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Original Article

SHADE MATCHING POTENTIAL OF UNIVERSAL SHADE RESIN COMPOSITE MATERIALS COMPARED TO MULTI SHADE RESIN COMPOSITE IN RESTORATION OF CARIOUS CERVICAL LESIONS IN ANTERIOR TEETH (RANDOMIZED CLINICAL TRIAL) – 1 YEAR FOLLOW UP

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Abstract

Aim: To clinically assess the shade matching of the Universal Shade composites versus the multi shade composite in cervical restorations of anterior teeth. **Subjects and methods:** A total of 27 patients with 60 teeth having cervical caries in the anterior teeth were randomly allocated into three groups (n= 20 teeth for each group). Group (A1) received composite restorations using Filtek Z350XT composite, Group (A2) received composite restorations using Omnichroma composite, while group (A3) received composite restorations using GC Essentia universal shade composite. Clinical performance of the restorations was evaluated after restored by 1 week (T0), after 6 months (T1), and after 12 months (T2) using the modified USPHS criteria. **Results:** Filtek Z350XT and Omnichroma have shown 100% success rate for cervical anterior restorations after 12 months, while Essentia has shown 95% success rate after 12 months. Overall success of all tested outcomes within each group have shown no statistically significant change between followup periods ($P<0.016$). **Conclusion:** Universal based resin composites could be a reliable restorative material for anterior cervical cavities. The shade matching of universal shade resin based composites and conventional multi shade resin based composites is similar and found to be clinically acceptable after 12 months of clinical use.

Keywords: Universal shade resin composite, Multi shade resin composite, Carious cervical lesions, Anterior restorations

I. INTRODUCTION

In direct esthetic restorative techniques, resin composite materials have found widespread use. Keeping the color match with the natural tooth structure is one of the clinical challenges of direct resin restoration procedures. In fact, aesthetic failure is one of the most frequent causes of restorative replacement. The resin material's surface wear may

reduce the color stability of direct restorations. ***(Oliveira et al, 2014)***. Resin based composites (RBC) are widely used because they provide excellent esthetics, optimal mechanical properties, acceptable durability, and feasible cost in addition to being noninvasive or minimally invasive. ***(Fahim et al, 2024)***. Modern RBCs enable minimal or no preparation to be applied to repairable, functional, and aesthetically pleasing restorations in a single visit. With the numerous advancements in composite materials over the years, more aesthetically pleasing composite kits with enhanced filler technology are now available. Inorganic nanofillers with improved shrinkage and polishing qualities are present in a large number of RBCs today. Furthermore, a higher number of particles and improved visible light scattering are made possible by the smaller particle size, allowing the composite material to better blend in with its surroundings in terms of color. By changing the composite color toward the color of the surroundings, the chameleon effect is produced. Simple, monochromatic aesthetic restorations in the anterior and posterior regions have been carried out using these RBCs. Manufacturers have started creating esthetic composite kits with fewer hues thanks to the chameleon effect property. But only two RBC kits—Omnichroma from Tokuyama Dental in Japan and Essentia Universal Shade from GC Corp. in Japan—are now on the market that include a single shade composite with an enhanced chameleon effect that matches any shade in the Vita Classic Shade Guide ***(Özcan and Korkut, 2022)***. Tokuyama Dental America unveiled Omnichroma in 2019 as the first resin composite that could be customized to match any tooth's color. Having this special quality might make it simple and quick to achieve a satisfying aesthetic restoration. Additionally, by eliminating the necessity for shade selection, Omnichroma has been shown to save the clinician time. Although Omnichroma's manufacturer claimed that the product was successful in terms of appearance, there was not enough information available in the literature about the product's clinical performance or mechanical characteristics. ***(El-Refai et al, 2022)*** 2 The clinical performance of Omnichroma composite in restoring anterior teeth has been the subject of numerous research; nevertheless, there is a deficiency in the comparison of this performance to that of other universal shade composites or the gold standard multishade composite Filtek Z350XT. This trial tested the null hypothesis that the clinical performance of the universal shade Omnichroma and GC Essentia universal composites is equivalent to that of the multi shade Filtek Z350XT composite in the restoration of anterior cervical lesions.

