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RESEARCH ARTICLE
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THE EFFECT OF PREHEATING OF COMPOSITE RESIN ON ITS COLOUR STABILITY WHEN IMMERSED IN TEA AND COCA COLA SOLUTION – AN IN VITRO STUDY.

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Abstract

Aim: Aim of this study was to evaluate the preheating effect of composite resin on its colour stability when immersed in tea and coca cola solutions.

Objective: To evaluate the preheating effect of composite resin on its colour stability when immersed in tea and coca cola solutions.

Materials And Methods: In this experimental study, 60 disks samples of a nano hybrid composite with a diameter of 5mm and thickness 2mm were prepared using plastic mould.

Specimens were divided into two groups. Group 1 of 30 specimens, composite was placed in refrigerator and placed in plastic moulds at room temperature. After condensing, celluloid strips were placed to achieve smooth, glossy surface. Samples were polymerized for 40 seconds.

In group 2 of 30 specimens , composite was placed in convection micro oven at temperature of 53 to 68^0C, the composite was immediately inserted in plastic mould to reduce heat dissipation and cured for 40 seconds.

All the samples were unmoulded and placed in 37^0C distilled water for 24 hours for complete polymerization. Samples were dried with moisture absorbing paper and colour stability was measured (t0). The samples of each group were randomly divided into 3 subgroups (n=10) and respectively immersed in distilled water, tea and coca cola.

Solutions were changed and samples were washed daily. After 30 days, colour stability of all the samples was measured using CIE-L*a*b* system.

RESULT. In the preheating group,the highest colour change was observed in tea followed by coca cola and least in water.

In the pre cooling group,the highest colour change was observed in tea followed by coca cola and least in water.

Preheating is more statistical significantly resistant to colour change as compared to pre cooling for all sub groups i.e. tea, coca cola and water

DISCUSSION: Preheating of composite resin rises its degree of polymerization leading to reduced absorption and penetration of the colorant solution causing higher resistance to discolouration.

CONCLUSION: The findings of the present study showed that preheating of the composite resin is effective in the reduction of its colour change.

Keywords – Composite resin, colour stability, preheating. Tea ,cocacola

INTRODUCTION

Esthetics is a very important in the field of cosmetic dentistry and to give the best possible esthetics, colour and staining plays a vital role in it. Composite resins are available in different colour and shades and thus they help in achieving a good esthetics in conservative and restorative dentistry. Since composite resins were introduced in the market, many improvements have been made towards increasing their longevity, colour stability as a restorative material in the oral cavity. Despite the fact that some improvements have been made, optical properties,colour stability still need to be improved.[1], [2] With rapid improvements in materials science, composite resins have performed a significant role in modern dentistry due to the increasing demands for esthetic restorations [3]. Over the last few years, there is massive improvement in the mechanical properties of composites, which includes reductions in polymerization shrinkage, which have encouraged clinicians to use resin composites in posterior restorations [4].

Unacceptable discoloration/ staining is a common problem encountered in tooth-coloured restorations and is a common reason for their replacement [5]. So,colour stability is the most important thing for the long term success of composite restorations. Colour stability is one of the important criteria for selection of composite during its placement or restoration. [6–8]. Color stability of the composite resin as a multifactorial phenomenon is the most effective factor in the successful clinical performance of direct tooth-colored restorative materials in dentistry [9,10], which gets affected by debonding of fillers or change in the nature resin matrix [11]. The discolouration of resin matrix is directly related to the degree of conversion (DC), physicochemical properties, and hydrophilic nature of the matrix [12,13].

Various studies Have been conducted on the effects of preheating of composite resins in improving its properties since its application in dental restorative materials since preheating leads to increase in molecular movement, increased degree of polymerization and resistance of the material to discolouration [14-19]. During preheating, the composite syringe is heated in the range of 39-68°C before use [20]. It was claimed that chair-side preheating increases the DC and crosslinking in the polymeric network by increasing the flow and reactivity of the active groups in the polymerization process and ultimately leads to improved mechanical properties [17,21]. The rise in the degree of polymerization can improve the resistance of the material to discoloration by the reduction in water absorption following drinking-colored beverages [22,23].

