Research Article

12- months color stability of direct resin composite veneers in anterior teeth: Clinical trial

Omar Faez Abdulateef [1, 2*], Nevin ÇOBANOĞLU [1]

[1]Department of Restorative dentistry, college of dentistry, University of Selcuk, Turkey.
[2]Fallujah Specialist Dental Center, Al-Anbar general health directorate, Ministry of Health, Iraq
*Correspondence: theincisor2004@yahoo.com

Abstract: Background: This clinical trial aims to evaluate the color changes of direct resin composite veneer (DCV) restorations based on spectrophotometric analysis of 4 different types of resin composites between the baseline immediately after polishing and after one year of follow-up. Materials and methods**:** 28 patients were assessed for eligibility for participation, aged between 18 and 38 years old, who indicated for DCV restorations in anterior maxillary teeth were considered for participation in this study. In total, 25 patients who met the inclusion criteria were selected (6 males and 19 females, mean age: 20.9 at the time of restoration placement), and 3 patients were excluded. Participants were divided into four groups based on the type of composite resin used for restorations. Group 1 nanohybrid Ips Empress direct (Ivoclar Vivadent)](IPS) (13 restorations/6 patients), group 2 microfilled [Essentia (GC cooperation Japan)](ES) (14 restorations / 7 patients), group 3 supra-nano filled [Estelite ∑ Quick (Tokuyama, Tokyo, Japan)](EQ) (17 restorations / 7 patients) and group 4 nanofill [Filtek Ultimate (3M ESPE)](FU) (13 restorations / 5 patients). Baseline Color measurements were performed with a spectrophotometer immediately after finishing and polishing (baseline), and after one year of recall, color change (ΔE) from baseline values and after one year of follow-up of DCVs were calculated according to CIELab color coordinates. For this, a silicone mold was fabricated for each patient and used as a guide for each measurement to standardize the site of the readings. Statistical analysis of the data was applied using the Kruskal-Wallis test with Dunn-Bonferroni posthoc test after controlling the distribution of data in terms of normality with the Shapiro Wilk test. Results: At the end of one year,25 participants(57restorations) were followed up. The mean ΔE of IPS, EQ, and FU composites were higher than the ES composite resin, but there was no statically significant difference between all types of composites ($P > 0.05$). There was no statistically significant difference in the mean ΔL^* between any types of composite resin ($p > 0.05$). There was a significant change in Δa^* and Δb^* after a one-year recall for all the types of DCV restorations ($p < 0.05$). Conclusion: After one year of follow-up, the spectrophotometer measurements of direct resin composite veneer restorations, it was concluded no difference between the mean ΔE of ES, IPS, FU, and EQ resin composite. ES (Microfilled hybrid) showed a lower mean ΔE value compared to the other groups. All groups of resin composite showed color changes within clinically acceptable levels after a one-year follow-up.

Keywords: Direct composite veneer, color changes, spectrophotometer.

Introduction

In the last decades, there was an era in bonding restorations especially composite resins. The development in the mechanical and optical properties of composite resin has enabled it to become one of the most used dental materials in dental practices in both anterior and posterior restorations [1]. With the evolution of composite resin technology, direct anterior composite restorations, including veneers, became an economical and visually pleasing solution compared to more complex restorations [2, 3]. The attractiveness and popularity of composites are easy to explain as these restorations have excellent

esthetic potential, excellent prognosis, and a reasonable fee [4]. There are several advantages of composite restorations. The first one is related to their adhesive properties, the minimal preparation size, the reinforcement of remaining teeth and the esthetic appearance [5].

Many esthetic clinical cases in the anterior region can be treated with direct composite restorations such as tooth discoloration, diastemata, extensive fractures, misaligned teeth, or dental caries lesions which may cause significant impairment in esthetic appearance and smile harmony, causing an impact on the quality of life [5, 6]. It has been frequently cited that direct resin composite veneers (DCV) are a more conservative option for some clinical cases planned for porcelain veneers [7, 8].