II. MATERIALS AND METHODS

- **Materials**

1. Phosphoric acid etchant gel (N etch, Ivoclar Vivadent, Switzerland)
2. Universal adhesive bonding agent (3M ESPE, USA)
3. Multishade nano hybrid resin composite (Filtek Z350XT 3M, USA)
4. Universal shade resin composite (Omnichroma, Tokuyama, Japan)
5. Universal shade resin composite (GC Essentia Composite, Japan)

- **Study Design**

The study was 12 months, double blinded, randomized, parallel arms with 1:1 allocation ratio. Twenty-seven patients with 60 teeth with cervical caries in the anterior teeth were randomly allocated into three groups (n= 20 teeth for each group). Group (A1) restored using composite restorations Filtek Z350XT composite, Group (A2) restored using composite restorations Omnichroma composite, while group (A3) received composite restorations using GC Essentia universal shade composite. The shade matching of the restorations was evaluated 1 week after placement (T0), after 6 months (T1), and after 12 months (T2) using the modified USPHS criteria.

- **Sample Size Calculation**

A power analysis was designed to have adequate power to apply statistical test of the research hypothesis to evaluate universal composites with single shade versus multi shade nano-filled resin

composite for restoration of carious cervical lesions regarding shade matching after 12 months. According to ***Nassar et al. in 2014*** in which the probability of score A for shade matching for nano-filled resin composite (comparator) was (0.7826), probability of score B was (0.2174) with effect size w=0.5652(n=25). If the estimated probability of shade matching for essentia universal composite was (0.9) for score A, (0.1) for score B with effect size w= 0.8 (n=13) and if the estimated probability of shade matching for omnichroma universal composite was (0.9) for score A, (0.1) for score B with effect size w= 0.8 (n=13) . By adopting an alpha (α) level of 0.05 (5%), power=80%. The predicted sample size (n) was a total of 51. Sample size was increased by (20%) to account for possible dropouts during follow-up intervals to be total of (60) cases i.e. (20) for each group. Sample size calculation was performed using G*Power 3.1.9.2.

- **Study Setting and Participants**

This clinical trial was held in the patients' clinic of the Faculty of Dentistry, Cairo University, Egypt. Participants were selected to fulfil the following eligibility criteria: Males or females medically free patients with age range 25-50 years. The patients should be co-operative approving to participate and having one or more class V carious lesions in more than one segment.

- **Eligibility Criteria**

Inclusion Criteria

Teeth related criteria: Class V carious lesions in anterior teeth with depth of 2 mm or less; Cervical margins should be in dentin and incisal margins in enamel, vital upper or lower anterior teeth with no signs of irreversible pulpitis and necrosis, and presence of favorable occlusion and teeth are in normal contact with the adjacent teeth. Patient related Criteria: Age range 25-50 years, males or females, co-operative patients having one or more class V carious lesions in more than one segment, and medically free patients.

Exclusion Criteria

Teeth related Criteria: Deep carious defects close to pulp, periapical pathosis or signs of pulpal pathosis, endodontically treated teeth, hypersensitive teeth, prosthodontic restoration of teeth, heavy occlusion or history of bruxism, severe periodontal affection, and lesions in posterior teeth. Patients related criteria: Allergy to methacrylates, rampant caries, disabilities, xerostomia, heavy smoking, lack of compliance, evidence of parafunctional habits, temporomandibular joint disorders, and non-carious lesions.

- **Sequence Generation and Allocation Concealment Mechanism:**

Simple randomization including generating numbers from 1:60 into three columns according to interventions and comparator assessment methods was performed. The allocation sequence will be generated using (www.researchrandomizer.com).

