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Color Match of Composite Resin and Remaining Tooth Structure over a Period of 28 Days Using Spectrophotometer—A Randomized Clinical Trial

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Clinical Relevance

The *in vivo* color match of composite restorations to the remaining tooth structure in Class IV restorations can take up to 28 days. The tooth structure can take 48 hours to 28 days to return to baseline color.

SUMMARY

OBJECTIVES: The tooth and the composite restoration can undergo a change in color after the restorative procedure over time. The purpose of this randomized clinical trial was to evaluate the color difference (ΔE) of two types of composite resins and remaining tooth structure over a period of 28 days.

METHODS AND MATERIALS: A total of 40 teeth in 30 patients with Class IV caries or EllisClass II fracture in maxillary incisors were randomized into two groups based on the type of composite resin used for restoration: IPS Empress (n=20 teeth) and Filtek Z250 (n=20 teeth). Shade selection was done using a spectrophotometer. Restorations were performed using an anatomical layering technique, and finishing and polishing was done after 48 hours. Baseline spectrophotometer color values for the remaining tooth structure were measured before isolation and for composite restorations, 10 minutes after light cure. Further color evaluations using a spectrophotometer for the remaining tooth structure and composite restorations were done at 48 hours (both before and immediately after finishing and polishing), 7days, 14 days, and 28 days, and color difference (ΔE) from baseline values for remaining tooth structure and restorations and ΔE between remaining tooth structure and restorations were calculated. Descriptive

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statistics including mean, standard deviation, and frequencies were computed. Mann–Whitney U test was done to compare spectrophotometer values.

RESULTS: There was a significant reduction in mean color difference (ΔE) from baseline values for both tooth ($p<0.05$) and composite restoration ($p<0.05$) at all evaluation periods in both groups. Filtek Z250 showed significantly lower mean ΔE between the tooth and the composite resin restoration than IPS Empress at 48 hours (before and after finishing and polishing), 7 days and 14 days ($p<0.05$). At the 28 day recall, mean ΔE value of IPS Empress restorations to tooth structure was 3.5, while the mean ΔE value of Filtek Z250 restorations to tooth structure was 3.6, which was not statistically different ($p>0.05$).

CONCLUSION: The remaining tooth structure as well as the composite restorations showed color changes at all evaluation periods, compared to baseline values in both the composite resin groups. Filtek Z250 exhibited less ΔE with remaining tooth structure at 48 hours, 7 days, and 14 days, when compared to IPS Empress. The composite restorations of both the groups reached clinically acceptable color match (mean $\Delta E<3.7$) with the remaining tooth structure 28 days after the procedure.

INTRODUCTION

Color matching is critical for success in esthetic dentistry, especially in restorations of polychromatic anterior teeth. Achieving optimal color match of composite resins to tooth structure remains a challenge in patients with high esthetic demands.[1]

Tooth color is mainly determined by the optical properties of dentin, and enamel contributes with thickness, translucency, and scattering of light.[2,3] Color match depends on various optical properties of teeth such as hue, value, and chroma, and chromatic properties of composite resins, including fluorescence and opalescence, light transmission and diffusion, surface roughness, and gloss.[4-6]

Composite restorations can change in color with time.[7,8] Most of the studies evaluating the color change of composite restorations were done in laboratory conditions and reported color changes after polymerization, water sorption,[1] accelerated hydrothermal, and photo ageing,[8,9] and UV light exposure.[10] Teeth can change color due to dehydration and rehydration.[11]

Clinically, color change in composites and teeth can be evaluated by color measuring devices like spectrophotometers that provide quantitative information on the magnitude and direction of color differences, and are not affected by ambient light.[2,12]

So far, only a few clinical studies have evaluated the color match of composite restorations to tooth structure using a spectrophotometer.[13,14] One published case series[14] evaluated the color changes in composite resin and remaining tooth structure in Class IV restorations and found a clinically acceptable color match at 14 and 28 days follow up. A pilot study by Dietschi and others compared the visual and spectrophotometer methods for evaluating the color match of composite to tooth in Class IV restorations.[13] Further randomized clinical trials comparing composite resin types are required to evaluate the color match of composite restorations to the tooth structure over time.

The optical properties of resin composites can also be influenced by the size, shape, and composition of filler particles[15] as well as the resin monomers.[16] Clinical data comparing anterior restorations done with nanohybrid/nanofilled composites and microhybrid composites is scarce.[17] Therefore, we formulated a randomized clinical trial to evaluate the color match of two different types of composite resins (microhybrid and nanohybrid) to the remaining tooth structure in Class IV restorations over a time period of 28 days[14] using a spectrophotometer. The null hypothesis evaluated was that color difference (ΔE) between resin composite restorations and remaining tooth structure does not change with time.

