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Research Paper

Comparative evaluation of color matching ability and color stability of Smart chromatic composite with that of Conventional resin composite - An in vitro study.

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ABSTRACT :
Aim *of the study is to assess the color matching ability and color stability of single-shade resin-based composite (Omnichroma) and conventional resin composite.* ***Materials and Methods*** *: Forty lower molar acrylic teeth of B2 shade were prepared with class I cavities. They were divided into two groups(n=20) based on the resin composite materials (Omnichroma and Tetric N Ceram) used for cavity restoration. The color matching ability of both the materials with the acrylic teeth was assessed. Specimens were further divided into 2 groups based on type of staining medium used. They were immersed in carbonated drink and pediatric milk formula for 2weeks and color stability was assessed.* ***Results :*** *Omnichroma showed significantly better color matching to acrylic teeth when compared to Tetric N Ceram specimens. Regarding the color stability in carbonated drink, the Tetric N Ceram samples showed significantly lower ΔE values (indicating better color stability) compared to Omnichroma samples. There was insignificant difference in ΔE values of Omnichroma and Tetric N Ceram samples in pediatric milk formula.* ***Conclusion*** *: Color matching ability of Omnichroma to acrylic teeth was better when compared to that of Tetric N Ceram. Omnichroma composite showed more compromised color stability than the conventional resin composite in carbonated drink and with insignificant difference in pediatric milk formula.*

KEYWORDS: *Omnichroma, Tetric N Ceram composite, color stability, color matching ability, spectrophotometer*

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I. Introduction

Recent advancements in dental materials offer practitioners a diverse array of options for crafting veneers that seamlessly blend with the natural aesthetics of patients' smiles. Originally intended for anterior restorations, resin-based esthetic materials have expanded their utility to encompass various classes and types of dental restorations[1]. The field has witnessed significant progress in the science and technology of composite dental materials, leading to the development of novel composite resin materials that boast enhanced longevity and color stability within the oral cavity. Manufacturers have introduced stringent requirements such as light-

curing capabilities, impeccable color matching, and stability. These innovations include condensable/packable, flowable, microhybrid, and nanocomposite materials[2]. Various techniques including layering of different shades help the conventional resin composites to closely mimic the natural appearance of teeth[3].

A cutting-edge single-shade resin restorative composite, Omnichroma, has recently been introduced, incorporating smart chromatic technology along with 260 nm spherical fillers to emulate the appearance of the adjacent tooth structure. Its wide color matching ability eliminates the need for a shade assessment procedure and reduces the composite inventory, allowing clinicians to minimize chair time, the wastage of unused composite shades, and to reduce reliance on shade matching procedures[4]. However, there is limited evidence on the success of its color matching ability and stability in dental restorations. Therefore, it is critical to ascertain the color matching ability and color stability of Omnichroma in comparison to conventional resin-based restorative materials. Therefore, in the present study we aim to assess the color matching ability and color stability of a single-shade resin composite (Omnichroma) material and conventional resin composite.

II. Materials And Methods

2.1 Specimen preparation

A sample of 40 lower molar acrylic teeth of B2 shade were used in the present study. Standardized, simulated class I cavities of 2 mm depth, 4 mm diameter were prepared using a high-speed hand piece and no.245 carbide burs. Cavities were rinsed with water and air-dried.

2.2 Specimen restoration and study groups (color matching)

The prepared teeth were divided into 2 groups of 20 teeth each based on the type of composite material used. Half of the prepared teeth were restored with a single-shade (Omnichroma - single-shade universal composite) (test group) and the other half were restored with a conventional resin-based composite (Tetric® N Ceram - B2 shade) (control group). Cleaned cavities were air dried and restored in 2 increments measuring 1mm deep and 2mm wide for both materials. Excess material was removed and margins were adapted with a plastic instrument with flat occlusal surface. A mylar strip was covered with a glass slide and restorative material was photocured for 40s on occlusal aspect and 20s on buccal and lingual aspect using LED light curing unit with a light intensity of 400 mW/cm^2 in a uniform, continuous curing mode. Initially color matching ability of both the materials to the acrylic tooth was assessed with spectrophotometer.

2.3. Specimen preparation (color stability)

For measuring the color stability, specimens were immersed in specific media. The above specimens were further divided into 2 subgroups based on type of staining medium used. In subgroup-A, carbonated drink was used and in sub group-B, pediatric milk formula was used. Both these solutions were replaced every 24 h for 2 weeks. After removal from the staining solution, specimens were washed under running water for 5 min and dried. All specimens were assessed for color change after staining.

