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THE EVALUATION OF THE EFFECT OF VARIOUS MOUTH RINSE ON THE DISCOLORATION OF DIFFERENT COMPOSITE RESINS

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ABSTRACT:

Aim: To determine the effect of various types of mouthrinse on the color stability of the composite resin materials.
Materials and Methods: 4 types of resin material were chosen and immersed in 4 different types of mouthrinses for 2 mins daily and then restored in artificial saliva for rest of the time for 3 months. The baseline color values and post immersion color values were evaluated using colorimetrics.
Results: All the resin material underwent discoloration. The lowest discoloration was seen during the usage of amflor mouthrinse. The lowest discoloration among the resin material was seen in nanofill resin material.
Conclusions: From this study we can conclude that mouth rinses with low pH are more detrimental. It's the filler material matrix that plays a key role on the color stability of the material.
Keywords: aesthetic dentistry, discoloration , mouthrinse.

INTRODUCTION

Patient's desire for esthetics has led to the increased use of tooth colored resins in dentistry. This demand of tooth-colored composite resin materials have evolved over the past decades and are widely used in dentistry. [1] Innovations in restorative dentistry for esthetics include micro fill, microhybird and nanofilled composite resin materials. [2]

Composites is considered superior , not only in terms of esthetics, but also functionally, economically, better durability, gloss retention and its of ease handling. [3]

These innovations have enabled clinicians to combine functionality and esthetics which has led to the introduction of "bulk fill" composites. Low and hybrid packable composites have replaced the amalgam in posteriors whereas the nano composites in the anteriors.

However, the shortcomings of these materials include discoloration, wear, leakage, and polymerization shrinkage.[4,5,] Composite resins are susceptible to various degrees of discoloration after prolonged exposure to the staining agents[6,7].

The clinical longevity of composite is affected by several intrinsic and extrinsic factors. Intrinsic factors include changes in filler, matrix or silane coating. Extrinsic factors such as adsorption or absorption of stains which may cause discoloration of esthetic materials.[8,9,10,11]

In addition to the personal desire to use oral hygiene aids, Media and social economics have increased the demands of the patient [12].Dentists

also recommend the use of antimicrobial mouth rinse daily.

Mouth rinses represent the simplest vehicle for chemo-prophylactic agents in order to maintain oral hygiene[13]. Inspite of all benefits, frequent use of mouth rinses have detrimental effects on oral and dental tissues. [14] Reports stated that the alcohol content in mouth rinses may soften the resin –composite restorations. But both alcohol-containing and alcohol free mouth rinses could affect the hardness of the restorative materials. As the hardness is related to material's strength and rigidity, it has great implication on the clinical durability and esthetics of restorations[15,16,8].

Intrinsic factors are initiated by UV irradiation or thermocycling with perceptible discoloration values. Material related factors such as initiators, inhibitor agents, polymerization systems , filler types, monomers and the conversion of carbon carbon double bonds of the composite resin materials seems to be co-factors.[9]The extrinsic effects of food components and beverages also produce perceptible discoloration and the increasing use of colored mouth rinses such as chlorhexidine , sodium fluoride and tea tree oil may also have a negative esthetic effect on composite resin materials.[10]

Initially color was measured only with colorimetric and photometric instruments only to eliminate the subjective aspect of color measurement. Evaluation of degree of discolouration can be measured using various techniques and instruments yet spectrophotometery is found to be the most accurate one. In assessing chromatic differences, the Commission Internationale del'eclairage (CIE L*, a*, b*) system was chosen for the present study. [18]

Though various studies has been carried out to find the discoloration of composite due to mouthrinses, but not comparing the various types of composite resin materials. The purpose of this study was to test the effect of different mouth rinse solutions on the color stability of the various types of composite resin materials.

