-PdP	57.48	0.59	6.43	56.48	1.02	7.82	-1.00	0.42	1.39
SF-PdP	56.54	2.53	9.26	55.63	3.40	12.63	-0.90	0.86	3.37

The values of ΔL*, Δa*, and Δb* were calculated to obtain the value of ΔE*. Table 4 presents the mean values of color change (ΔE*) for nanohybrid and spherical filler composite resins after immersion in black tea solution.

Table 4. Color change (ΔE*) in nanohybrid and spherical filler composite resins after black tea immersion

	Mean Values of Color Change (ΔE*) for Nanohybrid Composite Resin ± SD	Mean Values of Color Change (ΔE*) for Spherical Filler Composite Resin ± SD	p-value
Without polishing	9.71 ± 1.17	4.71 ± 0.47	0.000*
Disc	4.37 ± 1.28	4.00 ± 0.82	
Disc + Paste	1.81 ± 0.54	3.64 ± 0.37	

*One-Way ANOVA test with $p < 0.05$

The nanohybrid composite resin group without polishing (N-K) as shown in Table 4 indicates the highest ΔE* value, amounting to 9.71 ± 1.17, followed by the spherical filler group without polishing (SF-K), which recorded a ΔE* value of 4.71 ± 0.47. The nanohybrid group polished with a polishing disc (N-Pd) exhibited a ΔE* value of 4.37 ± 1.28, while the spherical filler group polished with a polishing disc (SF-Pd) showed a ΔE* value of 4.00 ± 0.82. Meanwhile, the spherical filler group polished with a polishing disc followed by paste (SF-PdP) displayed a ΔE* value of 3.64 ± 0.37, and the nanohybrid group subjected to the same polishing process (N-PdP) demonstrated the lowest ΔE* value, recorded at 1.81 ± 0.54.

To identify specific groups exhibiting statistically significant differences, Tamhane Post Hoc test was performed. The results are presented in Table 5.

Table 5. Tamhane post hoc analysis of mean color change (ΔE*) in nanohybrid and spherical filler composite resins

Group		p-value
N-K	SF-K	0.000*
	N-Pd	0.000*
	N-PdP	0.000*
SF-K	SF-Pd	0.703
	SF-PdP	0.008*
	SF-Pd	1.000
N-Pd	N-PdP	0.018*
SF-Pd	SF-PdP	0.996
N-PdP	SF-PdP	0.000*

*Tamhane post hoc test with $p < 0.05$

Tamhane post hoc test as shown in Table 5 revealed statistically significant differences in the mean values of color change (ΔE*) of the resin composite between the following groups: N-K and SF-K, N-Pd, and N-PdP; SF-K and SF-PdP; N-Pd and N-PdP; and N-PdP and SF-PdP ($p<0.05$). However, no significant differences were found between the SF-K and SF-Pd groups; N-Pd and SF-Pd; and SF-Pd and SF-PdP groups ($p>0.05$).

DISCUSSION

This study investigated the influence of polishing paste on the color stability of nanohybrid and spherical filler composite resins after immersion in black tea, a commonly consumed staining agent. The findings indicate that both the type of composite material and the polishing system significantly affect the degree of color change. Notably, the nanohybrid composite resin polished with a disc followed by paste exhibited the lowest color change (ΔE*), remaining within clinically acceptable thresholds. In contrast, the unpolished nanohybrid group demonstrated the highest degree of staining. These results emphasize the importance of appropriate finishing and polishing procedures, particularly the use of polishing paste, in enhancing the aesthetic durability of composite restorations under conditions that simulate daily dietary exposure. This observed difference in color stability underscores the importance of both material composition and surface treatment, suggesting that the interaction between composite type and polishing method plays a critical role in the aesthetic longevity of composite restorations.

Clinically, the spherical filler composite resin appears brighter than the nanohybrid composite resin, although it shows lower initial brightness (Table 3). This can be explained by Perez et al.'s study[25], which showed that spherical filler composite resin has the highest light transmission compared to nanofill, nanohybrid, and microhybrid composite resins. The high light transmission may be due to lower scattering values because of its spherical filler shape, unlike the irregular shapes of fillers in other test materials.[25] Higher light transmission allows more light to pass through the material. This can result in less light being reflected by spherical filler composite resin due to increased transmission. As a result, the colorimeter detects less light reflected by spherical filler composite resin, resulting in a lower L* value.

In addition to differences in light transmission, all specimen groups exhibited changes in color parameters after staining. All groups showed a decrease in L* (brightness) values, becoming darker after immersion in black tea solution. Besides, there was an increase in a* (redness) and b* (yellowness) values (Table 3). This is caused by the presence of a large amount of coloring compounds in black tea, including tannin (11.76% — 15.14%), theaflavin (0.25% — 0.48%), and thearubigin (19.5% — 27.2%).[26] Theaflavin gives a reddish-yellow color, while thearubigin gives a reddish-brown and yellow color.[24]

The color stability of composite resin is a crucial property affecting restoration longevity and is related to the type of material and polishing techniques employed.[24] The evaluation of composite resin color changes typically involves objective measurements using a colorimeter to mitigate subjective interpretations. In this study, only the nanohybrid composite resin group polished with a disc followed by paste demonstrated clinically acceptable color changes, whereas the remaining five groups exhibited clinically unacceptable color changes (Table 4).