2.4. Color assessment

The specimen color was assessed using a spectrophotometer to evaluate the color matching ability and color stability (staining resistance) of the single-shade Omnichroma resin in comparison to a conventional resin composite. The setting at which the tests were run included a 10 nm wavelength interval, 360 to 750 nm spectral range, and 45^0 reflectance angle. The CIELAB color system was employed, comprising L*, a*, and b* axes identification. Here, "L" ranged from 0 to 100 (brightness to darkness), the "a" axis represented red to green colors (90 to 70 range value), and the "b" axis represented yellow to blue colors (coordinate value range from: 80 to 100). For the color stability assessment (stain resistance), L*, a*, and b* differences (Δ) were calculated before and after stain solution immersion. The color change ΔE was calculated using the following equation:

$$\Delta E = (\Delta L^{2} + \Delta a^{2} + \Delta b^{2})^{½}$$

III. Statistical Analysis

Data were tabulated in excel and were statistically analyzed with Statistical Package for Social Sciences (SPSS version 23.0). The p value obtained for the color matching test was analyzed with student t-test where individual composite materials were compared with the acrylic teeth. Similarly for the color stability assessment, ΔE (color difference) values among the restorative materials and staining media were compared using ANOVA and a post hoc test. Here, p values of ≤0.01 were considered statistically significant.

IV. Results

Color Matching Ability

The present study evaluated the color matching ability of single-shade Omnichroma resin and conventional composite material (Tetric N Ceram) to the acrylic teeth where both the groups showed insignificant difference. Comparatively, Omnichroma showed better color matching ability than Tetric N Ceram to the acrylic teeth. Table1 shows the comparison of color matching ability among Omnichroma and Tetric N Ceram with that of acrylic teeth where Omnichroma showed better matching ability compared to Tetric N Ceram.

Table 1. Comparison of p-value for the color matching ability of the restorative materials with that of acrylic teeth

	Shade	**P value***
Acrylic tooth	B2 shade	0.048
Tetric N Ceram	B2 shade	0.0081
Omnichroma	Universal shade	0.08214

Color Stability

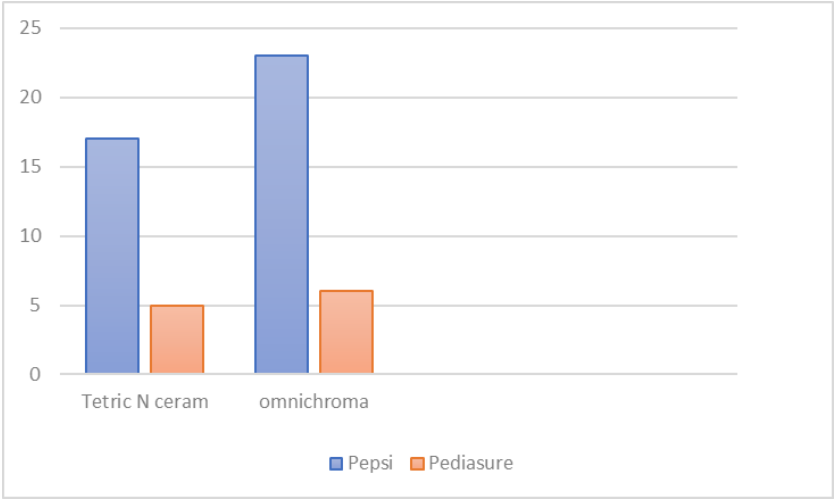
The color stability of the restorative materials (Tetric N Ceram and Omnichroma) was assessed using two commonly used beverages: carbonated drink and pediatric milk formula. Table 2 shows mean color differences of two materials after their immersion in the staining media. The lowest ΔE values were observed in Tetric N Ceram - carbonated drink (3.2 ± 0.13), while the highest ΔE values were observed in Omnichroma - carbonated drink samples (4.7 ± 0.60). After the immersion into pediatric milk formula, both the groups showed similar results but comparatively Omnichroma showed higher ΔE values. Figure 1 shows mean ΔE values of different restorative materials in different children's health drinks

Table 2. Mean color differences (ΔE) and standard deviations (SD) of the two composite materials regarding color stability

Comparison among groups	**Mean**	**SD**	**P value§**
Tetric N Ceram – carbonated drink	3.2	0.13	0.21552
Omnichroma – carbonated drink	4.7	0.60	0.04008
p-value	0.00005		
Tetric N Ceram – pediatric milk formula	0.67	0.279	0.00001
Omnichroma – pediatric milk formula	0.75	0.282	0.00001
p-value*	0.00001		

Note: * Tukey's post hoc test; § ANOVA.