MATERIALS AND METHOD

- The restorative materials used in this study included
  - Nanofill composite :filteksupreme XT;
  - Packable low-shrinkage composite: aelitels Packable;
  - Nanoceramic composite resin: Ceram-X
  - Microhybrid composite, Tetric Ceram
- Light cure (ivoclarvivadentbluephase N LED light cure unit)
- Artificial saliva (neutrasal)
- Rubber base putty consistency impression material (Dentsply Aquasil)
- 50 ml of Distilled water
- 50 ml of Four different types of mouth rinses –
  - Listerine (Johnson & johnson)
  - Amflor (indiamart)
  - Colgate plax (colgate)
  - Oral B (P&G)

Preparation of the composite samples

The experimental composites were prepared in disk shaped specimens from each restorative material, 10 mm in diameter and 2 mm thick. They were prepared using the putty consistency rubber base impression material (Dentsply Aquasil) mould. Composite resins were polymerized with a Ivoclar Vivadent Bluephase LED unit in standard mode (20 seconds) for two cycles with a light intensity of 400 mw/cm^2 from the upper and lower surfaces of the specimens through a glass slab for standardization of the distance.

After complete polymerization, finishing was done using 1200-gritsilicone carbide paper under running water. Hundred such disks were prepared for this study. The specimens were stored in saline to maintain its moisture content.

Measurement of baseline values

After immersion for 24 hours in distilled water, the samples were blotted dry and the baseline color values (L*, a*, b*) of each specimen were measured. A spectrophotometer was used to measure the colour change. Quality of the color was examined using the Commission Internationale de l'Eclairage(CIE Lab) system as tri-stimulus values. Measurements were repeated 3 times in each sample and mean values were calculated.

Immersion of the samples

Commercially available mouth rinses (Oral B Alcohol-free, Listerine, amflor, colgate plax) were chosen as experimental groups and distilled water as a control. Hundred specimens were prepared,

twenty five of each restorative material. And were divided into 4 groups (n=25) and then into 5 subgroups (n=5), randomly (**Table 1**) as follows:

Table 1: grouping of the resin materials.

Group A filteksupreme XT	**Group B** aelitels Packable	**Group C** ceram-X	**Group D** Tetric Ceram
A1 Distilled water	B1 Distilled water	C1 Distilled water	D1 Distilled water
A2 Oral B	B2 Oral B	C2 Oral B	D2 Oral B
A3 Listerene	B3 Listerene	C3 Listerene	D3 Listerene
A4 Amflor	B4 Amflor	C4 Amflor	D4 Amflor
A5 Colgate plax	B5 Colgate plax	C5 Colgate plax	D5 Colgate plax

Each subgroup was stored in 20 ml of one of the mouth rinses for 15 minutes daily and then in artificial saliva (neutrasal) for rest of the time. Specimens were kept at 37°C throughout the study, and solutions were shaken every 3 hours to provide homogeneity. At the end of the test period, the specimens were removed and washed under running water and stored in artificial saliva.

The pH of the test solutions are as follows:

- Listerine : 3.6
- Amflor : 5.7
- Colgate plax : 3.9
- Oral B : 5.2
- Distilled water : 6.8

Measurement of color change values

After the immersion, the color values of each specimen were re-measured after blotting dry method, and the color change value ΔE*ab was calculated according to the following formula:

$$\Delta E * ab = [(\Delta L *) 2 + (\Delta a *)2 + (\Delta b *)2]1/2$$

Where L* stands for lightness,

A* for green-red (−a=green; +a=red)

B* for blue-yellow (−b=blue; +b=yellow).

RESULTS

The specimens were immersed in the solution for 30 days. After the test period the specimen's color change value according to the CIELAB color coordinates are tabulated. The change in color was observed in all test groups except control group, and there was a statistically significant difference among the restorative materials and mouth rinses ($P<.05$)

The clinically acceptable threshold for color changes in dental materials is ΔE*ab ≤ 3.3, as found in earlier studies. [19]. The greatest color change i.e., ΔE*ab was 7.29 and hence the strongest absorption was seen in the composite disks immersed in Listerine mouth rinse, and the group C resin underwent the greatest change .i.e.. Ceram-X.