- **Clinical Procedures**

Pre-operative Assessment

Oral examination of the enrolled subjects was done. Professional prophylaxis was done using ultrasonic scaler (NSK, Japan) and polishing paste. Of the 45 subjects screened, a total of 27 subjects satisfied the criteria with one or more teeth with carious cervical lesions. Preoperative clinical photographs were taken to assess the width of the lesion. The pulp sensitivity was assessed with a cold test. Teeth with healthy pulp or reversible pulpitis felt cold within 3 seconds and the sensation didn't linger after removing the cotton.

Field Preparation

Local anesthetic agent was administered preoperatively. Cavities to be restored were isolated using heavy consistency rubber dam sheets to ensure moisture control and lack of contamination. Anterior surpra gingival or subgingival clamps were used for stabilization and isolation of the teeth.

Cavity Preparation Steps

Class V cavity was prepared according to the principles of minimally invasive dentistry by the same operator (D.K). Cavity preparation was limited

to just removal of carious lesion and making a bevel of 1mm incisally for esthetic considerations under magnification using magnifying loupes (3X). The preparation was performed using round diamond bur (BR-31) and a fissure diamond bur (SR-12) for the bevel. Any remaining soft caries was removed using a sharp excavator. Finishing of the bevel was done using yellow coded tapered stones TR-25EF.

Restorative Procedures

All restoration procedures were applied according to the respective manufacturer's instructions.

1. Acid Etching

Selective etching technique was done where the 35% phosphoric acid gel (N etch, Ivoclar Vivadent, Switzerland) was applied to the enamel only for 30 seconds. The cavity was then thoroughly rinsed with air-water spray for 15 seconds and the excessive water was then eliminated using gentle air to avoid desiccation of dentin.

2. Adhesive application

3M universal bond was applied to cavities with micro brush in a rubbing motion for 15 seconds according to manufacturer's instructions, followed by gentle air blow using oil free air for 10 seconds then light cured for 10 seconds using LED light curing unit with a light intensity of 1470 mW/cm².

3. Composite application

Each tooth is restored with the different resin composites using composite applicator according to the randomization plan.

4. Finishing and Polishing

Finishing of the restorations was done using yellow coded tapered stones TR-25EF and extended subgingivally using a fine needle tapered finishing stone in case of subgingival restorations. Polishing was done using Hiluster Plus polishing system and composite polishing paste.

- **Outcome Assessment**

Modified US Public Health Service (USPHS) criteria was the selected method to assess the shade matching of the restorations. Outcomes are evaluated and documented by the assessors at baseline, 6 months, and 12months. Table (1).

Table 1: Shade Matching according to modified USPHS criteria

Criteria	Score	Characteristic	Testing procedure
Shade matching	Alpha	Match tooth	Visual inspection
	Bravo	Slight mismatch	
	Charlie	Mismatch of color and nonesthetic appearance	

- **Statistical analysis**

Data was analyzed using Medcalc software, version 19 for windows (MedCalc Software Ltd, Ostend, Belgium). Categorical data was described as frequency and percentage, intragroup comparisons between interventions was performed using the Chi-Squared test with statistical significance level set at ($P \leq 0.016$), intragroup comparison within each intervention was performed using the Cochran's Q and Friedman's tests with statistical significance level set at ($P \leq 0.016$) after Bonferroni correction. Relative risk was used to assess the clinical significance. Survival rate was analyzed using Kaplan-meier and Log-rank test. The confidence limit was set at 95% with 80% power and all tests were two tailed.

III. RESULTS

- **Demographic data**

This study was conducted on (60) participants with cervical carious lesions that were randomly allocated to the interventions and the comparator arms (n=20). After 12 months 60 participants completed the follow-up with 100% retention rate. Gender

distribution is shown in table 2, there was no statistically significant difference between both groups regarding gender (P = 0.2557). Regarding age of the participants, there was no statistically significant difference between both groups regarding age (P = 0.431). Distribution of teeth is shown in table (3), there was no statistically significant difference between both groups regarding teeth distribution (P = 0.4927).