METHODS AND MATERIALS

Study Design

This was a randomized clinical trial with equal allocation between two groups. The trial was registered in the National Clinical Trial Registry of India (CTRI/2019/12/022546), and it followed CONSORT (Consolidated Standards of Reporting Trials) guidelines (Figure 1).

Recruitment

Study subjects were recruited from the pool of patients referred to the Department of Conservative Dentistry and Endodontics, Thai Moogambigai Dental College and Hospital from 02.01.2020 to 29.02.2020.

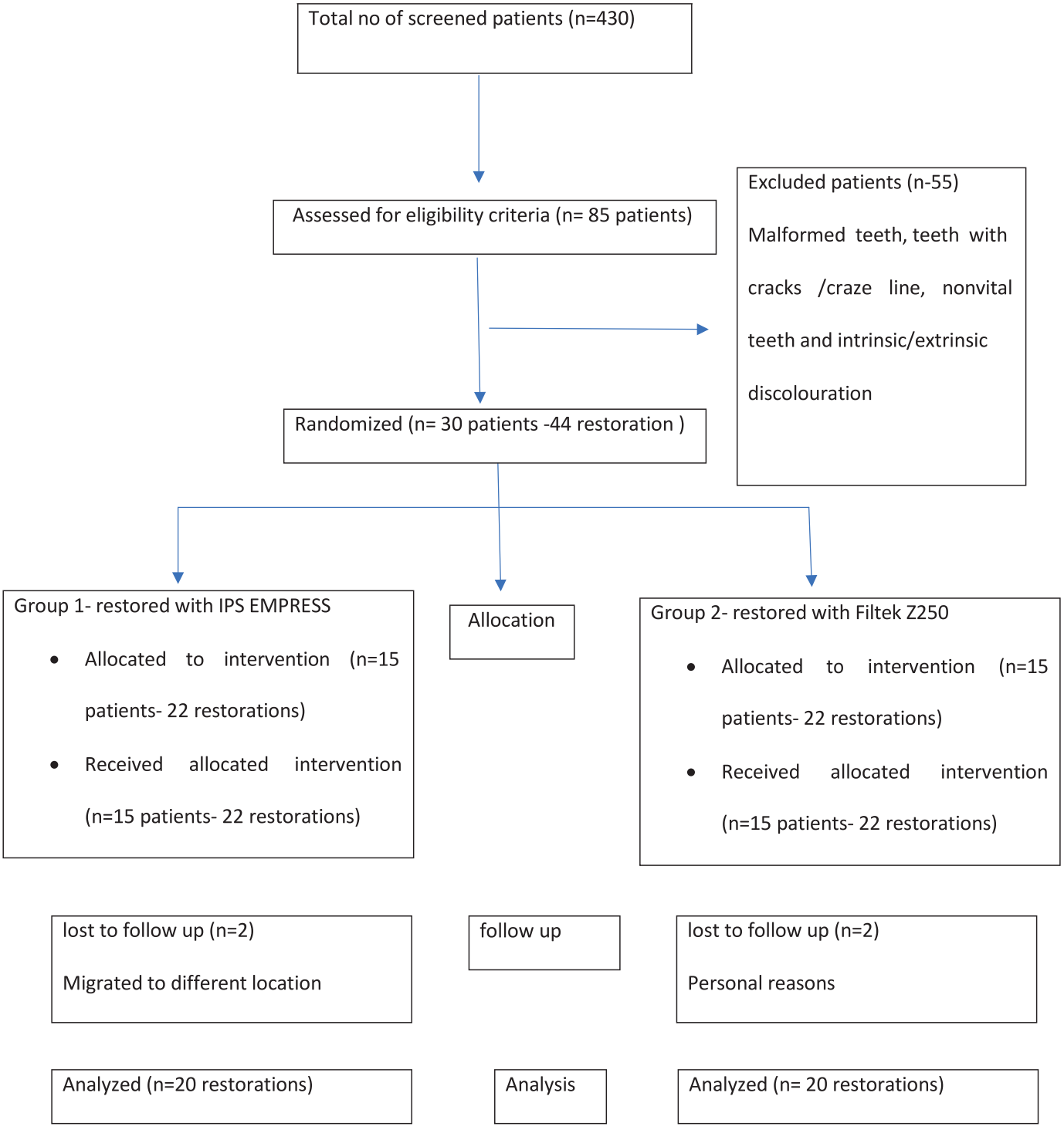

Figure 1. *CONSORT (Consolidated Standards of Reporting Trials) flow diagram detailing the recruitment and enrollment of the clinical trial.*