Despite these developments, several disadvantages have been recorded clinically and in in-vitro studies that affect the performance of the composite. These disadvantages are represented mainly by discoloration of restoration, which primarily affects the satisfaction of patients [9]. Color stability can be the difference between success and failure. Composite resin discoloration is multifactorial, including factors such as intrinsic discoloration and extrinsic staining. Nevertheless, a correlation between color (discoloration) and degree of conversion was established, with incomplete polymerized composite resins showing reduced mechanical properties and greater discoloration susceptibility [10, 11].

Therefore, this clinical study aimed to investigate the color changes of direct anterior resin composite veneer restorations after a one-year follow-up based on a spectrophotometric analysis of four different types of composites. The null hypothesis of this study was that there would be no difference in the color changes among resin composite materials (Microfilled hybrid, nanohybrid, nanofill, and supra nanofill composite resins) after one year of follow-up.

Materials and Methods

This clinical trial evaluated the ΔE value and color coordinates (L*, a*, and b*) of DCV restorations of 4 different types of composite resin after a one-year follow-up using a spectrophotometer.

Ethics committee approval for this study was obtained from the Selcuk University Faculty of Dentistry Clinical Research Ethics Committee (Ethics Committee Decision Date: 26.06.2018 / No:06). In this study, 28 patients were assessed for eligibility for participation, aged between 18 and 38 years old, who applied to Selcuk University Faculty of Dentistry, Department of Restorative Dentistry with aesthetic complaints in the anterior region between January 2017 and December 2018 and indicated for DCV restorations were considered for participation in this study. In total, 25 patients who met the inclusion criteria were selected (6 males and 19 females, mean age: 20.9 at the time of restoration placement), and 3 patients were excluded due to either failing to meet the inclusion criteria or declining to come for follow-up visits. Additionally, participants selected for this study were students at Selcuk University (undergraduate and postgraduate) and were able to come for recall visits. The selected patients received a total of (57) DCV restorations in anterior maxillary teeth, and each patient received 2-4 restorations from the same type of resin composite. The following inclusion criteria were used to evaluate and enroll potential participants: individuals at least 18 years old with fracture, diastema closure, peg-shaped laterals, congenitally missing lateral incisors (in cases of canine transformation to lateral incisors), enamel hypoplasia disorders, misaligned anterior tooth and discolored tooth that resist the internal endodontic bleaching, and able to read and sign the informed consent document, physically and psychologically able to tolerate the procedure.

Furthermore, patients who were selected for the study had full dentition and normal occlusion without generalized periodontal disease, as verified by the clinical and radiographic records. Patients were excluded when severe untreated bruxism, active caries, poor oral hygiene and heavy smokers. In this study, 4 different composite resins that contain different chromatic shades were used. An

experienced dentist restored all the DCV restorations using the different restorative materials. The teeth of the patients included in the study were divided into 4 groups according to the type of composite to be applied; group 1 nanohybrid [Ips Empress direct (Ivoclar Vivadent)] (IPS) (13 restorations/6 patients), group 2 micro filled [Essentia (GC cooperation Japan)] (ES) (14 restorations / 7 patients), group 3 supra-nano filled [Estelite ∑ Quick (Tokuyama, Tokyo, Japan)](EQ) (17 restorations / 7 patients) and group 4 nanofill [Filtek Ultimate (3M ESPE)] (FU) (13 restorations / 5 patients).

The self-etch 2-step adhesive system Clearfil SE bond (Kuraray, Osaka, Japan) with selective etching to the enamel was used as an adhesive system, restorations were performed using an anatomical layering technique and were light-cured using an LED polymerization unit Valo (Ultradent Products Inc, South Jordan, UT, USA). The restorations were finished and polished immediately in the same visit underwater cooling using fine diamond burs, finishing and polishing discs (Opti Disc, Kerr Corporation), and aluminum oxide strips (Hawe™ Finishing and Polishing Strips Kerr Corporation) for the interproximal surfaces. They were followed by using Enhance (Dentsply/Caulk, Milford, Delaware) or OneGloss (Shofu, Kyoto, Japan), then using carbide brushes (Astrobrush, Ivoclar Vivadent, Liechtenstein), and lastly, Synthetic and natural foam (Dentsply/Caulk, Milford, Delaware) with extra-fine polishing paste (Prima-Gloss; Dentsply, Latin America), were used for the natural gloss until all restorations were considered clinically acceptable. After polishing, there were no dietary restrictions or cleaning instructions that have been informed for patients to do during the follow-up time period. Therefore, the different dietary consumptions or cleaning materials that the patients may use could impact the color stability and the results of the current study.