- **Clinical evaluation:**

Shade matching:

Intergroup comparison between groups have shown no statistically significant difference within different follow up periods; baseline, 6 and 12 months (P > 0.016). Intragroup comparison within all groups have shown no statistically significant difference between different follow-up periods (P>0.016). (Table 4 and Figure 1)

Table (2): Gender distribution among groups:

Group	Gender		Row total (RT)
	Male	Female	
Filtek Z350XT	10 50.0% RT 26.3% CT	10 50.0% RT 45.5% CT	20 (33.3%)
Omnichroma	15 75.0% RT 39.5% CT	5 25.0% RT 22.7% CT	20 (33.3%)
Essentia	13 65.0% RT 34.2% CT	7 35.0% RT 31.8% CT	20 (33.3%)
Column total (CT)	38 (63.3%)	22 (36.7%)	60
P value	P = 0.2557		

Table (3): Age among groups:

Group	Mean	SD
Filtek Z350XT	37.90	7.55
Omnichroma	37.85	7.16
Essentia	40.65	8.47
P value	P = 0.431	

Table 4: Frequency and percentage for shade matching for the intergroup comparison within each follow-up and intragroup comparison within each group between different follow-up periods.

Follow-up	Filtek Z350XT			Omnichroma			Essentia			P value
	A	B	C	A	B	C	A	B	C	

Baseline	20 (100%)	0 (0%)	0 (0%)	20 (100%)	0 (0%)	0 (0%)	20 (100%)	0 (0%)	0 (0%)	P = 1.0000
6 months	19 (95%)	1 (5%)	0 (0%)	20 (100%)	0 (0%)	0 (0%)	18 (90%)	1 (5%)	1 (5%)	P = 0.5404
12 months	18 (90%)	2 (10%)	0 (0%)	18 (90%)	2 (10%)	0 (0%)	`17 (85%)	2 (10%)	1 (5%)	P = 0.7288
P value (friedman's)	P = 0.22735			P = 0.13509			P = 0.15008			
P value (Cochran's Q)	P = 1.0000			P = 1.0000			P = 0.368			