Inclusion and Exclusion Criteria

The following inclusion criteria were used: Patients of age 15-40 years with Ellis Class II fracture or Class IV dental caries in maxillary incisors who signed informed consent. Exclusion criteria were malformed teeth, teeth with extrinsic or intrinsic discolorations, teeth with craze lines/cracks, and nonvital teeth.[13]

Sample Size Calculation

An *a priori* analysis was carried out using G power[18] software to calculate the required sample size based upon the given alpha, power, and effect size. A pilot study was conducted among 10 samples each from both groups. The mean color change at 10 minutes, which was 6.3 for IPS Empress group and 4.5 for Filtek Z250 group, was used to calculate the effect size, which was estimated to be 0.40. With alpha error probability of 0.05 and 90% power along with the number of repeated measures (5) and correlation among the repeated measures (0.5), the final sample size was calculated. The resultant sample size was 20 restorations per group.

Random Sequence Generation and Allocation Concealment

A total of 430 patients were screened, and 85 patients with Ellis Class II fracture or Class IV dental caries were identified. Finally, 30 patients requiring a total of 44 restorations (20 plus 2 restorations per group to allow for dropouts) fulfilling the inclusion criteria were included in the study. Seven patients from each group required two restorations. Each tooth requiring a restoration was treated as a separate unit.[13]

Enrolled patients were informed about the study design and clinical procedures involved. Verbal and written consent was obtained. Patients were randomly assigned to one of the two designated treatment groups (Group I - IPS Empress, Group II - Filtek Z250) using a computer-generated randomization method (www.randomization.com, randomization number 16322).

STUDY INTERVENTION

After performing prophylaxis using prophylactic paste and nylon brush, shade evaluation of tooth structure was done using a spectrophotometer (Vita Easyshade V, Vivadent, Brea, CA, USA). Preoperative photographs were made. The enamel shade was selected from the middle-third and the dentin shade was selected from the cervical-third of the tooth, where the enamel is thinner.[19,20]

All the restorative procedures were performed by a single operator. Isolation was done using a rubber dam and high-volume suction. A bevel was prepared on the enamel margins with a flame-shaped diamond (TR-19, MANI, INC, Tochigi, Japan) at a 45° angle to the external tooth surface to a width of 0.25-2 mm, depending on the amount of tooth structure lost.[19,21]

The proximal surfaces of adjacent unprepared teeth were protected by using Teflon tape. 37% phosphoric acid etching gel (Total Etch, Ivoclar Vivadent, Schaan, Liechtenstein) was applied for 30 seconds on enamel and 15 seconds on dentin, approximately, 0.5 mm beyond the prepared margins. The etchant was rinsed with water for 5 seconds and dried with blotting paper to avoid overdrying of dentin. A universal adhesive (Adper Single Bond, 3M Oral Care, USA) was rubbed on the etched surfaces with a disposable brush (Dentsply Sirona, Milford, DE, USA) for 20 seconds and air-dried for 5 seconds following the manufacturer's instructions. The adhesive was light cured for 10 seconds with an LED curing unit (Bluephase N, Ivoclar Vivadent).[14]

The restoration was performed using the natural layering technique[22] using either IPS Empress Direct (Ivoclar Vivadent) or Filtek Z250 (3M Oral Care), based on the allocated group. The composite resin shades were based on the preoperative spectrophotometer readings as previously described. A matrix strip was held palatally, and a layer of enamel shade was placed followed by the dentin shade placed covering the bevel.[23] Finally, labial enamel shade was placed. Each layer was photocured separately for 20 seconds with an LED unit of intensity 1200 mW/cm^2 (Bluephase N, Ivoclar Vivadent), which was monitored using a radiometer before each restoration. Gross finishing and occlusal adjustments were done for all restorations. The restorations were finished and polished 48 hours after completing the restoration. Proximal surfaces were finished with abrasive strips (3M Oral Care). To remove excess and to reproduce anatomy, flame shaped and tapered carbide burs (Kerr Corporation, Brea, CA) were used. The labial surfaces were finished with sequentially reducing grit size polishing discs (Sof-Lex Pop On, 3M Oral Care). Final polishing was done using a felt disc (Diamond Felt Disc, FGM, Brazil) and diamond polishing paste (Diamond Excel, FGM).[14]

