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COMPARATIVE EVALUATION OF SHADE MATCH BETWEEN SINGLE SHADE AND UNIVERSAL SHADE RESTORATIVE COMPOSITE: AN IN VITRO STUDY

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ABSTRACT

Resin composites are preferred for their aesthetic and mechanical properties, making them suitable for various clinical situations. The "chameleon effect" or blending effect allows materials to match surrounding tooth shades, simplifying shade selection. Recently, "universal shade" composites have been developed to blend with all tooth shades using a single nominal shade. This study aimed to evaluate the shade matching of different universal shade composites. Using 80 extracted teeth, we tested Omnichroma, Charisma Topaz ONE, and Charisma Diamond in anterior (class V and IV) and posterior (class I and V) restorations. Shades were assessed visually and with a spectrophotometer before and after restoration. Statistical analysis with SPSS version 20 showed that group-shaded composites performed significantly better in shade matching than universal-shade composites. Further in-vivo studies are needed to explore the optical properties of universal-shade materials like Omnichroma and Charisma Topaz ONE.

KEYWORDS

Omnichroma, Charisma Topaz ONE, and Charisma Diamond, anterior (class V and IV) and posterior (class I and V) restorations

INTRODUCTION

Colour is universally acknowledged as essential in daily life, yet many struggle to deeply understand its importance. Discussions often remain abstract, and people fail to articulate the impact of colour or its absence on quality of life. This ambiguity makes exploring the significance of colour worthwhile.

In cosmetic dentistry, understanding primary, secondary, and complementary colours is vital for achieving desired aesthetic outcomes. Accurate colour matching in dental restorations impacts patients' confidence and self-worth, enhancing acceptance and satisfaction by creating a balanced, harmonious smile.

Psychophysics studies the link between physical stimuli and perceptions of colour. Tooth colour varies due to dentin hue, enamel thickness, dispersion, and translucency, changing across all directions of the tooth.[1]

In dentistry, colour determination is either visual or instrumental. Both methods face challenges, especially human observation, which depends on factors like light exposure, object-illuminant positioning, and illuminant colour properties. Mixing materials introduces further complexities, particularly in the oral environment, complicating accurate colour matching.[2]

An object's color is determined by the components of incident white light that are reflected. Light can flow through transparent materials with little alteration. Materials that are translucent can transmit, absorb, and disperse light. Materials that are opaque absorb and reflect light but do not transmit it. The majority of a natural tooth's color is innate to the tooth. [3] It can be stated that shade selection shows marked inter-observer variation. For many years, people have used dental shade guides to visually identify and communicate colour. Shade guide tabs, however, might differ even from manufacturer to manufacturer. In their investigations , O'Brien et al. [4] and Paravina et al. [5] have demonstrated that two shade guidelines from the same manufacturer may differ. It should be the aim of the practitioner to make the dentin and enamel layers of the composite replicate the anatomic thickness of that tooth before restoration in order to attain the desired qualities of natural teeth. [6] Tooth shade guides provide a range of standards that mimic natural teeth. It is up to the dentist to determine which standard provides the closest color match to the tooth or teeth in question and if the patient would be satisfied with the match. The suitability of the shade guide and the dentist's competence with fundamental color-matching techniques are critical factors that determine whether this operation is successful or unsuccessful.

Park et al.[7] found that two distinct shade guides had clinically unacceptable color distributions under different illuminants. Current shade guides lack the full dental shade spectrum, with aging, fatigue, lighting, contrast, and metamerism causing discrepancies.

Recent improvements in resin composites enhance properties but lack crystalline structure reduces translucency and fluorescence, complicating color matching with natural tooth structure and limiting biomimetic potential.

Computerized colourimetry or spectrophotometry allows mathematical comparison based on CIE-Lab (1971) characteristics: L (lightness), a (red-green chroma), and b (yellow-blue chroma).[8]

Tooth enamel gains brightness, depth, and vibrancy through opalescent effects, appearing different in reflection and transmission due to opalescence. This anisotropic light property influences visual appearance, demonstrating optical anisotropy in incisal halo width, chroma, and color under varying illumination angles.[9]

The "chameleon effect" in restorative dentistry describes materials that mimic surrounding tooth color. Advances like "group-shaded" composites initially covered VITAPAN shades, evolving to "one shade" composites that aesthetically blend with any tooth color, simplifying shade selection and replication.[10]

An object's color is determined by the wavelengths it reflects. Omnichroma, a one-shade resin by Tokuyama Dental, uses "smart chromatic technology" for precise color matching without pigments. New research highlights its enhanced color adjustment potential, similar to Kulzer's Charisma Topaz One's adaptive light matching.[11]

Dental materials that shift color to match surrounding tissues can improve aesthetics, ease shade matching, reduce the need for shade guides, and partially correct color mismatches.