The preheating of the composite resin is important in maintaining the colour stability to fulfill the needs of esthetics. Alsothe role of preheating to ensure the chemical durability of the resin matrix[24] and the effect of chemical differences among the composite resins on the colour stability was the focus of researches.[25,26] In clinical practices, preheating of the resin composite before its application has become a popular technique because it improves marginal adaptation and microleakage, potentially improving flowability and material extrusion.[16] Prior to polymerization, increasing the temperature of the resin composite has showed increased surface hardness and maximize polymerization. [16,27]

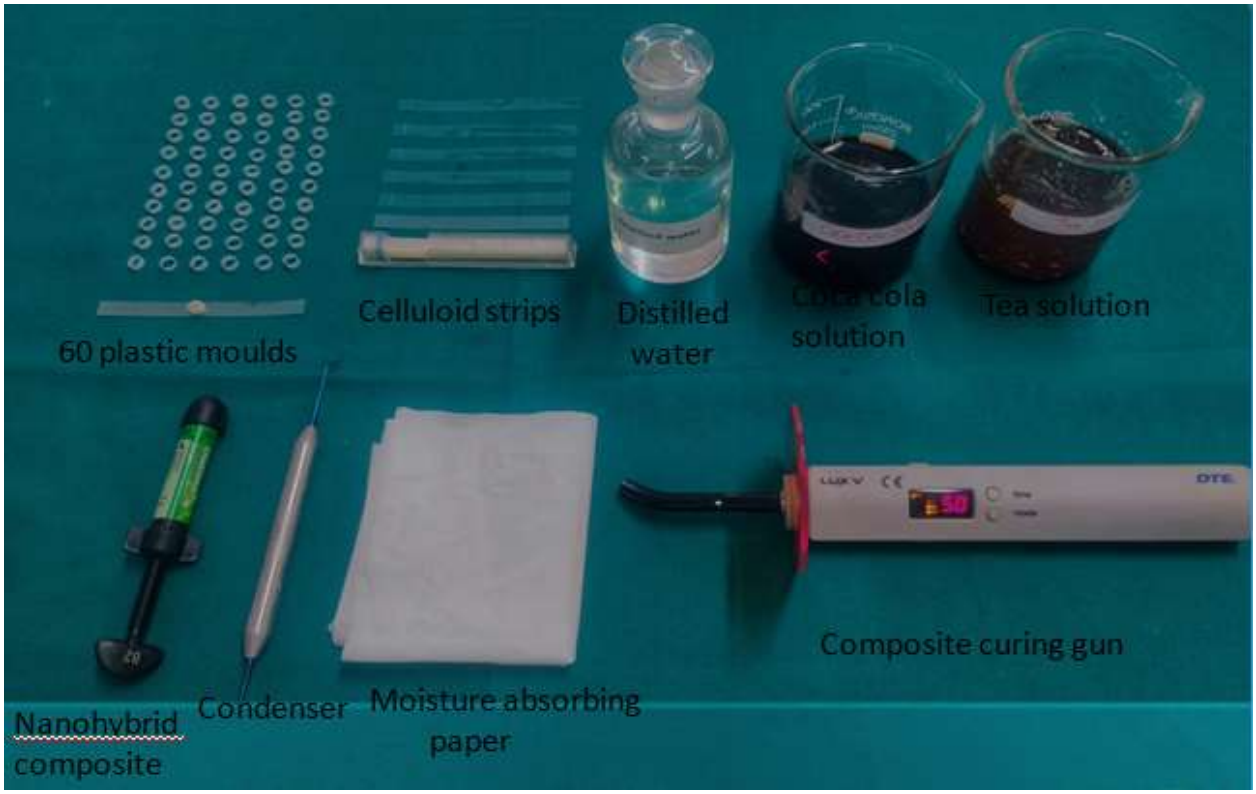
Despite some assumptions there are few studies which have been conducted on the effects of preheating on color stability of composite resins. Some studies reported the effects in the positive results of such a technique [28,29] and one study did not find any effects [22]. Therefore, the aim of this study is to evaluate the preheating effect of a nano hybrid composite resin on its color stability

when immersed in tea and coca cola solution. The null hypothesis tested in this study is that the preheating of composite resin had no effect on the colour stability of the material, irrespective of the coloring solutions.