Baseline color of the tooth was recorded before isolation, and baseline values of composite restorations were taken 10 minutes after restoration using a spectrophotometer (VITA Easyshade V, Vident, Brea, CA, USA). The color of the restorations and remaining tooth structure was measured at different evaluation periods: 1) at 48 hours, before finishing and polishing; 2) at 48 hours, after finishing and polishing; 3) 7 days after completing the restoration; 4) 14 days after completing the

restoration; and 5) 28 days after completion of the restoration.[14] Three consecutive readings of $L^*a^*b^*$ values were recorded and the mean calculated. To standardize the placement of the spectrophotometer on the tooth surface and composite restoration at each time interval, silicone matrix indices (Aquasil Soft Putty, Dentsply) were made with the perforations matching the diameter of the tip of the spectrophotometer.[14] Evaluations were performed with the spectrophotometer and silicone matrix positioned on the tooth without any colored background. An independent and calibrated evaluator, who was not involved in the restorative procedures and blinded to the group assignment, performed all the assessments. Figures 2 and 3 represent preoperative and postoperative photographs of teeth restored with IPS Empress and Filtek Z250, respectively, at various evaluation periods.

The ΔE at each evaluation period (48 hours before and after finishing and polishing, 7 days, 14 days, and 28 days) from baseline was calculated from the $L^*a^*b^*$ values for remaining tooth structure and restoration based on the following equation:[24] $(\Delta E) = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$ where $\Delta L^* = L_{Final} - L_{Initial}$, $\Delta a^* = a_{Final} - a_{Initial}$, and $\Delta b^* = b_{Final} - b_{Initial}$. Color difference between the tooth structure and composite restoration was also calculated for each evaluation period.

STATISTICAL ANALYSIS

Statistical analysis of the data was done using Statistical Package for Social Sciences, (SPSS v 21, IBM Corp, Chicago, IL, USA). Descriptive statistics including mean, standard deviation, and frequencies were computed for various clinical parameters. Normality of the data was assessed using Shapiro–Wilk test. Further analysis was done using non-parametric tests, since the data did not follow a normal distribution. Friedman test was used to compare the mean rank differences within the study groups at different time intervals. Mann–Whitney test was used to compare the differences between the groups.

RESULTS

A total of 28 patients with 40 restorations IPS Empress group (n=20) and Filtek Z250 group (n=20) reported for follow up at 48 hours, 7 days, 14 days, and 28 days, while one patient (with two restorations) from each group was lost to follow up, since one had migrated to a different location and the other due to personal reasons.

IPS Empress Group

In the IPS Empress group, mean ΔE values of the remaining tooth structure and the composite restorations showed a significant reduction at all evaluation periods (Table 1). Mean ΔE values of the remaining tooth structure and mean ΔE values of composite restorations were similar at 48 hours (after finishing and polishing) 7, 14, and 28 days ($p>0.05$) (Figure 5).

When evaluating the color difference (ΔE) between remaining tooth structure and composite, mean ΔE values significantly reduced at all evaluation periods to a minimum value of 3.5 at 28 days, which was below the clinically acceptable threshold of 3.7 (Table 3).[25]

Filtek Z250 Group

In the Filtek Z250 group, mean ΔE values of the remaining tooth structure and composite restorations showed a significant reduction at all evaluation periods (Table 2). Mean ΔE values of the remaining tooth structure and mean ΔE values of composite restorations were significantly different at all the evaluation periods ($p<0.05$) (Figure 5).

When evaluating the color difference (ΔE) between remaining tooth structure and composite restorations, mean ΔE values significantly reduced at all evaluation periods to a minimum value of 3.6 at 28 days, which was below the clinically acceptable threshold of 3.7 (Table 3).[25]

Post hoc analysis

The mean color difference values (ΔE) between tooth and composite compared at all time points for both IPS Empress and Filtek Z250 were statistically significant ($p<0.05$). Comparison of mean ΔE values of composite restorations at different time points were significant for both types of composite ($p<0.05$). When the mean color difference (ΔE) of tooth structure was compared at different time points, all comparisons were significant ($p<0.05$).

When IPS Empress and Filtek Z250 were compared, Filtek Z250 exhibited significantly less mean color difference (ΔE) between the tooth and composite resin restoration than IPS Empress at 48 hours (before and after finishing and polishing), 7 days, and 14 days ($p<0.05$). At 28 days evaluation, both composite groups showed similar mean color difference (ΔE) between the tooth and composite restoration ($p>0.05$) (Figure 4).

