

Spectrophotometric Analysis of Color Stability of Omnicroma Composite and Multi-Shade Composite Material Under The Effect Of Chlorhexidine in the Presence and Absence of Anti-Discoloration System –an in-Vitro Study

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ABSTRACT:

Introduction: Omnicroma, a single-shade composite is commonly used for aesthetic restorations due to its notable color-matching properties. However, studies have indicated that some modern universal composite resins may exhibit suboptimal color stability.

Aim: The aim of the study was to assess the colour stability of single shade omnicroma and multi-shade composite restorative materials.

Methods and Material: 40 specimens of dimension 7*7mm were prepared. 20 specimen of Omnicroma (Tokuyama) and 20 specimens of Tetric n ceram (Ivoclar,vivadent) were prepared using composite filling instrument. Each group was further subdivided into 2 subgroups. 1 subgroup from each group was exposed to CHX with an ADS while the other subgroup was exposed to CHX without ADS. Specimens were then cured for 20 seconds with light curing unit and were polished with composite polishing disks. Color values of the prepared samples were recorded. All the samples were then subjected to mouthrinses. Post immersion sample's color values were noted with the similar spectrophotometer. Statistical analysis: Paired and unpaired t test were used to statistically analyse the data.

Results: For the single-shade samples, there was no statistically significant difference in light reflectance values between the baseline and after exposure to mouthrinses. In contrast, the multi-shade samples showed a statistically significant difference in light reflectance values between the baseline and post-exposure to mouthrinses when treated with both CHX with ADS and CHX without ADS.

Conclusions: Based on the findings of this study, although both composites exhibited discoloration, Omnicroma demonstrated superior color stability compared to Tetric N-Ceram Ivoclar.

Key-words: Anti-discoloration system, chlorhexidine mouthwash, Composites, mouthrinses, Omnicroma, Spectrophotometer.

INTRODUCTION:

As advancements in dental materials continue, restorative dentistry is also evolving. The increasing demand for aesthetic enhancements has led to the development of a wide range of restorative materials. Numerous composites have been introduced with technological improvements to meet aesthetic expectations; however, a vital aspect influencing their clinical longevity is their capacity to retain color stability in the ever-changing oral environment. In particular, the long-term color stability of resin composites is essential for the clinical success of aesthetic restorations, especially in the anterior region.^[1]

Multilayer restorative techniques require precise shade matching and significant clinical skill, which increases the complexity of the procedure, extends chair time, and raises treatment costs. One-shade (monochromatic) composites aim to improve efficiency by minimizing the need for advanced technical expertise, thereby streamlining the process for dental practitioners.^[2]

In contrast to traditional methods that rely on pigments, monochromatic composites offer a single-shade solution capable of adapting to various tooth shades. Manufacturers claim that these materials can blend seamlessly with surrounding teeth, regardless of their original color, due to the chameleon effect.^[3]

Composite discoloration may result from both intrinsic and extrinsic factors. Intrinsic factors include filler particle size, depth of polymerization, and the presence of coloring agents. Extrinsic factors involve lifestyle habits such as drinking, smoking, dietary choices, and the use of mouthwashes.^[4,5]

Mouthrinses are commonly prescribed as chemical aids in plaque control and are used in conjunction with mechanical cleaning methods to help prevent and manage dental caries, periodontal diseases, plaque accumulation, and halitosis. While they offer antibacterial benefits and support oral health, they also come with certain disadvantages. One notable drawback is the potential discoloration of composite restorations, a multifactorial issue in which commercial mouthrinses play a significant role.^[6]

Literature suggests that the staining effect linked to chlorhexidine (CHX) use is due to several mechanisms, including the Maillard reaction, the formation of pigmented metal sulfides, and interactions between CHX and polyphenols or tannins present in food and beverages.^[7]

The low pH of mouthrinses can affect the composite's durability, hardness, and color stability. The staining caused by CHX use is believed to result from the formation of colored metal sulfides and interactions between tannins and polyphenols in food and drinks with CHX. To combat CHX-related tooth staining, a new formulation containing an anti-discoloration system (ADS) was developed and launched. This enhanced mouthrinse combines CHX with ADS to effectively control plaque while reducing the risk of tooth discoloration.^[5]

The ADS system consists of sodium metabisulphite and ascorbic acid, two compounds that appear to disrupt the key processes responsible for pigmentation formation.^[8]

The null hypothesis states that the color of aesthetic restorative materials remains unchanged clinically with the regular use of different mouthwashes.

SUBJECTS AND METHODS:

Forty composite specimens were fabricated using a plastic mold measuring 7 × 7 mm. Mylar strips were placed above and below each specimen to ensure a smooth surface. The specimens were divided into two main groups: Group A (Omnichroma) and Group B (multi-shade Ivoclar Vivadent). Each group was further subdivided into two subgroups (n=10 each). One subgroup from each main group was exposed to chlorhexidine (CHX) with an anti-discoloration system (ADS), while the other subgroup was exposed to CHX without ADS.