Table 2: ΔE*ab values for the different resin materials

	Distilled water	Listerine	Amflor	Colgate plax	Oral B
Filteksupreme XT	1.67	4.88	2.92	4.19	3.61
Aelitels Packable	1.95	6.67	3.97	5.37	4.07
Ceram-X	2.09	7.29	5.38	6.86	5.94
Tetric Ceram	1.84	5.82	3.56	5.01	4.13

Figure 1: Composite disks being made with a mould of putty consistency rubber base material

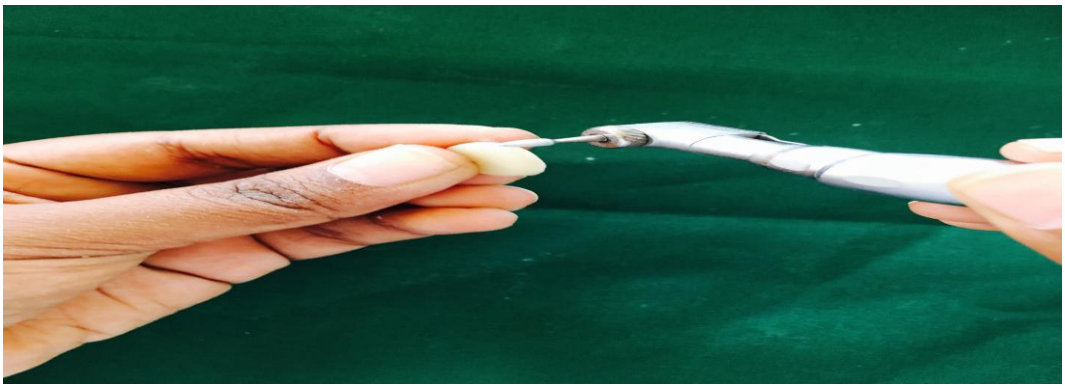

Figure 2: Finishing and polishing of the composite disk

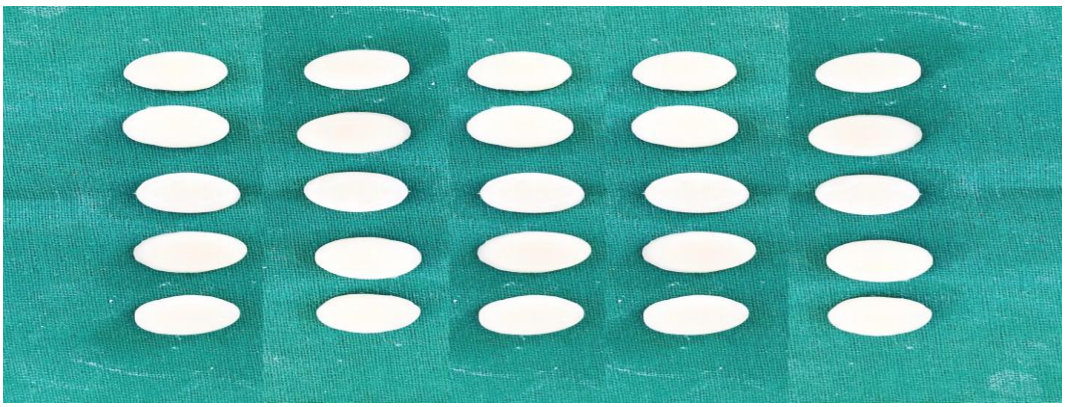

Figure 3: Composite disks finished and ready for immersion

Figure 4: Composite disks immersed in the chosen staining solutions

DISCUSSION

Patient's desire, as well as the increasing awareness through media, for esthetics has led to the increased use of tooth colored resins in dentistry. Though esthetics attracts the patients but the durability always set them in a confused state.

The clinical longevity of composite is affected by several factors such as fracturing of the restoration or discoloration. In the series of discoloring agents, after caffeine, mouth rinse also plays an inevitable role.

This study was aimed to evaluate the effect of four commercially available mouth rinses, using distilled water as a control, on the color stability of four resin materials, in-vitro, having different compositions of hybrid, micro-hybrid, and nano resin-based materials.

With the improving standards in quality of life, people prefer the usage of mouth rinse in day to day lifestyle and has become an essential aid for cleansing. In such a scenario it is necessary for us to know and inculcate others its detrimental effects on dental tissues.