Color measurement was performed with a spectrophotometer VITA Easyshade V (VITA Zahnfabrik, Bad Säckingen, Germany) immediately after finishing and polishing (baseline) and after one year of recall, the equipment was calibrated before each reading, and a single trained investigator made all the color measurements under the same ambient light conditions. The active tip of the spectrophotometer was placed at the middle third of the buccal surfaces of composite veneer restorations of each tooth. For this, a silicone mold was fabricated for each patient and used as a guide for each measurement to standardize the site of the readings. The color of all restorations was measured three times, and their average values were taken. Color measurement was performed from the buccal surfaces of restorations after drying by using air from a triple syringe and L*, a*, and b* were recorded. Where L* is a measure of the lightness, a*is a measure of redness (positive direction) or greenness (negative direction), and b* is a measure of yellowness (positive direction) or blueness (negative direction). The ∆E value was calculated for each restoration using the following formula

$$\Delta Eab^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

Where, ∆L*, ∆a*, ∆b* are the differences in L*, a* and b* values of restorations immediately after finishing and after a one-year recall.

Statistical Analysis

The statistical analyses were performed using SPSS for Windows 26.0 (SPSS, Chicago, IL, USA). In the statistical analysis of ∆E values of composite veneer restorations, the descriptive statistics are frequency, percentage, and simple chart bars for demographic data such as age and gender and mean and standard deviation (SD) for quantitative data. While the inferential statistics is the Kruskal-Wallis test with Dunn-Bonferroni posthoc test was used after controlling the distribution of data in terms of normality with the Shapiro Wilk test.

Results

The initial color measurements (baseline) were recorded as L, a, and b for the subject's teeth, and they are no significant differences among resin composites using the Kruskal-Wallis test, whereas p values for a, L and b are 0.234,0.102, and 0.546 respectively which mean the correct standardization and randomization of shades between subjects to get rid of bias.

Color change (ΔE^*) of the DCV restorations after one year of the recall are shown in Table 1. Also, changes in ΔL^*, Δa^*, and Δb^* of DCV restorations after one year were illustrated in Table 2. Color changes of the different composite resin materials in the range of 0.464 -8.95 ΔE^* unit. After one year, the mean color change ΔE in EQ composite (4.2 ± 2.41) was higher than the mean values of color change in both FU (4.22 ± 3.07) and IPS (4.1 ± 1.6) composite resin. At the same time, ΔE of IPS, FU, and EQ composites were higher than the ES (2.77 ± 2) composite resin, but there was no statically significant difference between all types of composites. (p value=0.280).

Table 1: Descriptive and statistical test of color change ΔE (Mean± SD) among composite resin groups after 1 year.

Groups	Number of restorations	ΔE ± SD
IPS	13	4.109 ± 1.63[a]
ES	14	2.778 ± 2.00[a]
FU	17	4.286 ± 2.4[a]
EQ	13	4.220 ± 3.07[a]

*Different superscript small letters refer to statistically significant differences between rows (p< 0.05).

ΔL^* (brightness) values

A positive ΔL^* indicates that the restorations became lighter, whereas a negative ΔL^* indicates that the restorations became darker. All the types of composites showed negative ΔL^* after a one-year recall. There was no statistically significant difference in the mean ΔL^* between any types of composite resin (p=0.761). In all four types of composites used in this study, the maximum change in mean ΔL^* was seen in FU composite (-2.41 ± 3.74), while the minimum change in mean ΔL^* was seen in EQ composite resin (-1.3 ± 3.3).