Figure 2. *IPS Empress group.*
a) Preoperative
b) 10 minutes after placement
c) 48 hours before finishing and polishing
d) 48 hours after finishing and polishing
e) 7 days
f) 14 days
g) *28 days*

DISCUSSION

Color match of composite restorations to teeth can be challenging due to changes in optical properties of the tooth structure[11] and composites,[1,14] following the restorative procedure. *In vitro* studies have reported a clinically acceptable color match of composite resins to tooth structure in Class IV restorations performed by natural layering techniques evaluated using different methods.[26,27] However, clinical research is necessary, as it may not be possible to directly extrapolate laboratory results to clinical conditions.[26] There are only a few clinical studies evaluating the color match of esthetic anterior composite restorations to teeth.[13,14,25] Therefore, the present *in vivo* randomized clinical trial was done to assess the color change in the

Figure 3. *Filtek Z250 group.*
a) Preoperative
b) 10 minutes after placement
c) 48 hours before finishing and polishing
d) 48 hours after finishing and polishing
e) 7 days
f) 14 days
g) *28 days*

remaining tooth structure and composite resin and color match of composite resin to the remaining tooth structure using a spectrophotometer over a period of 28 days. Spectrophotometer evaluation can result in a more objective and superior color match between restorations and tooth.[2,12,28]

Patients evaluated included young adults between 15 and 40 years of age. Older patients were excluded, as teeth can become darker with increasing age due to secondary dentin deposition.[29] Seven patients required more than one restoration. Since each tooth was treated as a single unit, and the color difference between the restoration and remaining tooth structure was evaluated, this might not affect the validity of the results.[13,14] The teeth selected for this study had structural loss not more than the middle-third region, and also the teeth were vital and without any discolorations. Dentin

Table 1: (IPS Empress Group) *Mean and Standard Deviation Values of ΔE of the Remaining Tooth Structure and ΔE of Composite Restorations at Different Evaluation Periods Compared with the Baseline Values*

Period of Evaluation	Tooth (Δ*E*)	Composite (Δ*E*)	p-value
48 h before polishing	5.0±1.1 *a**	5.3±1.0 *b**	<0.001
48 h after Polishing	4.8±0.8 *a**	4.8±0.6 *a**	0.601
7 days	4.3±0.9 *a**	4.2±0.7 *a**	0.562
14 days	3.8±0.7 *a**	3.6±0.4 *a**	0.333
28 days	3.4±0.4 *a**	3.3±0.3 *a**	0.378
p-value	<0.001	<0.001	

*Different letters denote significant differences between ΔE of tooth and ΔE of composite restorations at various time intervals. *Denotes significant difference within the groups at various time intervals.*

shade was selected from the cervical-third, and enamel shade was selected from the middle-third of the remaining tooth structure[13,19,20] Anatomical layering technique was performed to match the color of the tooth.[13,14,26,27]

The present study evaluated mean Δ*E* values between remaining tooth structure and composite resin at different time periods. The baseline color value of the tooth was recorded before isolation. Baseline color values of composites were recorded 10 minutes after light curing,[14] since the most clinically relevant color changes have been shown to occur immediately after polymerization. Also, polymerized resin composite mock-ups have been recommended to clinically evaluate the color match to tooth structure.[1,30]

The acceptability threshold of color match between tooth and restorations (Δ*E*) has been reported to range from 2.6 to 5.6,[25,28,31] while a literature review has reported that most studies considered the perceptibility threshold (Δ*E*) as 1.[32] In laboratory research, an acceptability threshold (Δ*E*) below 3.3 has been recommended,[33] while clinical conditions may require a higher acceptability threshold.[34] Research to evaluate color match threshold can be affected by the number of observers, methods, and conditions of color matching, disparity between the visually observed region, and the region measured by the instrument and type of color measuring instrument.[35] A prospective multicenter study using ceramic specimens in a simulated clinical setting found the 50%:50% acceptability threshold to be 2.7. Also, a recent literature review reported an acceptability threshold of Δ*E*<2.7 for a clinical color match between tooth and restoration.[36]

Previous clinical studies evaluated the tooth–composite color match with different acceptability thresholds.[13,25] While Dietschi and others[13] did a