The nanohybrid composite resin group without polishing exhibited higher color change value compared to the spherical filler composite resin group without polishing (Table 4). This phenomenon is attributed to the chemical composition of both materials, particularly the resin matrix, which has the capacity to absorb water and other fluids. According to the manufacturer information, nanohybrid composite resin contains a resin matrix composition of Bis-GMA, UDMA, Bis-EMA, PEGDMA, and TEGDMA, while the resin matrix of spherical filler composite resin consists of UDMA and TEGDMA. The UDMA matrix is found to be more resistant to staining than Bis-GMA due to its hydrophobic characteristics and lower water absorption rate.[27] Consequently, spherical filler composite resin experiences lesser color changes compared to nanohybrid composite resin.[28]

The nanohybrid composite resin group without polishing exhibited the highest color change value (Table 4). This significant color alteration is consistent with Shetty et al.'s findings[7], which indicated that all control specimens experienced the most intense color changes. Additionally, the staining ability of the black tea solution used could contribute to the high color change in the control specimens.

Lower color change value was observed in the nanohybrid composite resin group polished with a disc followed by paste compared to the nanohybrid composite resin group without polishing (Table 4). This finding is attributed to the polishing procedure, which eliminates the OIL on the composite resin surface, making it less susceptible to staining. Moreover, polishing with paste results in a smoother composite resin surface effectively.

While polishing significantly improved the color stability of nanohybrid resin, its impact on spherical filler resin was less pronounced. The spherical filler composite resin group without polishing did not show significant difference in color change value compared to the group polished with a disc (Table 4). This can be attributed to the good surface roughness of spherical filler composite resin even before further polishing which is in line with El-Rashidy et al.'s study findings.[4]

In the spherical filler composite resin groups, the color change value after polishing with a disc followed by paste were lower than those without polishing (Table 4). This difference may be due to the low surface roughness resulting from polishing with paste as demonstrated by Kurt et al.[13]

Polishing using a disc followed by paste resulted in lower color change values compared to using only the disc on both tested composite resins (Table 4), likely due to the diamond paste's superior wear capacity creating a smoother surface, as previously observed by Lainović, et al.[11] This is attributed to the diamond paste's ability to homogeneously remove both the resin and filler phases of the composite resin, owing to the diamond particles' greater hardness than the filler components.

When considering the types of composite resins tested, after polishing with a disc, spherical filler composite resin showed no significant difference in color change value compared to nanohybrid composite resin (Table 4). This finding is in line with Aytac et al.'s study.[10] However, after polishing with a disc followed by paste, nanohybrid composite resin exhibited lower average color change values than spherical filler composite resin. This may be due to the nanohybrid composite resin filler system used in this study, which contains a combination of nanoparticles and nanoclusters bound in the matrix.[15,16]

In addition to mean color change values, the degree of variation in color change values between the two materials tested in this study also differed. This variability is likely due to differences in their filler contents, which underpin their distinct technologies.[6] Specifically, the spherical filler composite resin exhibited smaller variations in color change values compared to the nanohybrid composite resin (Table 4). This can be attributed to the composition of the spherical filler composite resin matrix, specifically UDMA, known for its low water absorption.[6]

The lower water absorption results in smaller variations in color change compared to nanohybrid composite resin. In contrast, the nanohybrid composite resin exhibited greater variations in color change values. This could be attributed to the filler content, which may result in a more significant reduction in color change values after polishing, thus explaining the greater variations. This can occur because the smaller nanofiller size in nanohybrid composite resin (20 nm silica) produces superior surface quality and polish retention compared to submicron fillers in spherical filler composite resin (SiO_2-ZrO_2 spherical 260nm).[4] Additionally, the presence of nanoclusters in nanohybrid composite resin produces higher surface polishing stability over time compared to micron-sized fillers.[25]

The results of this study reject the null hypothesis, which stated that the color change of nanohybrid and spherical filler composite resins would not differ depending on the applied polishing systems. On the contrary, significant differences were observed between the two materials and among the various polishing protocols. Notably, the nanohybrid composite resin polished with a disc followed by paste exhibited the lowest color change values, while the unpolished nanohybrid group showed the highest. These findings underscore the critical role of both composite type and polishing method in determining the color stability of esthetic restorations.

Based on the findings of this research, to achieve optimal restoration results, it is recommended to use a combination of nanohybrid composite resin with polishing using a disc followed by paste. It is recommended to always use paste in polishing when spherical filler composite resin is selected as the restorative material.

While this study provides insights into the effect of polishing techniques on color stability, several limitations should be acknowledged. First, the study was conducted in vitro, and thus, the results may not fully simulate the complex conditions of the oral environment. Factors such as saliva, pH variation, and mechanical stress could affect the longevity of the composite resins and their staining behavior. Second, only black tea was used as a staining agent, limiting the ability to generalize findings to other beverages or foods that may have different staining potentials. Additionally, the study did not evaluate the influence of polishing techniques on surface roughness, which may provide more insight into the polishing effect on color stability. Future studies could include a more diverse range of staining agents, long-term in vivo trials, and surface roughness assessments to provide a more comprehensive understanding of the factors influencing color change in composite resins..

CONCLUSION

The utilization of paste in composite resin polishing has been shown to reduce color changes attributed to black tea consumption. Furthermore, nanohybrid composite resin polished with a disc followed by paste exhibits superior resistance to color changes compared to spherical filler composite resin. Implication of this research is recommended to use a combination of nanohybrid composite resin with disc polishing followed by paste for optimal restoration results. Additionally, polishing paste should always be used with spherical filler composite resin. This approach demonstrates the lowest color change values, indicating that polishing paste enhances resistance to color changes and contributes to the clinical success of composite resin restorations.

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