Δa^* (change along the red-green axis) values

A negative Δa^* indicates a shift toward green color, whereas a positive Δa^* indicates a shift toward red color). ES, EQ and FU composite resin showed positive Δa^*, and IPS composite showed negative Δa^*. There was a statistically significant difference in the Δa^* values between all types of DCV restorations after a one-year recall (p =0.041). After a one-year recall, the maximum change in Δa^* was seen in FU (mean Δa^*, 0.49 ± 0.89). There was a statistically significant difference in the Δa^* values between IPS and 3M. (p=0.015).

Δb^* (change along the yellow-blue axis) values

After a one-year recall, there was a statistically significant difference in the Δb^* values between all types of composite resin materials (p =0.000). A positive Δb^* indicates a shift towards yellow color, while a negative Δb^* denotes a shift toward blue color. IPS and ES composite resin showed negative a mean Δb^*, while EQ and nanofill composite resin showed a positive mean Δb^*. After a one-year recall, the maximum change in Δb^* was seen in the EQ composite (mean Δb^*, 2.65 ± 2.1). There was a statistically

significant difference in the Δb* values between IPS and TOKU (p=0.010) and between IPS and 3M (p=0.000).

Table (2). Mean± SD values of color coordinates of different composite resin groups after 1-year Recall.

Type of composite	ΔL*± SD	Δa*± SD	Δb*± SD
IPS	-2.03± 2.9[a]	-0.30 ±0.60[a]	-1.56 ±2.1[a]
ES	-1.58 ± 2.7[a]	0.1 ±0.54[ab]	-0.02±1.3[ac]
FU	-2.4 ± 3.7[a]	0.49 ±0.89[b]	0.93 ±2.55[bc]
EQ	-1.3 ± 3.3[a]	0.35 ± 0.75[ab]	2.65 ±2.10[b]

*Different superscript small letters refer to statistically significant differences between rows (p< 0.05).

Discussion

In vitro studies contribute to clinical evaluations by enabling the development and evaluation of restorative materials. Although an attempt is made to imitate clinical conditions, this does not accurately reflect the clinical performance of the materials due to variable parameters in the mouth. Therefore, well-planned, controlled clinical trials are necessary to evaluate newly produced materials' clinical performance and compare different restorative materials. This clinical study aimed to evaluate the color changes of direct resin composite veneer restorations of 4 types of resin composites; nanohybrid, microfilled, supra-nano filled and nanofill, after one-year follow-up by using a spectrophotometer. The null hypothesis of this study was accepted because there was no significant difference in color changes among resin composite materials tested in this study.

The discoloration of composite resin can be evaluated either by visual or instrumental techniques. The color evaluation by visual observation may not be a reliable manner due to inconsistencies inherent in color perception and specification amongst observers [12-14]. Instrumental techniques for color measurement include colorimetry, spectrophotometry, and digital image analysis, of which spectrophotometry has been reported to be reliable technology in dental material studies. The human eye cannot detect ΔE values of less than 1.5, although this value is measurable with the help of a spectrophotometer [15].

Despite the accuracy of instrumental evaluation of color changing of different restorative materials, the visual assessment stilled the dependable method for the clinical estimation; this is due to incompatibility between both visual and instrumental evaluations; this finding is in agreement with the suggestion of Douglas et al.(2007) that reported future in vivo studies related to color stability by using intraoral spectrophotometer should follow the thresholds of color perceptibility (ΔE* of 2.6) and acceptability (ΔE * of 5.5)[16]. At the same time, Sabatini (2012) reports in their study that the concept regarding the color change (ΔE) that exceeds 3.3 clinically unacceptable applies to laboratory conditions and cannot be extrapolated as a threshold for ''clinical unacceptability'' [17]. According to these findings, in this study, the mean values of ΔE between the baseline and after one year of all resin composite types were at acceptable levels.