All samples were incubated at 37°C for 24 hours, after which their baseline color values were recorded using a spectrophotometer. Subsequently, the specimens were subjected to mouthrinse treatment. For 21 days, samples were immersed twice daily for one minute each time in mouthrinses containing 0.2% CHX. Between exposures, the samples were stored in artificial saliva at 37°C, with the storage medium refreshed after each mouthrinse. Post-immersion color measurements were then recorded using the same spectrophotometer



Figure 1: Samples tested in spectrophotometer.



Figure 2: Vita easy shade

RESULTS:

Group	Sub group	N	Mean	SD	T value	P value
Single shade	Sub Group 1: Omnichroma chx with ads	10	1.14	0.46	7.408	0.4683
	Sub Group 2: Omnichroma chx without ads	10	1.40	1.01		
Multi shade	Sub Group 1: Ivoclar and chx with ads	10	4.46	0.72	2.1858	0.0423*
	Sub- Group 2: Ivoclar and chx without ads	10	5.80	1.80		

Table 1 : Comparison of color stability among different sub-groups

Group	Material	N	Mean	SD	T value	P value
With ads	Omnichroma chx	10	1.14	0.46	12.2879	<0.0001*
	Ivoclar and chx	10	4.46	0.72		
Without ads	Omnichroma chx	10	1.40	1.01	6.7413	<0.0001*
	Ivoclar and chx	10	5.80	1.80		

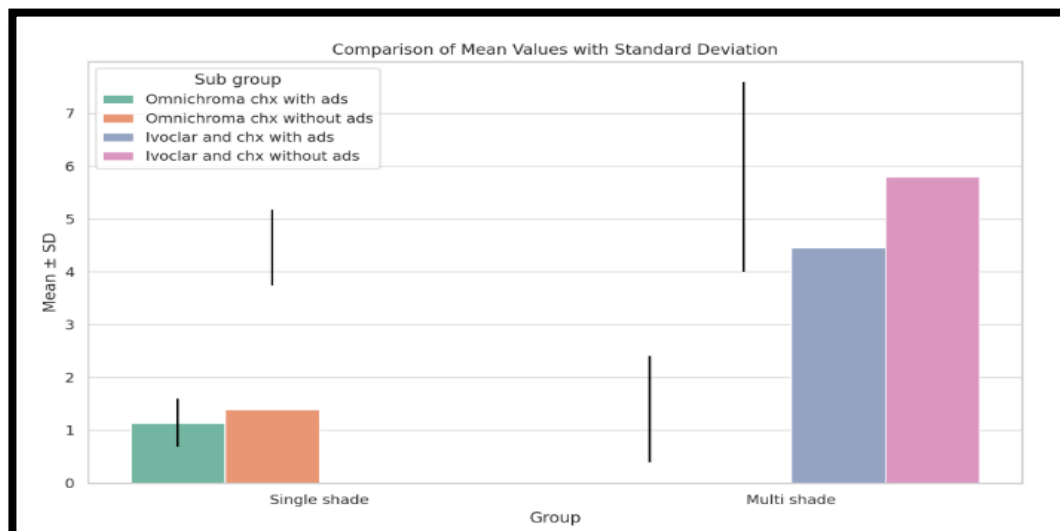
Table 2: Comparison of color stability among different materials

The present study revealed that:

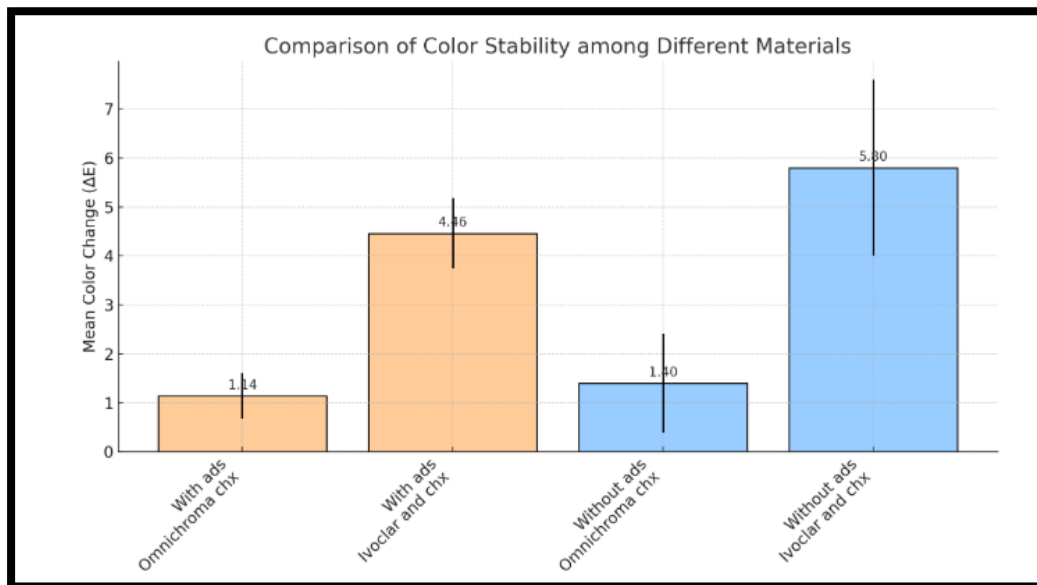
- There was no statistically significant variation in the reflectance values of light between the baseline and post-exposure to mouthrinses for single shade samples that were treated to CHX with ADS and CHX without ADS.
- Baseline and post-exposure to mouthrinses light reflectance values differed statistically significantly in multi-shade samples treated to CHX with ADS and CHX

Statistical analysis: Paired and unpaired t test were used to analyse the data.