OMNICHROMA and CHARISMA TOPAZ ONE are universal composites with single shades designed for most direct restorations. They enhance color matching, reduce chair time, and lower composite inventory. The study tested if these composites match tooth shade.[12]

Aim & Objectives

Aim

The aim of this study is to comparatively evaluate the colour match obtained with single shaded composite and the two universal shade composite restorative materials used.

OBJECTIVES

1. To comparatively evaluate the shade match obtained with

universal shaded composite resin and the single shaded composite.
2. To evaluate the shade match obtained with Omnichroma (Tokuyama) both in anterior and posterior teeth in the cervical, incisal and occlusal areas.
3. To evaluate the shade match obtained with Charisma Topaz ONE (Kulzer) both in anterior and posterior teeth in the cervical, incisal and occlusal areas.
4. To comparatively evaluate the shade match obtained with Omnichroma and Charisma Topaz ONE in the cervical, incisal and occlusal areas.
5. To evaluate if the visual shade match is reliable with the help of a spectrophotometer.

MATERIALS AND METHODOLOGY

The study at Babu Banarasi Das College and ITS Dental College involved freshly extracted teeth from patients aged 25-50. The teeth were cleaned, stored in hydrogen peroxide, and later cleaned with an ultrasonic scaler for research purposes.

METHODOLOGY

Sample Preparation

Eighty teeth were selected, restored thrice: first with Omnichroma (Group A), then Charisma Topaz ONE (Group B), and finally Charisma Diamond (Control Group C).

Division of the Samples

Control group: In the control group, 40 anterior teeth (Group C) were restored with Charisma Diamond composite, split into C1 (Class IV cavities) and C2 (Class V cavities). Similarly, 40 posterior teeth (Group D) were divided into D1 (Class I cavities) and D2 (Class V cavities).

Experimental group: In the experimental group, 80 teeth were divided into two subgroups, A and B. Subgroup A (Omnichroma) and B (Charisma Topaz ONE) each had 40 anterior and 40 posterior teeth. These were further divided into subgroups based on cavity types (Class IV, Class V, and Class I). Each sample's shade was evaluated using a spectrophotometer before cavity preparation.

For Cavity Preparation

The cavities (class V, IV, I compound) were prepared using an airotor and diamond points under magnifying loupes for magnification with prismatic light for illumination.

Restoration

Restorations were done under magnifying loupes using the same bonding agent for both experimental and control groups. The control group used Charisma Diamond composite with oblique layering, while experimental groups used Omnichroma and Charisma Topaz ONE with bulkfill. Restoration was completed in 2mm increments to minimize shrinkage, followed by finishing with burs and polishing with a Shofu kit.

For Shade Evaluation

Before cavity preparation, baseline shade evaluation was performed on each tooth. After restoration, shade was assessed in two stages: Stage 1 involved visual evaluation by two independent observers using a custom scale (Grades I-III).
Grade I- Excellent (No difference present between the tooth structure and restorative material)
Grade II- Good (A discrepancy between tooth structure and restorative material visible with clear interfacial demarcation)
Grade III- Poor (The shades of the tooth structure and restorative material distinctively different with obvious interfacial margin)
Stage 2 used a spectrophotometer to measure shade at a 10-degree angle with D65 illuminant on a grey background.

RESULTS

Analysis was done using unpaired t-tests. The data was statistically analysed using SPSS version 20.

Table 1: Comparison between the restoration by Omnichroma and Charisma Topaz ONE

		After Charisma Topaz one			P-value
		Discrepancy	Good	Total	
After Omnichroma	Discrepancy	8	11	19	0.306
	Good	18	43	61	
	Total	26	54	80	

The table compares the restoration outcomes of Omnichroma and Charisma Topaz ONE in terms of VITA shade change. Results indicate no statistically significant difference between the groups (p>0.05), but Omnichroma performed better than Topaz ONE.