The ΔE of these restorations were calculated according to CIE L*a*b* color system. It describes the color based on human perception and designates it according to 3 spatial coordinates, L*, a*, and b*. L* represents the brightness (value) of a shade, Δa* represents the amount of red-green color, and Δb* represents the amount of yellow-blue color. In accordance with several studies, parameters L* and b* were responsible for the most abundant of the observed changes, whereas changes to the a* parameter were the least to the overall color change and were even regarded negligible [18-21]. In the current study, the mean (ΔL*) of all types of the composite was negative that indicating the lightness decreased in all materials and became darker; this is in agreement with results from previous in-vitro studies about the color stability of composite resin, which have shown a decrease in the L*. The decrease in L* values may be due to the presence of unreacted carbon double bonds that occur according to the degree of conversion, making the composite more susceptible to degradation [18, 19], which also alters the refractive index by a scattering pattern leading to change in the opacity of the composite [19-21]. Mean Δa* shifted to the red direction for all composite materials except IPS shifted toward the green. Mean Δa* shifted to the red direction for all composite materials except IPS shifted toward the green. The increased redness demonstrates the influence of amine-based accelerators in the resin composites; since all amines are known to form by-products during photoreaction, which tend to cause yellow to red-brown discolorations under the influence of light or heat [22]. While mean Δb* values of FU and EQ showed positive mean and shifted to yellow, the ES showed slightly shifting toward blue while IPS shifted toward blue. This difference in the Δb* values may be due to the type of photoinitiators used in their composition; CQ in the resin leads to an undesirably yellowish effect in the final cured resin-based material. Additionally, CQ/amine percentage affects the color change of composite resin, as a more significant yellowing effect is expected with a higher amine rate because the excess of the amine has excellent potential for darkness due to oxidative reactions [23, 26]. The mean Δa*of IPS shifted toward the green, while the mean Δb* value of IPS showed shifting toward blue; the differences between IPS and other resin composite groups may be because it was based on a different photoinitiator Lucirin that eliminated the amine group [21, 23, 24].

In the current study, the restorations were finished and polished under cooling water; finishing and polishing under dry or wet conditions remained a controversial topic. It is recommended to polish the resin composite under water coolant to reduce the detrimental effects of dry finishing and polishing on the interface between the tooth and adhesive bond; interestingly, it also affects the bond between the particles and the surrounding matrix of the resin composite [25]. Aydın et al. (2022) found in their in-vitro study that wet and dry use of polishing systems showed similar color changes on the composite resins used in their study [26].

This study presents some limitations, such as the small number of patients and restorations. Additionally, a one-year evaluation of resin composite color changes is a short-term follow-up evaluation time, and this is one of the limitations of this study. Split-mouth study designs can decrease most inter-patient variability, such as oral hygiene, diet, brushing habits and other habits that affect the color stability of resin composite restorations. The possible patient loss is a disadvantage of split-mouth designs since more restorations than one would be lost when a patient did not come for a follow-up appointment. Although this study was not designed as split-mouth, and the variables between patients were ignored, the patients not fulfilling the inclusion criteria were excluded from the study. Further clinical studies are required to determine the long-term color changes of DCVs.

Conclusion

At the end of one year, the spectrophotometer measurements of direct resin composite veneer restorations it was concluded no difference between the mean ΔE of ES, IPS, FU, and EQ resin composite. ES (Microfilled hybrid) showed a lower mean ΔE value compared to the other groups. All groups of resin composite showed color changes within clinically acceptable levels after a one-year follow-up.

Conflict of interest: None.

References

1. Strassler HE, Harvey K, Ladwig E. Dimer chemistry for anterior and posterior restorations. Inside Dent. 2009:110-113.

2. Christensen G. Zirconia: most durable tooth-colored crown material in practice-based clinical study. Clin Rep. 2018; 11:3-6.

3. Klaff M, Ward G. Composite technic for restoration of malformed teeth. Dent Surv. 1973;49(3):34-36.

4. LeSage BP. Aesthetic anterior composite restorations: a guide to direct placement. Dent Clin North Am. 2007;51(2):359-378.

5. Prieto LT, Araujo C, de Oliveira D, de Azevedo Vaz SL, D'Arce M, Paulillo L. Minimally invasive cosmetic dentistry: smile   reconstruction using direct resin bonding. Gen Dent. 2014;62(1):28-31.