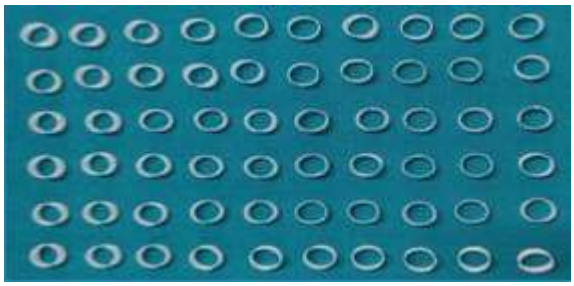
MATERIALS AND METHOD

In this experimental study, a nano hybrid composite resin (Kulzer Charisma Diamond Composite) was used for the study. The properties of this studied nanohybrid composite resin are described in (Table 1).

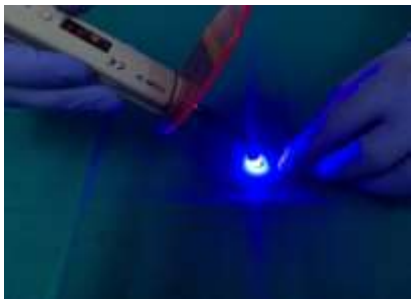
Material	Type	Resin	Filler content	Manufacturer
Kulzer Charisma Diamond Composite	Nano hybrid composite Packable	BIS-GMA, UDMA, TCD-Urethaneacrylate	64% filler by volume, 5 nm- 20 µm, highly discrete nanoparticles, Barium Aluminium Fluoride glass.	Kulzer, Germany.