Table 2: Comparison between the restoration by Omnichroma and Charisma Diamond

		After Charisma Diamond			P-value
		Discrepancy	Good	Total	
After Omnichroma	Discrepancy	0	19	19	0.046
	Good	11	50	61	
	Total	11	69	80	

The table compares Omnichroma and Charisma Diamond restorations in terms of VITA shade change. Results show a statistically significant difference (p<0.05), with Charisma Diamond outperforming Omnichroma.

Table 3: Comparison between the restoration by Charisma Diamond and Charisma Topaz ONE

		After Charisma Diamond			P-value
		Discrepancy	Good	Total	
After Charisma Topaz ONE	Discrepancy	0	26	26	0.013
	Good	11	43	54	
	Total	11	69	80	

The table compares Charisma Topaz ONE and Charisma Diamond restorations in terms of VITA shade change. Results show a statistically significant difference (p<0.05), with Charisma Diamond outperforming Topaz ONE.

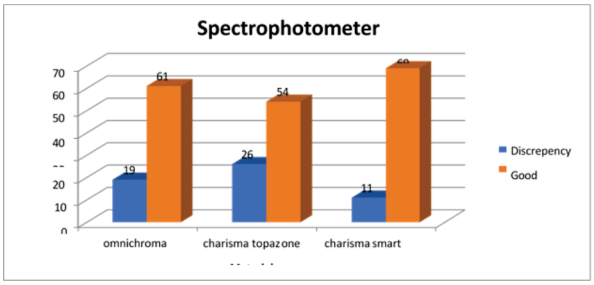


Table 4: Visual comparison between the restoration by Omnichroma and Charisma Topaz ONE

Grading of shade match		After Charisma Diamond				P-value
		Excellent	Good	Poor	Total	
After Omnichroma	Excellent	51	12	0	63	0.031
	Good	9	0	1	10	
	Poor	4	2	1	7	
	Total	64	14	2	80	

The table compares Omnichroma and Charisma Diamond in grading shade match and VITA shade change. Results reveal a statistically significant difference (p<0.05), with Omnichroma outperforming Charisma Diamond.

Table 5: Visual comparison between the restoration by Omnichroma and Charisma Topaz ONE

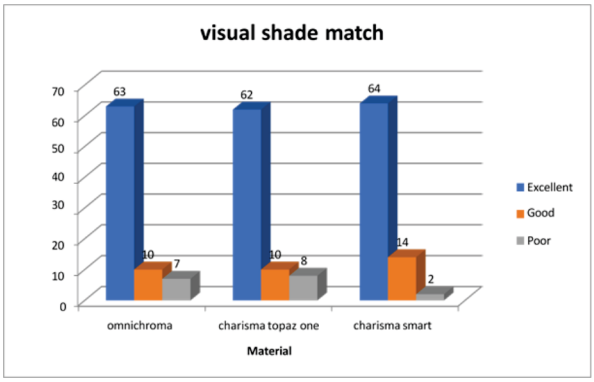
Grading of shade match		After Charisma Diamond				P-value
		Excellent	Good	Poor	Total	
After Omnichroma	Excellent	50	9	4	63	0.243
	Good	7	1	2	10	
	Poor	5	0	2	7	
	Total	62	10	8	80	

The table compares Omnichroma and Charisma Topaz ONE in grading shade match and VITA shade change. Results show no statistically significant difference (p>0.05), but Omnichroma achieved better results.

Table 6: Visual comparison between the restoration by Charisma Diamond and Charisma Topaz ONE

Grading of shade match		After Charisma Diamond				P-value
		Excellent	Good	Poor	Total	
After Charisma Topaz ONE	Excellent	50	11	1	62	0.430
	Good	8	2	0	10	
	Poor	6	1	1	8	
	Total	64	14	2	80	

The table compares Charisma Topaz ONE and Charisma Diamond in grading shade match and VITA shade change. Results show no statistically significant difference (p>0.05), but Charisma Diamond performed better.



Graph 2: Visual comparison

DISCUSSION

For an aesthetically acceptable restoration, the composite resin and natural tooth color must match closely, appearing indistinguishable. Layering techniques in composite resin restorations offer effective color matching but require more time and advanced professional skill.[13] New techniques in dentistry aim to simplify clinical protocols, reduce treatment time, and ease the color selection process.