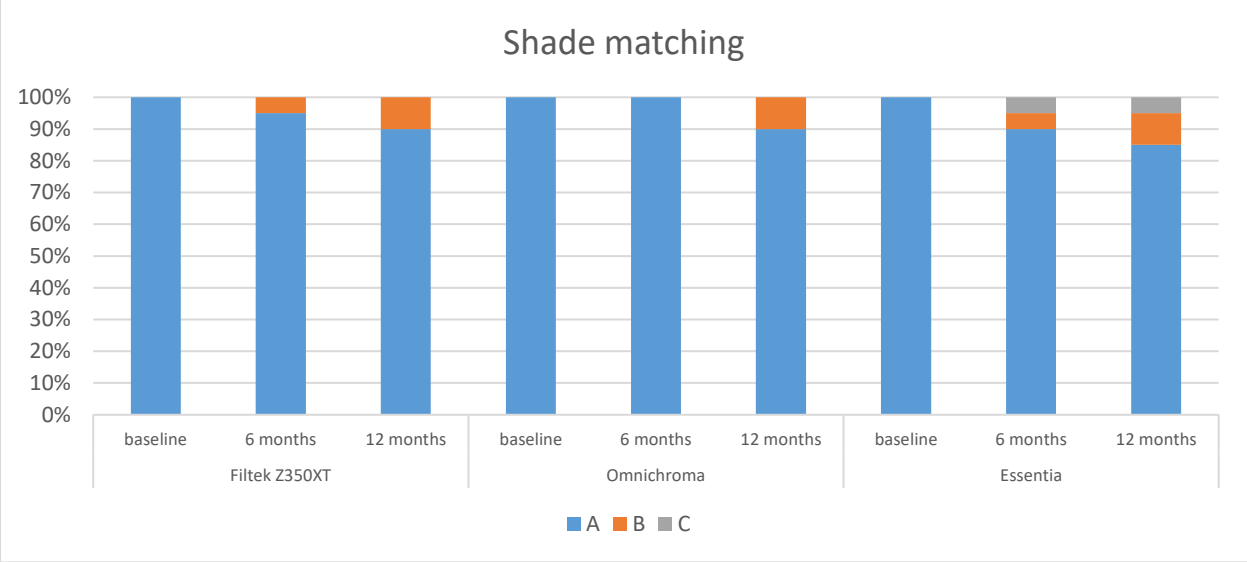

Figure 1: Bar chart showing percentage of shade matching scores within each group at different follow-up periods

- **Survival analysis:**

  Overall survival of Essentia, Omnichroma compared to Filtek Z350XT resin composites for cervical restorations was assessed after 12 months. There was no statistically significant difference between all groups (P = 0.368). (Figure 2)

  Filtek Z350XT and Omnichroma have shown 100% success rate for cervical anterior restorations after 12 months, while Essentia has shown 95% success rate after 12 months. Overall success of all tested outcomes within each group have shown no statistically significant change between follow-up periods (P<0.016).

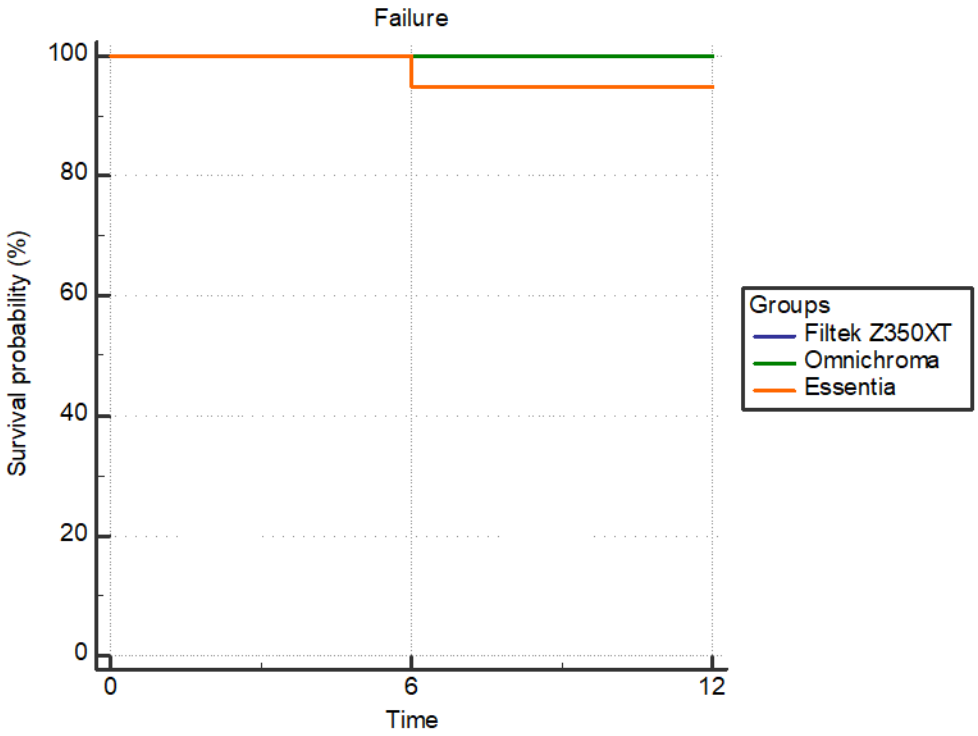

Figure 2: Survival analysis of Essentia and Omnichroma compared to Filtek Z350XT after 12 months

IV. DISCUSSION

The present study used Filtek Z350 XT universal nanocomposite as a control group. Despite having many filler and matrix systems, it is still regarded as one of the most researched composite materials, particularly in terms of gloss and color stability ***(Kim & Park, 2018; Poggio et al., 2017)***.