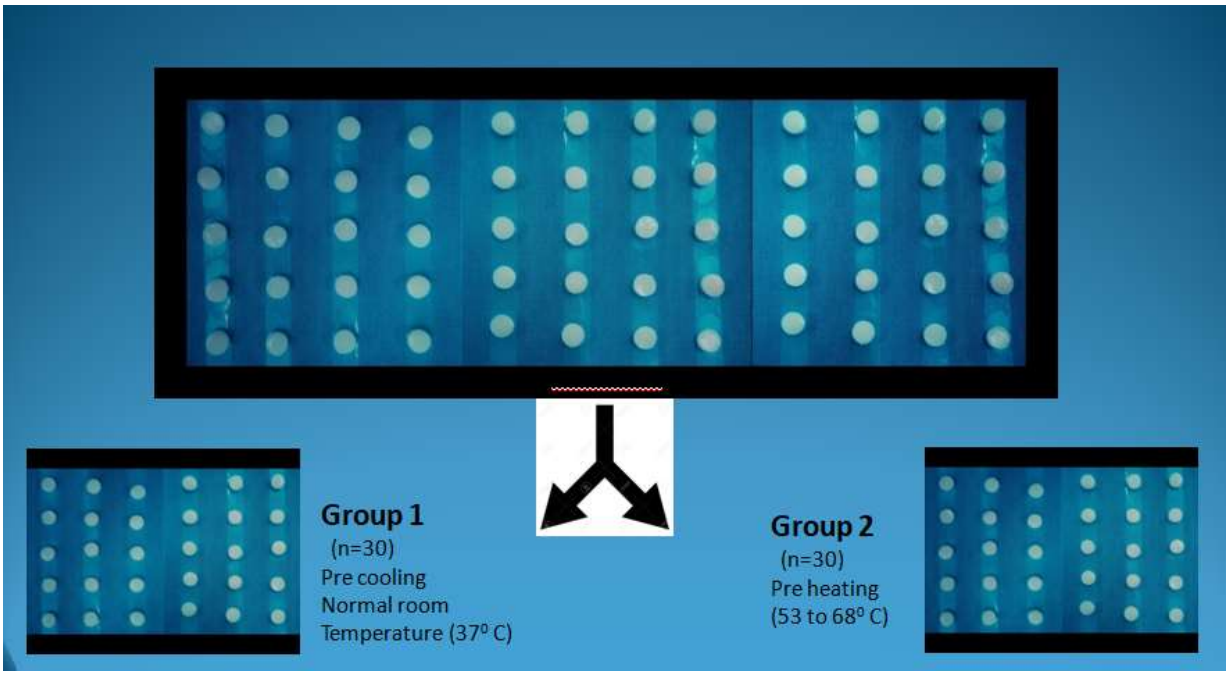


60 disk samples of nanohaybrid composite resin were prepared with a diameter of 5 mm and thickness of 2 mm using a plastic mold.



60 Plastic moulds

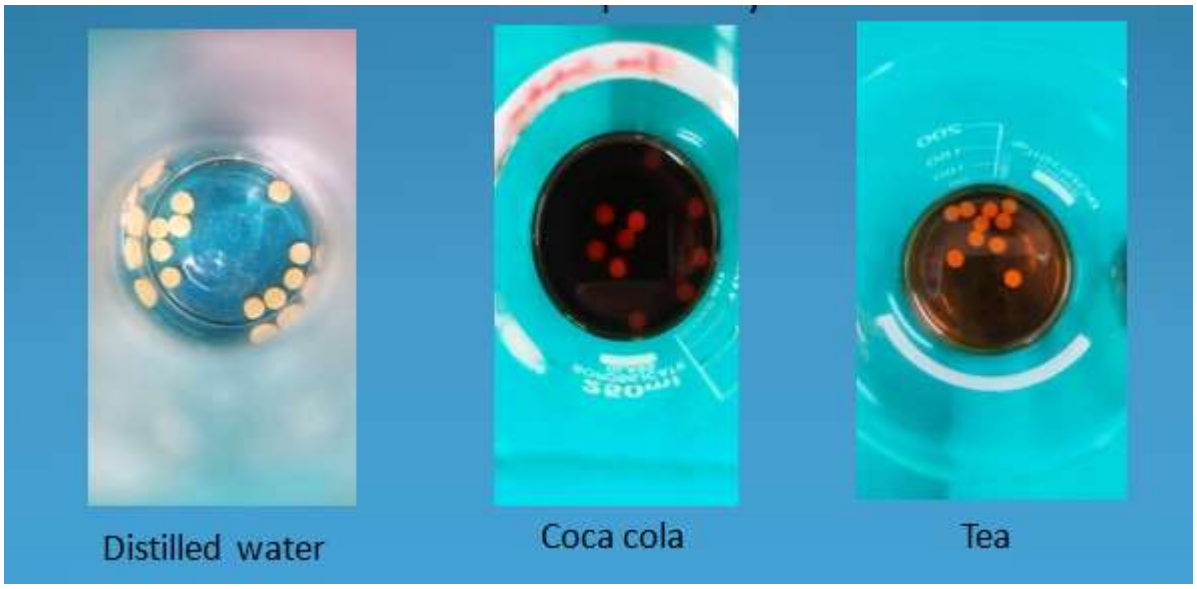




Specimens were then divided into 2 main groups according to the temperature of preparation (n=30).

Group 1 was prepared based on following instructions. The composite that was previously placed in refrigerator removed from it and placed at room temperature (25°C) for at least 10 minutes was placed inside a plastic mold. The samples were polymerized from both sides for 40 seconds using an LED light curing unit (ALPAR 3M ESPE) at 1100 mW/cm2.The room temperature was maintained at 25°C using a cooling equipment and regulated by a mercury thermometer.

To prepare group 2, Composite was placed in convection micro-oven at temperature of 53 to 680 C and the composite was immediately inserted in the plastic mold and then it was cured from both sides as that of group 1. To decrease heat distribution, the time between the removing of the composite resin from the oven and placing it in the mold was 10 seconds.



