Comparative evaluation of color stability of bulk fill and flowable composite restorative materials after immersion in different Indian spices - An in vitro study

M.I. Sheefaa[1], Balaji Ganesh S*[2], S. Jayalakshmi[3]

[1]Undergraduate student, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai- 77, India

[2,3]Reader, White lab-Material Research Centre, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai- 77, India

Corresponding Author: Dr. Balaji Ganesh S, Reader, White lab-Material Research Centre, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai- 77, India Email Id: balajiganeshs.sdc@saveetha.com

ABSTRACT:

Introduction: Mercury containing dental amalgam restorations are being replaced with dental composites as the restorative materials of choice mainly because of their color stability. An ideal esthetic restorative material should mimic the natural tooth in all terms such as in color and surface texture. Colour stability is a crucial property that assesses the success or failure of restorative treatment. The aim of our study is to analyse the colour stability of bulk fill and flowable composite restorative materials before and after immersion in Indian spices, such as turmeric and chilli powder. **Materials and Methods:** Two types of commercially available Bulk and flowable composite namely Pyrax and DTech were taken for the study. A total of 12 disc shaped samples, 6 from each type of the dimensions 10 mm and 2 mm in thickness were made. Required quantities of turmeric, chilli powder were weighed and taken in a beaker and made to dissolve in 100ml of distilled water. The specimens were immersed in glass beakers containing the turmeric solution and chilli solution separately for 24 hrs. Colour stability (delta E) values using spectrophotometer and analysed statistically using SPSS software version 23.0. **Results:** The mean delta E value for bulk composite resin restorative material was 23.82. The mean delta E value for flowable composite resin restorative material was 22.20. Flowable composite resin samples had better color stability when compared to bulk fill composite after immersion in chilli and turmeric spices. P value = 0.333(> 0.05), so it is statistically not significant. **Conclusion:** Flowable composite resin samples had superior color stability when compared to bulk fill composite after exposure to Indian spices such as turmeric and chilli powder.

KEYWORDS: Colour stability, Indian spices, Composite resin, Spectrophotometer, Innovative measurement

Introduction:

Mercury containing dental amalgam restorations are being replaced with dental composites as the restorative materials of choice mainly because of their color stability. Composites consists of mixture of two materials in which one of the materials is known as reinforcing material, variety of forms are available such as fibers, sheets, or particles, which have been embedded in the other materials called the matrix phase.(1) In recent era dental composite have been used in dental clinics, because dental amalgam restoration had several problems related to aesthetics and biocompatibility in the oral cavity.(2,3) Recent technological advancements are created within the field of dental aesthetics for augmenting and repairing broken teeth. Among the restorative materials, composite and glass ionomers cements are the foremost used.

An ideal esthetic restorative material should mimic the natural tooth in all terms such as in color and surface texture. Colour stability is a crucial property that assesses the success or failure of restorative treatment.(4) Bulk fill and flowable composite have good esthetic properties, such as good colour stability and colour matching. Dentists use light curable direct composite resin material to restore teeth. Bulk fill composite resins are used in thicker layers of composite filling materials, in increments of 4–5 mm.(4,5) Resin composite materials have the ability to mimic the natural colour as well as tooth shades.Flowable composite resins are widely used in clinical practice and are the most common resin materials that are recommended for restoring these lesions instead of conventional resin composites.(6) Flowable resin composites are low-viscosity materials with the reduced percentage of inorganic filler particles (44-55% in volume) and higher amount of resinous components. Consequently, the polymerization process leads to volumetric contraction, but with minimal stress contraction.(7) Turmeric contains numerous plant compounds and nutrients. The main active compounds in turmeric are the curcuminoids. They are responsible for turmeric's orange-yellow color and most of its health benefits. (8)They are especially used as a source of colouring matter for food industries and textiles. Chilli is an important spice crop and India is one of the leading producers and exporters of chilli in the world. Chilli is widely used around the world in food as a spice, both in fresh and dried form that adds flavor to the meal by creating a spicy and pungent taste.(9)

Color stability is a critical property for dental restorative materials, particularly in composites used for aesthetic purposes. It refers to the ability of a material to retain its original color and resist any alterations over time, despite exposure to various external factors such as food, beverages, and oral hygiene products. In dental composites, color stability is essential for maintaining the aesthetic integrity of restorations, especially in visible areas of the mouth.(10) Various factors, including the chemical composition of the composite, the type of resin matrix, and the presence of pigments, can influence how well a material resists discoloration. Immersion in certain substances, such as spices, can accelerate color changes due to the interaction between the composite and staining agents. Spices, commonly used in Indian cuisine, contain strong natural pigments that may seep into the porous structure of restorative materials, leading to noticeable changes in color. (11) Therefore, evaluating the color stability of composites, especially after exposure to such substances, is crucial for predicting the long-term performance of these materials in the oral cavity.(12)The aim of our study is to analyse the colour stability of bulk fill and flowable composite restorative materials before and after immersion in Indian spices, such as turmeric and chilli powder.

Materials and methods:

For the study we used two different composites of bulk fill and normal composite resin, the composite brand we used was Pyrax and DTech. The composites were purchased from a retailer dental store. For immersion, composite discs were made using a circular mould of standard diameter of 10mm and thickness of 2mm. As an immersion base we used two different spices such as turmeric and chilli powder. In total we had 12 composite disks samples, that is 6

flowable and 6 bulk fill composite, out of which 3 disks in each type of composite were immersed in chilli powder and remaining 3 disks were immersed in turmeric powder.