Fig 1: Mean ΔE values of different restorative materials in different children's health drinks



V. Discussion

As a part of esthetic concern and caries prevention, various materials are coming into existence. In order to provide better quality of the esthetic restorative materials, various modifications of composites have been done. One such composite that came into existence include Omnichroma. Even though the composites have been playing a vital role in esthetics, intake of different pediatric milk formula and their dietary habits also influence their color stability.

In the present study, the color matching ability of the single-shade resin composite (Omnichroma) and conventional resin composite (Tetric® N Ceram) was compared to the acrylic teeth. Furthermore, the color stability (staining resistance) of the both materials (Omnichroma and Tetric N Ceram) after carbonated drink and pediatric milk formula immersion was investigated. The outcomes revealed a significantly better color stability for Omnichroma compared to Tetric N Ceram composite resin in carbonated drink. In addition, Omnichroma showed lower color stability in carbonated drink compared to the conventional composite.

Brewer et al. suggested that the changes in the filler size and composition greatly influence the material's color stability and optical properties. In the present study, the Omnichroma filler consisted only of specific, single-sized spherical particles, which enhanced the light reflection within a specific wavelength inside the tooth color space.

Moreover, the tooth factor is another variable that influences the color matching ability of the restorative material. In the present study, acrylic teeth were used to establish standardization as it is impossible to standardize the color of natural teeth. Researchers believe that a material's composition greatly influences its optical properties and color matching effects[5].

Maranhao et al. suggested that the composition of the composite restoration, type of pigmenting solution, and immersion time determine the color change. In this study, both resin materials were discolored, but the severity of discoloration also depended on the type of immersion media[6]. This finding is in accordance with those of **Gupta et al.** which suggested that the color match of esthetic restorations in the oral cavity is affected by dietary habits[2].

Resin materials that have lower filler content and higher resin content tend to absorb more water at the resin–filler interface, leading to hydrolytic degradation of the filler with poor color stability. Additionally, water sorption is mostly due to direct absorption in the resin matrix. Excessive water sorption causes plasticization and expansion of the resin, which leads to reduced hydrolysis of saline and longevity of the composite resin, which in turn creates micro-cracks. Moreover, the universal ability of Omnichroma to match with each color might be attributed to the high translucency, which aids in light reflection from the wall of the tooth, thereby enabling the tooth to mimic similar shades[7].

Moreover, in the present study, the color stability levels of the composites (Tetric N Ceram and Omnichroma) were measured after specimens had been submerged in carbonated drink and pediatric milk formula for 2 weeks. The restorative composites demonstrated significant differences in carbonated drink compared to pediatric milk formula. Tetric N Ceram showed better stain resistance in carbonated drink compared to Omnichroma, while Omnichroma and Tetric N Ceram showed similar results with pediatric milk formula. The possible explanation for the color changes is the small filler particles and acidic properties, which erode the surface texture and increase water sorption when teeth are exposed to the fluids, allowing for greater levels of restorative staining, affecting light transmission[8]. A study by **Mousavinasab**[9] showed higher translucency values for composites with high filler contents compared to materials with low filler contents, which also influences the blending effect[10].

Oral conditions and ageing influence the color stability of resin composites. As the impacts of aging were not assessed in the present study, future studies are recommended to assess the color stability of Omnichroma with ageing. In addition, the surface polish and finish of resin materials impacts their translucency, color stability, and aesthetic outcomes. Therefore, further studies investigating the influence of the surface finish, ageing, occlusal loads, and clinical conditions on Omnichroma are warranted.

VI. Conclusion

Omnichroma showed better color matching ability to acrylic teeth when compared with Tetric N Ceram. The color matching ability of the single-shade resin composite (Omnichroma) was influenced by the acrylic tooth color. Regarding the color stability, there is no significant effect of pediatric milk formula on the restorative materials when compared with carbonated drink. The color stability of the Omnichroma was dependent on the staining medium. Hence, it shows color change when immersed in carbonated drink.

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