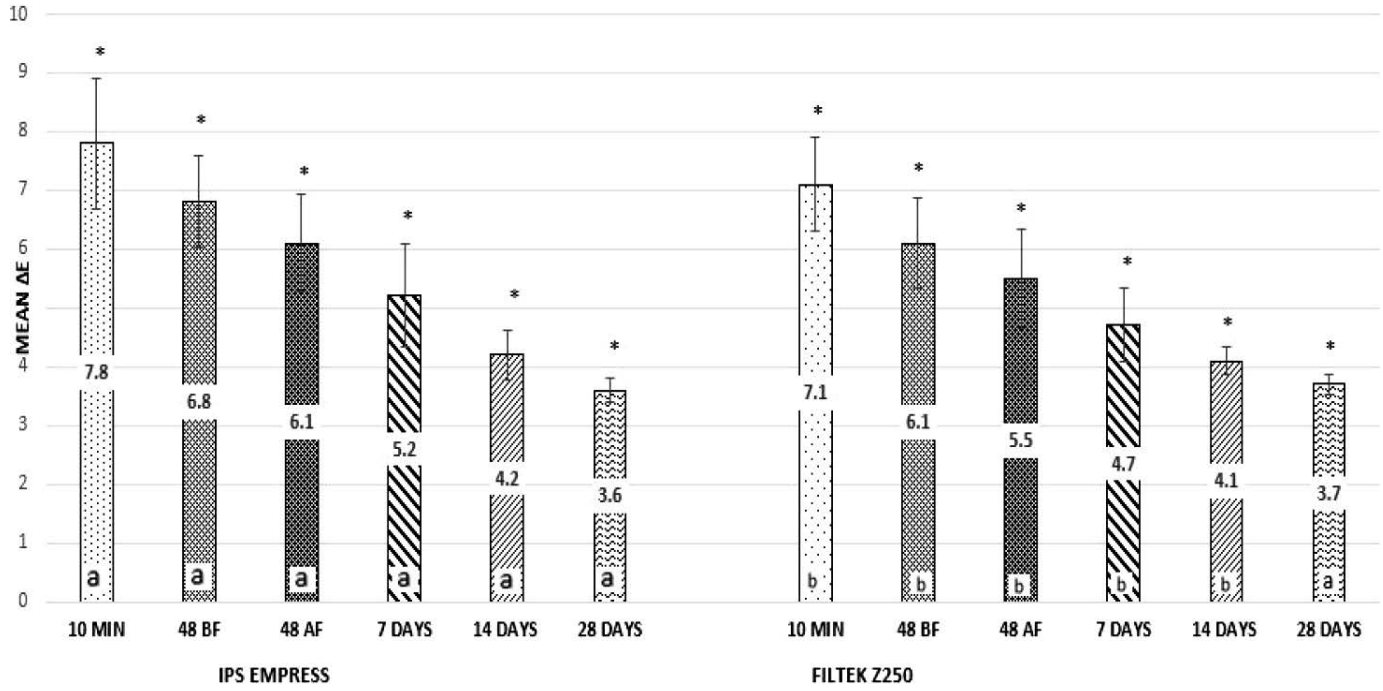

Figure 4. *Mean ΔE between tooth and composite. Different letters denote significant difference between the composite groups at corresponding time intervals. *Denotes significant difference within the composite groups.*