Single-shade composite resins adapt to the surrounding tooth color, exhibiting a "chameleon effect" that blends with adjacent structures for a seamless match.[12] Single-shade composite resins can mimic all tooth colors with one shade, offering a promising, efficient alternative to multi-shade materials for clinical use.

Omnichroma (OC) is a single-tone composite resin designed to match all 16 Vita Classical shades, from A1 to D4.[13] Omnichroma resin utilizes smart color technology and structural color principles, manipulating light wavelengths to blend with tooth color. Unlike other resins, it doesn't rely on added pigments.

Color is a key aesthetic factor in dentistry, influenced by composite resins' translucency, chroma, hue, and lightness.[3] Natural teeth have irregular morphologies and uneven surface structures.[14] Choosing and matching composite resin hues is challenging due to tooth morphology and measurement limitations. While instruments like spectrophotometers help, visual assessment remains the most popular method for accurate color matching.[6]

Studies on single-shade resins show positive results, achieving acceptable color matching in vitro with composite resin specimens.[13] Kobayashi et al. found single-tone resins had good color adaptation. Forty human incisors were used to assess color-matching potential of four single-tone composite resins, yielding positive results, unlike unsatisfactory outcomes in other in-vitro studies. Nagi and Moharam found Omnichroma single-tone resin had unsatisfactory color matching in patients with class V and III carious lesions.[15]

No studies have compared single-shade resins to multishade resins in extracted teeth. This study aims to visually and instrumentally evaluate the color matching of two single-shade resins versus a multishade resin.

This study found no significant color-matching differences between Omnichroma and Charisma Topaz ONE, with 80% of samples showing an excellent match between tooth structure and restorative material.

The findings align with Sanchez et al.'s study, which assessed five composites' color-matching abilities across 16 VITA shades. They found Omnichroma, a single-shade material, had superior color correction, reducing contrast with surrounding tooth structure compared to other composites.[15]

Erika Thaís Cruz da Silva studied color matching between single-shade and multishade composite resins in extracted human teeth. Visually, 77.49% of the teeth had an acceptable color match, with the closest match having the highest value, regardless of the assessment group.

Rasha M. Abdelraouf et al. found that universal shade bulk-fill resin composites showed close color matching in composite models and natural teeth despite shade variations. This satisfactory matching is attributed to high translucency, which reflects surrounding shades. Paravina et al. also noted the blending effect increases with translucency.[16]

This study found Charisma Diamond had the best shade matching, with the most samples showing excellent results, consistent with Surelee Chavan et al.'s in-vitro study comparing shade matching of single, group, and multi-shade composites in acrylic teeth using spectrophotometry at two preparation depths. Results align with de Abreu and Al Hamdan's studies, showing multi-shade composites had better color matching than single-shade composites.[17] Mohd Samad et al. evaluated color matching of single-shade versus multi-shade composites in vitro, across different cavity depths and shades (S1, S2, S3) in teeth.[17]

Single-shade composites use "smart chromatic technology" to blend with tooth color by adjusting filler particle size, without dyes or pigments, matching the surrounding structural color.

The study found multi-shaded composites generally performed better than single-shaded ones due to varying optical behavior, with anterior restorations possibly appearing gray due to oral cavity translucency.

Erika Thaís Cruz da Silva et al. found multi-shade composites inferior to single-shade ones. This contrasts with Zulekha et al., who found single and multi-shade composites comparable, and Durand et al. and Pereira Sanchez et al., who noted Omnichroma's superior color adjustment due to its uniform supra-nano particles.[15]

Polychromatic stratification and layering techniques replicate natural tooth colors and reduce polymerization shrinkage stress. These methods enable superior esthetic restorations with better marginal seals and lower caries risk. However, they require longer chair-side time and a steep learning curve.[18]

This in-vitro study using extracted teeth has limitations, including factors like tooth structure, cavity type, evaluation methods, and resin brand. Future research should vary cavity sizes and assess color stability, translucency, and perform clinical studies to validate these findings.

CONCLUSION

Tooth color variation is crucial in cosmetic dentistry, impacting restorative procedures. An object's color is influenced by wavelength reflection, with pigments affecting materials like ceramics and resin composites. Multishade resins showed better color matching than single-shade ones, with layering techniques yielding superior aesthetic results. Single-shade composites did not differ significantly in color matching. Future research should focus on in-vivo assessments and evaluate properties like color stability and translucency for single-shade resins.

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