CALCULATION OF COLOUR STABILITY:

The colour stability values were identified before immersion and after immersion by using instrument Vita EasyShade Spectrophotometer. The colour stability was checked on 2 different sessions, Pre immersion, and 7 days after immersion. We have only collected the L, a, b values from the Vita EasyShade Spectrophotometer for the colour stability. The CIELAB colour space also referred to as L*a*b is a colour space defined by the International Commission on Illumination in 1976. L* for perceptual lightness, represents the lightness to darkness values ranging from 0 to 100. a* and b* for the four unique colours of the human vision, a* represents the greenness to redness with values of -127 to +128, b* represents the blueness to yellowness with values of -127 to +128. Delta e was calculated by using this formula :

$$\Delta E^*_{ab} = \sqrt{(L^*_2 - L^*_1)^2 + (a^*_2 - a^*_1)^2 + (b^*_2 - b^*_1)^2}$$

Then the delta E values of pre immersion and post immersion were compared and analysed by using SPSS version 2.0

Results:

In this study we have calculated the colour stability of two composite resin materials after immersion in different indian spices such as turmeric and chilli. The mean delta E value of Bulk fill composite in chilli was 28.05 and for Bulk fill composite in turmeric was 26.61. For Flowable/normal composite in chilli the mean delta E value was 17.79 and for Flowable/normal composite in turmeric the value was 18.93 (Table 1). The mean delta E value for bulk composite resin restorative material was 23.82. The mean delta E value for flowable composite resin restorative material was 22.20. Flowable composite resin samples had better color stability when compared to bulk fill composite after immersion in chilli and turmeric spices. Paired T test done. P value = 0.333(> 0.05), so it is statistically not significant. (Table 2)

Table 1: Delta E Values of different groups

Groups	Mean delta E values
Bulk fill composite in chilli	28.05
Bulk fill composite in turmeric	26.61
Flowable/normal composite in chilli	17.79
Flowable/normal composite in turmeric	18.93

Table 2: Mean. std. deviation and significance testing between groups

Groups	Mean	Std. Deviation	Std. Error Mean	Significance

Bulk fill	23.82968	12.855696	6.427848	0.333
Flowable	22.20078	5.977791	2.988895	

Discussion:

Composite restoration is considered as one of the most common and important dental procedures in the field of dentistry. This original study is basically on exploring a two variety of composite restorative materials.We have identified the Delta E value in order to compare the colour stability of the composite materials. Color stability of dental restorations is one of the most important characteristics of composite resin materials in terms of longevity. Although there have been several studies on the effect of different indian spices on the color stability of composites, there is little information regarding the color stability of a new bulk-fill composite, which has been introduced for applying in thicker layers.(13) Turmeric is a widely used spice in India due to its various therapeutic properties. The major constituent curcumin present gives it the required yellow colour.

The CIELAB color system was chosen for the color assessment in a current study. This system is a standard method for measuring color differences based on human perception. (14) The value presents relative color differences of dental materials or tooth surfaces before and after an intervention. Values of Pre immersion and post immersion were calculated and it is evident that both bulk as well as normal composite have the capacity to absorb colour when immersed in spices. In another study, the staining capacity of microhybrid and nanohybrid resin-based composites, to saffron extract, tandoori powder, and turmeric powder was analysed. Forty samples of microhybrid (Kulzer Charisma) and nanohybrid (3M Filtek Z350) resin composites were immersed into solutions of saffron extract, tandoori powder, and turmeric powder. Distilled water was used as the control group. They concluded that microhybrid and nanohybrid resin composites tend to stain to Indian food colorants, especially to turmeric powder.(15)

In another study the colour stability upon exposure to spices of a nano-filled and a micro-hybrid resin composite finished either with Sof-Lex™ discs (SLD) or against plastic strips (PS) was evaluated. Forty cylindrical specimens of 3 mm thickness were fabricated from Filtek Supreme XT ™ (FS) and Gradia Direct X™ (GD). Samples were immersed in staining solutions (0.1% weight turmeric, paprika and tamarind) and distilled water at 37 °C.

In other study , They found that all the spices tested have the potential to stain resin composites with turmeric causing the most significant discolouration.The reasons for the change in color of the composites tested in this study to various spices can be attributed to many variables: characteristics of the colorant, type of matrix in the resin, and filler content and type in the resin.(16,17) Both Turmeric and chilli produced higher color changes in the composite resin specimens. Flowable composite resin samples had greater color stability when compared to bulk fill composite because of lower delta E values. The limitations of our study is less sample size and only 2 composite resin materials we tested. Therefore in future research the need to compare the colour stability of different types and modified composites material on exposure to various other Indian spices.

Conclusion: Within the limitations of the study, it can be concluded that Indian spices such as turmeric and chilli powder have the capacity to stain both, bulk and normal flowable composites. In comparison, flowable composite resin samples had superior color stability when compared to bulk fill composite after exposure to Indian spices such as turmeric and chilli powder. Further study is required to correlate the other variables such as time, temperature, aging and pH, concentration of the staining solutions. Characterization of the staining elements in these spices and understanding the mechanism of discoloration are mandatory to ensure long-lasting esthetic restorations in the Indian context.

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