People use mouth rinse twice a day, commonly. Therefore the immersion time of composite disks was chosen as 15 minutes daily as some of the mouth rinses also have the substantivity effect. To simulate the oral environment, it was immersed in artificial saliva for rest of the time. The color change was measured at the end of 30 days.

The change in color can be determined by two methods - Visually or by using Colorimeter and Spectrophotometer. Instruments are most widely used to measure discoloration, since visual methods are not that reliable. Monochromatic and photodiodes present in Spectrophotometers makes them more reliable as they measure the reflectance curve of the product's color every 10 nm or less, therefore it was used in this study.

The amount of color change at the end of the immersion period was denoted ΔE. The quality of color was measured by CIELAB coordinates. The clinically acceptable value for color changes in dental materials is assumed to be $\Delta E^*ab \leq 3.3$. [19]

The effect of staining solutions on color changes of composite resins may be material dependent, and the staining susceptibility of a restorative material may be attributed to its resin matrix or filler type.

Group A specimens were the least to undergo color change followed by Tetric Ceram then by packable followed by the nanoceramic. This result may be attributed due the particle size of the resin material. composites is majorly affected by the resin matrix formulation, the interlocking between the filler particles, and the interfacial interaction between filler particles and the resin matrix. [20,21]

In nanofilled composite resin the majority of TEGDMA (tri [ethylene glycol] dimethacrylate) has been replaced with UDMA and Bis-EMA (Bisphenol A polyethylene glycol diether dimethacrylate). Both of these resins have a higher molecular weight and fewer double bonds per unit, which improves the degree of cure of the polymer matrix and therfore, wear resistance . [22] The use of finer particles of filler results in decreased inter-particle spacing and reduced wear .[23] Good bond between the filler and matrix through the silane coupling agent and increasing the filler surface area by using finer particles of filler improved the wear of dental composites.

Ceram X is an ormocer-based, nanoceramic composite that contains glass fillers (1.1-1.5 µm). It uses methacrylate-modified silicon dioxide-containing nanofiller (10 nm) in place of the microfiller (agglomerates of silicon dioxide particles) typically used in hybrid composites, and also most of the conventional resin matrix is replaced by highly dispersed methacrylate-modified polysiloxane particles (2-3 nm). And also according to the manufacturer's information, these nanoceramic particles contain inorganic/organic hybrid particles, that have methacrylate groups available for polymerization [24,25]. Therefore these groups allow the penetration of the stains into their matrix.

Whereas as far as the mouth rinses are compared, the one with neutral pH undergoes least change in color. This was attributed to the pH of the solution it was immersed. Therefore it is also affected by temperature and the duration of immersion.

With respect to the color change, the amflor mouth rinse was least to impart color to the permeable composite resin. It can explained by the fact that the alcoholic content of the mouth rinse

makes it an acidic solution which in turn makes the resin components more plastic, by affecting the structural integrity of the resin. Therefore enlarging the micro pores present in the matrix and also the increase in the interfacial gap between the matrix and filler and particles. Acidic solutions are also known to erode the polished surface hence adsorption of the discolorants for more time. Thus the penetration of the colorants into the resin. [26].

Also the molecular interface plays an important role. Absorption of water leads to plasticization of the adhesive resulting in lower bond strengths. [27] The water sorption rate increases the rate of penetration of colorants into the resin. As the BisGMA present in the resin makes it hydrophilic, it increases the water sorption, which makes the resin matrix plastic hence more interfacial gaps between the filler particles and matrix therefore penetration of the colorants.

CONCLUSION

From this study, the following can be concluded:

- All types of mouth rinse cause a perceptible and undesirable color change of composite restorations that have a ΔE* > 3.3.
- All types of composite resin underwent a perceptible and undesirable color change that have a ΔE* > 3.3.
- The colour change was directly proportional to the time of exposure, material's surface, and filler particle size (composition).
- The colour change was indirectly proportional to the pH of the mouth rinse.
- Hence, the discoloration of composite restorations produced by mouth rinse is a multifactorial phenomenon.

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