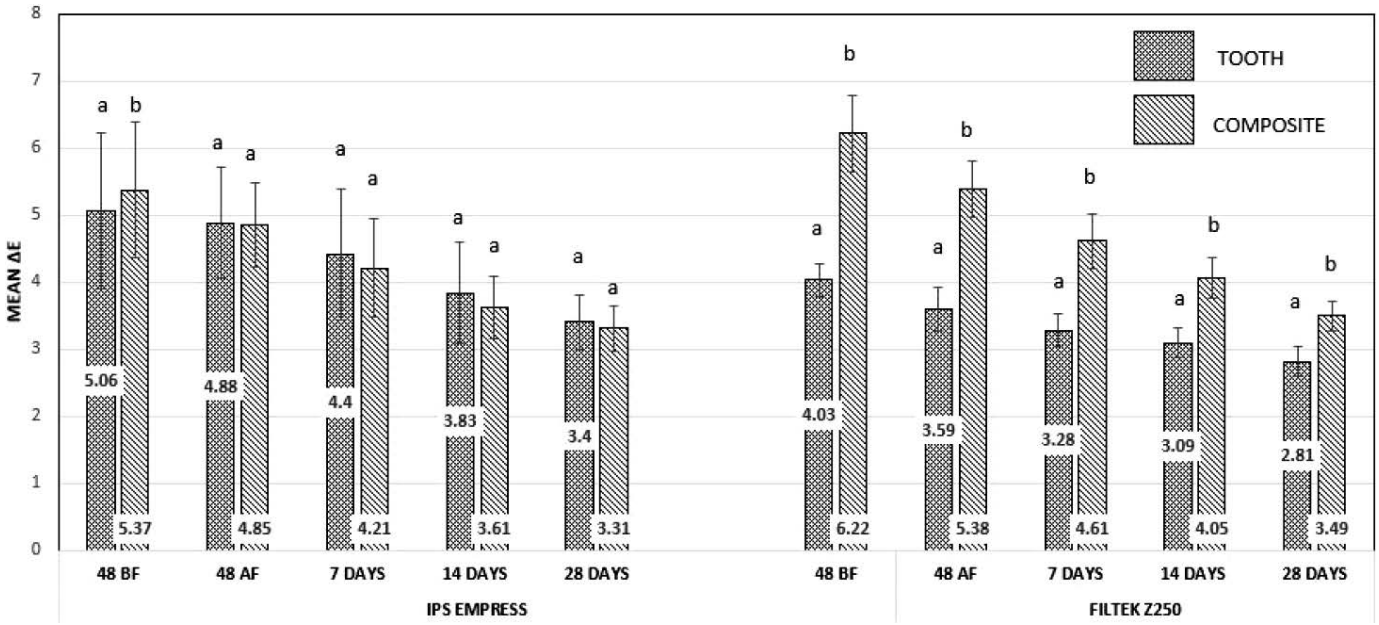

Figure 5. *Comparison of ΔE of tooth and ΔE of composite for IPS Empress & Filtek Z250 groups. Different letters denote significant difference between ΔE of tooth and ΔE of composite restorations at corresponding time intervals.*

pilot study with 11 patients and reported a mean ΔE of 2 as acceptable, Johnston and Kao have more thoroughly evaluated the color match of composite veneer restorations with adjacent, opposing, or contralateral teeth and recommended a mean acceptability value of 3.7 using a colorimeter.[25] Also, Khashayar and others have reported that one-third of clinical studies referred to an acceptability threshold (ΔE) of 3.7.[32]

There have been no previously published articles evaluating the color threshold for clinical acceptance of composite restorations using an intraoral spectrophotometer. Therefore, in the present study, tooth–composite color match was assessed with a clinical acceptability threshold of 3.7,[32] and it was found that mean ΔE values in both the groups reached below 3.7 at 28 days.

The thickness and optical properties of the composite layers in restorations can also affect the color match with tooth structure.[37,38] Hence, in our study, we used a natural layering technique with anatomical proportions of enamel and dentin shade composite resin.

Table 2: *(Filtek Z250 Group) Mean and Standard Deviation Values of ΔE of the Remaining Tooth Structure and ΔE of Composite Restorations at Different Evaluation Periods Compared with the Baseline Values*

Period of Evaluation	Tooth (ΔE)	Composite (ΔE)	*P* Value
48 h before polishing	4.0±0.2 a^*	6.2±0.5 b^*	<0.001
48 h after Polishing	3.5±0.3 a^*	5.3±0.4 b^*	<0.001
7 days	3.2±0.2 a^*	4.6±0.4 b^*	0.03
14 days	3.0±0.2 a^*	4.0±0.3 b^*	0.04
28 days	2.7±0.2 a^*	3.4±0.2 b^*	0.02
P value	<0.001	<0.001	

*Different letters denote significant differences between ΔE of tooth and ΔE of composite restorations at various time intervals. * Denotes significant difference within the groups at various time intervals.*

Table 3: *Mean and Standard Deviation of Color Difference (ΔE) Between Remaining Tooth Structure and Composite Restorations of IPS Empress Group and Filtek Z250 Group*

Period of Evaluation	IPS Empress	Filtek Z250	*P* Value
10 min after restoration	7.7±1.1 a^*	7.1±0. 8 b^*	0.031
48 h before Polishing	6.8±0. 7 a^*	6.1±0. 7 b^*	0.001
48 h after Polishing	6.1± 0.8 a^*	5.4± 0.8 b^*	0.004
7 days	5.1 ±0.8 a^*	4.7 ±0.6 b^*	0.039
14 days	4.2 ±0.4 a^*	4.0 ±0.2 b^*	0.001
28 days	3.5±0.2 a^*	3.6±0.1 a^*	0.110
P value	<0.001	<0.001	

*Different letters denote significant difference between the composite groups at corresponding time intervals. *Denotes significant difference within the composite groups.*

The results of the present clinical study showed that a color match was achieved for anterior teeth restored with the microhybrid resin Filtek Z250 and the nanohybrid resin IPS Empress at 28 days. This finding agrees with a meta-analysis done by Maran and others, which could not find any statistical difference in the color match between traditional microhybrid, nanofilled, and nanohybrid posterior composite resin restorations. However, the studies included in that meta-analysis[39] analyzed the color match using modified USPHS criteria in posterior teeth, while the present study used the more objective method of color measurement using a spectrophotometer and was done in anterior teeth where the color match is more critical.