All samples were de moulded and placed at 37° C in distilled water for 24 h until the polymerization was completed. The upper surface of the composites was polished for 20 sec using aluminium oxide disks. Each disk was used for one sample. The colour assessment of the samples was performed using a VITA Easy shade spectrophotometer. The samples were previously dried with moisture absorbent paper and were placed against a flat white background and then their colors were measured (t0).

The samples of each group were again randomly subdivided into 3 groups (n=10). Samples of subgroup 1,2 and 3 were respectively immersed in tea, Coca cola and distilled water.
SAMPLE GROUPS

Material	Solutions	Room temperature (25^0C)	Pre heated (53 to 68^0C)
Kulzer Charisma Diamond Composite	Tea	1A	2A
	Coca cola	1B	2B
	water	1C	2C

The colouring solutions were daily changed and samples were washed and brushed for one minute in order to remove any debris. The mean time for drinking of a cup of tea/coca cola and the amount of drink have been reported about 15 minutes and 2-3 cups per day respectively [30]. Therefore, an exposure time of 30 days seems to simulate approximately 30 months of tea/coca cola consumption. At the end of 30 days period, All samples were placed against a flat white background and their colour was measured (t1).

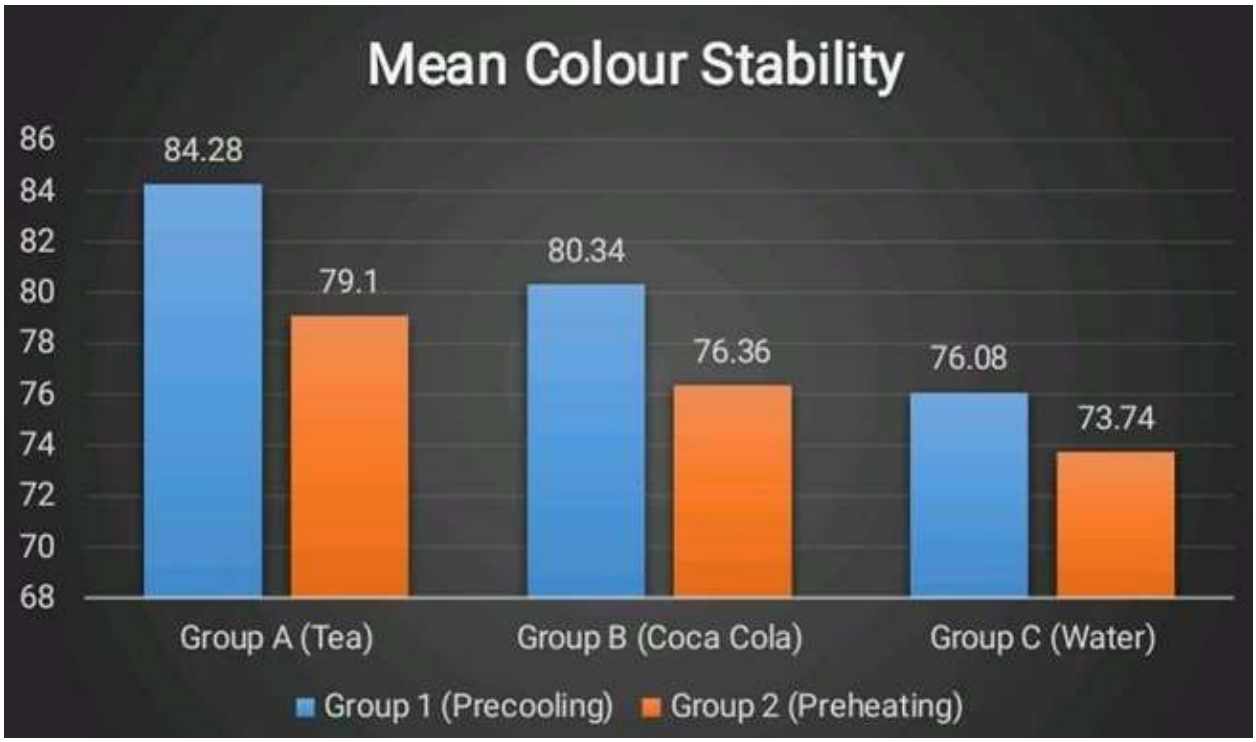
RESULTS

This experimental study was carried out on 60 samples of nanhybrid composite resin to evaluate the efficacy of preheating on its colour stability after immersion in tea andcoca cola solutions and distilled water as a control group.