6. Coelho-de-Souza FH, Gonçalves DS, Sales MP, Erhardt MCG, Corrêa MB, Opdam NJ, Demarco FF. Direct anterior composite veneers in vital and non-vital teeth: a retrospective clinical evaluation. J Dent. 2015;43(11):1330-1336.

7. Araujo E, Perdigão J. Anterior veneer restorations-an evidence-based minimal-intervention perspective. J Adhes Dent. 2021; 23:91-110.

8. Christensen GJ. Veneer mania.   J Am Dent Assoc. 2006;137(8):1161-1163.

9. Meijering A, Snoek P, Roeters F. Patients' satisfaction with different types of veneer restorations. J. Dent. Res. 1996; 75:2896-2896.

10. Gürses M, Çobanoğlu N, Abdulateef OF. Comparative evaluation of the color stability of universal composites. Int. Dent. Res. 2021;11(Suppl. 1):234-237.

11. Micali B, Basting RT. Effectiveness of composite resin polymerization using light-emitting diodes (LEDs) or halogen-based light-curing units. Braz. Oral Res. 2004; 18:266-270.

12. Brook A, Smith R, Lath D. The clinical measurement of tooth colour and stain. Int. Dent. J.2007;57(5):324-330.

13. Ferracane J, Marker V. Solvent degradation and reduced fracture toughness in aged composites. J Dent Res. 1992;71(1):13-19.

14. Johnston W, Kao E. Assessment of appearance match by visual observation and clinical colorimetry. J Dent Res. 1989;68(5):819-822.

15. Cho B-H, Lim Y-K, Lee Y-K. Comparison of the color of natural teeth measured by a colorimeter and Shade Vision System. Dent Mater. 2007;23(10):1307-1312.

16. Douglas RD, Steinhauer TJ, Wee AG. Intraoral determination of the tolerance of dentists for perceptibility and acceptability of   shade mismatch. J Prosthet Dent. 2007;97(4):200-208.

17. Sabatini C. Color stability behavior of methacrylate-based resin composites polymerized with light-emitting diodes and quartz-tungsten-halogen. Oper Dent. 2015;40(3):271-281.

18. Ferracane JL. Hygroscopic and hydrolytic effects in dental polymer networks. Dent Mater. 2006;22(3):211-222.

19. Oliveira DCRSd, Souza-Júnior EJ, Prieto LT, Coppini EK, Maia RR, Paulillo LAMS. Color stability and polymerization behavior of direct esthetic restorations. J Esthet Restor Dent. 2014;26(4):288-295.

20. Lee Y-K, Powers JM. Influence of background color on the color changes of resin composites after accelerated aging. Am J Dent 2007;20(1):27.

21. Vichi A, Ferrari M, Davidson CL. Color and opacity variations in three different resin-based composite products after water aging. Dent Mater.2004;20(6):530-534.

22. Lee Y-K, Yu B, Lim H-N, Lim JI. Difference in the color stability of direct and indirect resin composites. J Appl Oral Sci. 2011;19(2):154-160.

23. Dietschi D, Abdelaziz M, Krejci I, Di Bella E, Ardu S. A novel evaluation method for optical integration of class IV composite restorations. Aust Dent J. 2012;57(4):446-452.

24. Ruyter I, Nilner K, Möller B. Color stability of dental composite resin materials for crown and bridge veneers. Dent Mater. 1987;3(5):246-251.

25. Kaminedi RR, Penumatsa NV, Priya T, Baroudi K. The influence of finishing/polishing time and cooling system on surface roughness and microhardness of two different types of composite resin restorations. J Int Soc Prev Community Dent. 2014;4(Suppl 2): S99.

26. Aydın N, Karaoˇ glanoˇ glu S, Kılıçarslan MA, Oktay EA, Ersöz B. Effect of Wet and Dry Polishing Conditions by Two Finishing and Polishing Systems on the Surface Roughness and Color Changes of Two Composite Resin Restoratives: An In Vitro Comparative Study. J Adv Oral Res. 2022;13(1):127-134.