Mean ΔE of remaining tooth structure from baseline values significantly reduced from 5.0 (at 48 hours) to 3.4 at 28 days in the IPS Empress group and from 4 (at 48 hours) to 2.7 (28 days) in the Z250 group, as tooth structure dehydrated during the restorative procedure can progressively rehydrate and revert to the original color.[11,14,40,41]

Composition of the resin matrix, filler loading, filler particle size distribution, and type of photoinitiator may also play a role in color stability.[15,16,42] Also, it has been demonstrated that the color stability of composites can be affected after exposure to various physicochemical conditions, such as UV radiation, heat, and water or food colorants.[43-48]

Composite restorations in both the IPS Empress group and the Z250 group showed a significant reduction in mean color change from baseline values at all evaluation periods to 3.3 and 3.4, respectively, at 28 days. Similar reduction in mean ΔE values of composite restorations at 48 hours, 7 days, 14 days, and 28 days were previously reported by Ruschel and others.[14]

Both composite resin groups showed improvement in color match with the remaining tooth structure after finishing and polishing, which is consistent with several studies stating that finishing and polishing can have a significant effect on the color change of composite resins.[49,50]

In the IPS Empress group, the mean ΔE value of the remaining tooth structure from baseline was not significantly different from the mean ΔE value of composite resins from 7 to 28 days, indicating a similar rate of color change from baseline values. In the Z250 group, significantly different mean ΔE values of remaining tooth structure and composite restorations were found even at 28 days, indicating dissimilar rates of color change. When the color difference between tooth and composite was compared, Filtek Z250 showed less color difference (mean ΔE) values at 48 hours, 7 days, and 14 days, when compared with IPS Empress. However, the color difference between the tooth and the composite restorations reached below the clinically acceptable threshold of 3.7 at 28 days in both groups, indicating a clinically acceptable color match. Similarly, color match with the remaining tooth structure at 7 days[13] and 14 days after restoration[14] have been reported.

Our results are not in agreement with a previous *in vitro* study, which demonstrated a clinically acceptable color match of the composite to tooth structure using a spectrophotometer after placing in distilled water for 24 hours.[26] However, *in vitro* research may not match clinical conditions. The color difference between the remaining tooth and composite restoration reduced significantly at 48 hours, 7, 14, and 28 days in both groups compared to baseline values. Hence, the null hypothesis was rejected.

The results of our study imply that it can take up to 28 days for color match between composite and remaining tooth structure, even if proper shade selection is done preoperatively using a spectrophotometer. This can be explained on the basis that color selection of the composite was done before dehydration (isolation) of the tooth. However, after the restorative procedure, tooth as well as composite restoration can exhibit color change over time.[1,11,14] One of the limitations of the present study was that the thickness of the various layers of composite resin could not be standardized. A split-mouth design, which could have better accounted for the within subject factors, was not used due to a paucity of suitable patients willing to take part in this study. Also, individual color coordinates were not analysed independently. To the best of our knowledge, there are no previous clinical studies that have reported color change of composite restorations over a period longer than 28 days using a spectrophotometer. Hence, future studies with longer follow-up periods are needed to assess long-term color changes in composites.

CONCLUSIONS

The remaining tooth structure as well as the composite restorations showed color changes at all evaluation periods, compared to baseline values in both composite resin groups. Filtek Z250 showed less color difference (ΔE) with remaining tooth structure at 48 hours, 7 days, and 14 days, when compared to IPS Empress. The composite restorations of both the groups reached clinically acceptable color match

(mean $\Delta E<3.7$) with the remaining tooth structure 28 days after the procedure.

Conflict of Interest

The authors of the present study certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in the present article. This study did not receive any external financial support directed to its development, aside from the author's support and human and facilities' resource.

Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects' oversight committee guidelines and policies of the Ethics Committee of the Dr MGR Educational and Research Institute. The approval code for this study is 1312002.

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