Graph 1: Comparison of mean values with standard deviation



Graph 2: Comparison of colour stability among different materials



DISCUSSION:

In the aesthetic zone, discoloration is the primary reason for replacing dental restorations. The lack of color durability in composites often necessitates their replacement.¹ Satou et al. reported that microvoids and microcracks at the interface between the matrix and filler are likely sites where stains can penetrate.^[5]

Chlorhexidine is an antimicrobial mouthwash that is effective against a broad spectrum of microorganisms. A typical rinse involves using 10 ml of a 0.2% chlorhexidine solution, delivering a total dose of 20 mg. Lower concentrations can minimize side effects while maintaining therapeutic effectiveness.^[9] However, the most common side effect of chlorhexidine use is brown staining on teeth, dental restorations, and the tongue.^[11,12]

Approximately 30% to 40% of composite resin restorations are replaced within five years because of discoloration.^[13] Immersing composite resin in chlorhexidine mouthrinse for 24 hours is comparable to using the mouthrinse for 2 minutes daily over a two-year period.^[14]

The color of a tooth is determined by its light reflectance and absorbance properties. When light hits the tooth surface, some of it is absorbed while the rest is reflected. Staining can be evaluated through visual inspection or instrumental techniques. Among these, spectrophotometry is preferred because it offers objective, precise measurements, avoiding the subjective biases often present in visual assessments.^[15,16]

Jagnath B.M. and colleagues suggest that staining could negatively affect a patient's willingness to adhere to the prescribed use of chlorhexidine (CHX).^[3]

Plasdone K-29/32, a patented compound incorporated into chlorhexidine with ADS, was developed as an anti-discoloration agent to reduce staining. This water-soluble polymer, based on N-vinylpyrrolidone, functions by binding to stain-causing substances, increasing their solubility and helping to eliminate the stains.^[3]

The CIE Lab system describes a three-dimensional color space consisting of lightness (L), red-green (a*), and yellow-blue (b*) components. One important aspect of this system is its ability to quantify color differences between samples with a single value called ΔE .^[17] This approach is particularly effective for identifying subtle color changes and provides benefits such as high repeatability, sensitivity, and objectivity.^[18]

In the present study, Group A (Omnichroma) with the two subgroups showed the mean value 1.14 and 1.40 while Group B (Tetric N ceram ivoclar) with two subgroups showed mean value 4.46 and 5.80. This

result could be explained by the fact that omnichroma composition includes urethane dimethacrylate (UDMA), which is considered more resistant to staining than bisphenol A-glycidyl methacrylate (bis-GMA) due to its low water solubility and absorption.^[19]

The final outcomes can be linked to the presence of nanoparticles, which blend with the surrounding tooth structure to create a chameleon effect and possess wavelengths shorter than visible light.^[20]

The current study found that Omnichroma displayed minimal color change, consistent with Kalender S. et al.'s findings. This may be due to its nanoparticle technology, which enables it to blend with the surrounding tooth structure, and its wavelength being below the visible light spectrum. In contrast, Beautifil-Bulk, containing bis-GMA, showed more significant discoloration^[10]

Research by Abdelahmed B. et al. suggested that composite resins with high resin content and water adsorption are more prone to staining. However, Poggio et al. (2016) emphasized the significance of the resin matrix in maintaining color stability and found that higher filler content correlates with improved color stability. Essentia, with its high filler content, demonstrates enhanced color stability, irrespective of filler size and distribution.^[21]

A study conducted by Zulekha et al. revealed that Omnichroma and Tetric-N-Ceram exhibited comparable retention rates at both 6 and 12 months. The clinical performance of both materials was observed to be better at the 6-month mark compared to the 12-month mark. The similarity in their performance can be attributed to several factors, including their similar filler content, which helps reduce polymerization shrinkage. Additionally, the use of the same clinical technique, bonding agent, and isolation protocol, as well as exposure to the same oral environment, may have contributed to the comparable results.^[22]

Within the scope of this study, Omnichroma was selected as a single-shade resin composite and is recognized as one of the most clinically successful products in this category. It is among the most extensively studied single-shade materials, with numerous studies exploring its color adaptation capabilities.^[23,24]

CONCLUSION:

Omnichroma composite resin typically demonstrates strong color stability, effectively preserving its original shade over time. Within the limits of this study, although both composites experienced discoloration, Omnichroma showed superior color stability compared to Tetric N Ceram Ivoclar. To reduce discoloration caused by chlorhexidine mouthrinse and improve patient compliance, prescribing chlorhexidine with an anti-discoloration system (ADS) is advisable.

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