In this study, Omnichroma resin composite (Tokuyama Dental, Tokyo, Japan), was chosen as it supposedly has the potential to match all VITA Classical shades (Vita, Vita Zahnfabrik, BadSäckingen, Germany), from A1 to D4. According to the manufacturer, this ability can be achieved due to the inclusion of uniformly sized 260 nm spherical fillers in the composite, which could generate red-to-yellow color as ambient light passes through the composite ***(Pereira Sanchez et al., 2019)***. With a refractive index of 1.47 before and 1.52 after polymerization, Omnichroma becomes more translucent. This is in line with earlier studies that found a robust relationship between the color-shifting-related blending effect and the translucency parameter ***(Paravina et al., 2007)***. Omnichroma is a one-shade dental composite with a supra-nano globulous filler that has consistent dimensions. They have strong flexural and compressive strength, minimal polymerization shrinkage, enhanced stain resistance, and high finish potential ***(Baroudi, 2015)***.

Our results showed that in shade matching, the intergroup comparison between groups has shown no statistically significant difference within different follow-up periods; baseline, 6 and 12 months ($P > 0.016$). Also, the intragroup comparison within all groups has shown no statistically significant difference between different follow-up periods ($P > 0.016$). There was 3 times more risk for shade matching (score C) of Essentia when compared to Filtek Z350XT after 12 months ($P = 0.4933$). While there was no risk for shade matching (score C) of Omnichroma when compared to Filtek Z350XT after 12 months ($P = 1.0000$). Similarly, Zulekha et al. claimed that Omnichroma showed no statistically significant difference in the shade match at baseline ($P = 0.716$) and that the clinical performance of Omnichroma in terms of shade match, stability, and retention was comparable to nanohybrid composite ***(Zulekha et al., 2022)***. The authors studied shade

match at baseline, stability, and retention after 6- and 12- month follow-ups.

AlHamdan et al., 2021 discovered that the traditional resin-based composite had superior color matching than the universal shade composite (Omnichroma). Furthermore, they found that the universal shade resin-based composite's ability to match color was impacted by variations in the tooth shade. This was concluded when the results showed that, in 49 comparisons to Omnichroma resin, the traditional resin had a noticeably higher capacity to match colors for shades B1 and A3. On the other hand, traditional resin and Omnichroma resins were able to match colors in shades B2 and C3. Furthermore, in coffee, Omnichroma showed similar color stability to the traditional composite, but worse color stability (stain resistance) in the cola.

Regarding discoloration, the intergroup comparison between groups has shown no statistically significant difference within different follow-up periods; baseline, 6 and 12 months (P > 0.016). The intragroup comparison within all groups has shown no statistically significant difference between different follow-up periods (P>0.016). There was 3 times more risk for discoloration (score C) of Essentia, when compared to Filtek Z350XT after 12 months (P = 0.4933). There was no risk for marginal discoloration (score C) of Omnichroma when compared to Filtek Z350XT after 12 months (P = 1.0000).

These results were in concordance with a study conducted by Anwar et al (Anwar. R. S, 2024). In carious lesions in posterior teeth, the authors assessed the clinical behavior of single shade universal resin composite (Omnichroma) and multi shade nano hybrid resin composite (Tetric®N-Ceram). Color measurements and marginal discoloration were assessed visually by three blinded operators at baseline followed after 1,3,6,9, and 12-month periods utilizing the Modified United States Public Health Services (USPHS) criteria. Statistical analysis was adopted utilizing the Wilcoxon test with a 0.05 significance level. The two groups revealed nonstatistically significant differences up to 6 months regarding color match and color stability. After 9 and 12 months, the multi-shade group demonstrated a statistically significant higher prevalence of color match (Alpha) scores than the single-shade universal group. Regarding marginal discoloration, all restorations in the two groups had no discoloration (Alpha scores). But since the percentage of Alpha and Bravo scores was considered clinical success, both the singleshade universal and the multi-shade nanohybrid resin composites demonstrated 50 satisfactory optical performance and marginal discoloration as posterior restorations after a 12-month follow-up period.