العنوان: 12 شهرًا من ثبات اللون لقشرة مركَّبة من الراتينج المباشر في الأسنان الأمامية: تجربة إكلينيكية عشوائية

الباحثون: عمر فائز عبد اللطيف 1,2، نيفين جوبان اوغلو 1

المستخلص:

الهدف: الهدف من هذه التجربة السريرية العشوائية هو تقييم تغيرات اللون في ترميمات قشرة الراتينج المركب المباشر (DCV) بناءً على التحليل الطيفي لأربعة أنواع مختلفة من مركبات الراتينج بين خط الأساس مباشرة بعد التلميع وبعد عام واحد من المتابعة . المواد والطرق: تم تقييم 28 مريضًا من أجل الأهلية للمشاركة، تتراوح أعمارهم بين 18 و 38 عامًا ، والذين أشاروا إلى ترميم DCV في الأسنان الفكية الأمامية تم اعتبارهم للمشاركة في هذه الدراسة. في المجموع ، تم اختيار 25 مريضًا استوفوا معايير التضمين (6 ذكور و 19 إناث ، متوسط العمر: 20.9 في وقت وضع الاستعادة) ، وتم استبعاد 3 مرضى. تم تقسيم المشاركين عشوائيًا إلى أربع مجموعات بناءً على نوع الراتينج المركب المستخدم للترميم ، المجموعة 1 (13) (IPS) [(Ivoclar Vivadent) Ips Empress Direct nanohybrid ترميمًا / 6 مرضى) ، المجموعة 2 [Essentia microfilled (التعاون GC باليابان)] (14) (ES) عملية ترميم / 7 مرضى) ، المجموعة 3 [Estelite supra nano fill Quick (Tokuyama ∑ ، طوكيو ، اليابان)] (17) (EQ) عملية ترميم / 7 مرضى) والمجموعة 4 (FU) [Filtek Ultimate (3M ESPE) nanofill 13) ترميم / 5 مرضى). تم إجراء قياسات اللون الأساسي باستخدام مقياس الطيف الضوئي مباشرة بعد الانتهاء والتلميع (خط الأساس) ، وبعد عام واحد من الاستدعاء ، تم حساب تغيير اللون (ΔE) من قيم خط الأساس وبعد عام واحد من متابعة DCVs وفقًا لإحداثيات ألوان CIELab. لهذا الغرض ، تم تصنيع قالب سيليكون لكل مريض واستخدامه كدليل لكل قياس لتوحيد موقع القراءات. تم تطبيق التحليل الإحصائي للبيانات باستخدام اختبار Kruskal-Wallis مع اختبار Dunn-Bonferroni posthoc بعد التحكم في توزيع البيانات من حيث الحالة الطبيعية مع اختبار Shapiro Wilk. النتائج: في نهاية عام واحد ، تمت متابعة 25 مشاركًا (57 ترميمًا). كان متوسط ΔE لمركبات IPS و EQ و FU أعلى من راتينج ES المركب ، ولكن لم يكن هناك فرق ذو دلالة إحصائية بين جميع أنواع المركبات (P> 0.05). لم يكن هناك فرق معتد به إحصائيًا في المتوسط L * بين أي نوع من أنواع الراتينج المركب (P> 0.05). كان هناك تغيير كبير في Δa * و b * بعد استرجاع لمدة عام واحد لجميع أنواع ترميمات DCV (p> 0.05). الخلاصة: بعد عام واحد من المتابعة ، قياسات مقياس الطيف الضوئي لترميمات القشرة المركبة من الراتينج المباشر ، تم التوصل إلى عدم وجود فرق بين متوسط ΔE لمركب ES و IPS و FU و EQ الراتينج. أظهرت ES (Microfilled hybrid) متوسط قيمة ΔE أقل مقارنة بالمجموعات الأخرى. أظهرت جميع مجموعات الراتينج المركب تغيرات في اللون ضمن المستويات المقبولة سريريًا بعد متابعة لمدة عام واحد.