The results of this study showed a statistically significant difference in the mean colour changes between the groups (p<0.0001). The highest and lowest color change were obtained for 1A (room temperature materials in Tea solution) and 1C (room temperature materials in distilled water) groups, respectively.

Colour Change-Precooling	Group 1 (Precooling) Mean (SD)	Group 2 (Preheating) Mean (SD)	Unpaired t test	P value, Significance
Group A (Tea)	**84.28 (1.31)**	**79.1 (1.32)**	**t = 8.8**	**p<0.001****
Group B (Coca Cola)	**80.34 (1.03)**	**76.36 (0.56)**	**t = 10.6**	**p<0.001****
Group C (Water)	**76.08(0.61)**	**73.74 (1.45)**	**t = 4.691**	**p<0.001****

Pre-heating is more statistical significantly (p<0.001) resistant to colour change as compared to pre-cooling for all subgroups (media) like tea, coca cola and water



DISCUSSION

The null hypothesis tested in this study is partially rejected as the preheated composite resin showed significantly lower discoloration when immersed in coca cola but this reduction was not that significant in tea solution.

Discoloration of composite resin material can be external and/or internal by adsorption and/or absorption of the colorant solutions. The resistance to staining of composite resin depends on many factors such as filler particles of the composite material, polymerization type and type of staining agent. Since instrumental measurements rule out the subjective interpretation of visual colour comparison, Spectrophotometers, colorimeters have been used to measure the colour changes in dental materials [34].

Preheating of the composites leads to reduction in absorption and penetration of the colorant solution via increase of polymerization. The preheating of composite resin rises its degree of polymerization and can cause higher resistance to discoloration. In our study, pre heating of composite resin caused higher resistance to discoloration of them in coca cola than in tea solution. Tea solutions have yellow pigments with different polarity [35].

The colour change of composite resin in the tea solution may be because of adsorption of polar colorants onto the surface of composite resin material, which causes more discoloration than coca cola. In this study, we observed colour change of the composite resin in the distilled water (controlled group). However, it was not statistically significant. It seems water sorption itself and departure of soluble material can be the cause of this discoloration. [35]

Coca cola was chosen as an experimental solution because it has been shown to have strong staining effect on composite resins as well as on natural tooth structures [36].

Um and Ruyter studied the staining effects of tea on resin-based veneering materials and they concluded that discoloration by tea occurred by surface adsorption and absorption of colorants, whereas the low PH of coca cola may affect the surface integrity of the material and soften the matrix, the lack of yellow colorant in coca cola may be the reason why it did not cause the discoloration similar to tea..[13]

Micali and Basting studied the effectiveness of composite resin polymerization using different light-curing units and they concluded that residual monomers in the polymeric chain can form colorimetric degradation products. [37]

Non-converted double carbon link in composite resin can lead to microcrack formation and making composite resin more susceptible to discoloration. Thus, microleakage accelerates the penetration of extrinsic stains into the composite restoration.

Thus, this study concludes that preheating of composite resin before its placement can lead to better colour stability by increasing marginal adaptation and degree of conversion which decrease number of free monomers, microleakage and non-converted double carbon link. But more clinical studies are needed to be done to evaluate colour stability of preheated composite resin due to various intraoral factors.

CONCLUSION

Within the limitations of the study, the findings of the present study showed that the technique of preheating of the composite resin is effective in improving the colour stability.

In the preheating group, the highest colour change was observed in tea followed by coca cola and least in water. In the pre cooling group, the highest colour change was observed in tea followed by coca cola and least in water.

Preheating is more statistical significantly resistant to colour change as compared to pre cooling for all sub groups i.e. tea, coca cola and water.

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