In this clinical study, the overall survival of Essentia, Omnichroma compared to Filtek Z350XT resin composites for cervical restorations was assessed after 12 months, only 1 restoration failed after 12 months in the Essentia group. The comparison of survival curves showed there was no statistically significant difference between all groups (P = 0.368). After a year, Filtek Z350XT and Omnichroma have demonstrated a 100% success rate for cervical anterior restorations, whereas Essentia has demonstrated a 95% success rate. There has been no 53 statistically significant difference in the overall success of all assessed outcomes within each group between follow-up periods (P<0.016). Similarly, Korkut et al. stated that the cumulative overall survival rates of Essentia and Omnichroma restorations were 94.6% (97.3% for the first year) and 88.6% (95.3% for the first year), respectively, with no significant difference from each other (p = 0.316) (Korkut, Ünal, et al., 2023). Regarding the composite materials, there were no significant differences between the success rates of the restoration types (p = 0.442 for Essentia, p = 1.000 for Omnichroma).

After four years of clinical examination, a retrospective analysis found no statistically significant difference between polychromatic restorations using micro-nanohybrid Essentia MD and LE colors and monochromatic crown fracture repairs made with the Essentia ***(Korkut & Özcan, 2022)***. Also, opdam et al. reported survival rate of the

composite resin restorations was 87% at 5 years, resulting in an annual failure rate of 2.8% (Opdam et al., 2004). The overall survival rate of composite restorations was 90.7% after 3 years, 89.5% after 5 years, 89.3% after 7 years and 75.6% after 10 years as reported by ***Kodzaeva et al., 2019.***

Casagrande et al., 2017 reported that the survival of the composite resin and resin-modified glass ionomer cement restorations reached 57.9 % up to 36 months follow-up with an overall annual failure rate of 16.7 %. Multi-surface restorations showed more failures than single-surface and teeth restored with resin-modified glass ionomer cement had a lower survival rate than those restored with composite resin.

The current clinical study showed that Omnichroma and Essentia universal composites have clinically acceptable results in anterior class V cavities of cervical lesions. There are certain limitations on the current clinical trial, including those related to the follow-up period and clinical trial design. Comparing the one-year clinical evaluation period to other lifespan trials, it was quite brief. Unfortunately, there is a paucity of clinical data in the literature about universal resin composites; hence, this short-term evaluation may help determine the materials' clinical viability. More long-term assessments ought to be carried out in order to obtain more trustworthy findings. The study did not evaluate the patient's eating habits, which could potentially impact the restorations' ultimate aesthetic result. Since failed behavior varies, differences in the restorative technique's efficacy can only be assessed after a few years. Furthermore, because only one kind of resin composite was examined, the current study's findings cannot be applied to other resin composites. The categories might not accurately represent the clinical success of the restoration 54 and the updated USPHS criteria have poor sensitivity. Universal shade resin composites need more studies to assess their other physical and optical properties.

V. CONCLUSION

Under the parameters of this study and based on the results:

• Universal based resin composites could be a reliable restorative material for anterior cervical cavities.

• Universal shade resin composites could be helpful to simplify anterior restorations eliminating shade selection procedure and minimizing clinical errors.

• The shade match of universal shade resin-based composites and conventional multi shade resin-based composites is similar and found to be clinically acceptable after 12 months of clinical use.

VI. RECOMENDATION

Further randomized clinical trials with larger sample sizes and longer follow up periods are recommended to confirm the current results. • Further clinical studies using universal shade resin composites as well as other types of cavities to support the findings are highly recommended. • Utilization of FDI criteria in conjunction with modified USPHS criteria to compare the results of the materials clinical performance is recommended.

Conflict of interest:

Authors declare no conflicts of interest.

Funding:

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Ethics:

Ethical approval was obtained prior to the start of the study. The study was approved by Research Ethics Committee (CREC), Faculty of Dentistry, Cairo University on 26 / 7 / 2022 with ID: 28722.

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