

Effects of Different Bleaching Regimens on the Flexural Strength of Hybrid Composite

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Abstract

Aim: To evaluate & compare the effect of different bleaching regimens on the flexural strength of hybrid composite resin.

Method: Sixty specimens of hybrid composite resin were fabricated and randomly divided into four groups each group comprising of 15 specimens. Group 1 was considered as control group and specimens were stored in distilled water for 24 Hrs. In-office bleaching agent (Whiteness HP Maxx) was applied in Group 2 or at Home bleaching agent (24% Carat) was applied in Group 3 and Both (in-office or home bleach) were used in combination Group 4. The flexural strength was evaluated by a Universal Testing Machine. All results obtained were analyzed by using SPSS software version 17 using ANOVA and Tukeys post hoc statistical test. After ascertaining normality by Shapiro-Wilk's test and homogeneity of variance between groups by Levene's test.

Results: A two-tailed ($\alpha=2$) $P<0.05$ was considered statistically significant. At home bleaching agent

(Carbamide peroxide) showed the highest flexural strength compared the combination group, control group and in-office bleaching agent (hydrogen peroxide).

Conclusion: Home bleaching agent group (carbamide peroxide) has highest flexural strength as compared to in-office bleaching agent (hydrogen peroxide). Carbamide peroxide was better than hydrogen peroxide in the present research.

Keywords: Flexural strength, Home bleaching, Hybrid composite resin, In-office bleaching.

Introduction

Colour is undoubtedly the most complex and least understood artistic element. It is an area in which numerous independent factors exist, all of which contribute to the final esthetic outcome of the restoration. Therefore, although complex, but a basic knowledge of the colour is imperative to produce the consistently esthetic restoration.¹ Colour is a vital determinant to be taken up last because it is often necessary to employ colour creating illusion of contour, when the latter may be difficult to achieve under

natural condition. Colour is something which make an object more appealing, attractive and give the pleasure of observation. With the age, the colour of teeth changes to more yellow or greyish yellow due to increase in dentin thickness and decrease in enamel thickness.²

Today, the modern civilised community is more focussed towards well contoured and well aligned white teeth which set the standard for beauty. With the increase in patient awareness of the ability to improve their smiles as presented on national television, patients have accepted and like the concept appearance of their teeth changed with esthetic dentistry, the more conservative technique of tooth whitening with vital bleaching has gained wider acceptance.³

Tooth whitening refers to any procedure that changes the shade and appearance of discoloured teeth without using restorative materials. Bleaching can be used as the treatment for this type of teeth which is discoloured due to any of the reasons like intrinsic or extrinsic stain.³ Intrinsic tooth discoloration is caused by incorporation of chromogenic material into dentin and enamel either during odontogenesis or after eruption whereas stains caused by coffee, tea, pigmented fruits, tobacco and many more factors give rise to extrinsic stains.⁴ Bleaching, especially at home bleaching interest dentists and patient alike because it is the most conservative ,non-invasive treatment modality currently available to the dental clinician to change the appearance of teeth. This technique can include a variety of concentrations of hydrogen and carbamide peroxide used as bleaching agents.³ During bleaching a critical point is attained when the discoloration goes off completely this point is called as saturation point. The point of saturation is the moment in which the maximum bleaching occurs, from that stage the

pigments are no longer bleached .This fact is of high clinical relevance because the indiscriminate use of high concentration of and prolonged times can cause undesirable damage to the tooth structure.⁵

Apart from tooth whitening the other modality for masking discoloration is direct resin based composite restorations .Although great improvement have been achieved during recent years, one of the major disadvantage of resin based materials is the tendency to discolour after a prolonged exposure to the oral cavity environment.^{6,7} The stability of bonded resin composite restoration to tooth structure plays an important role in determining the durability of these restoration materials and its success.⁸ Resin composites are widely used as restorative materials because of their excellent esthetic properties.^{9,10,11} Many studies have examined the reduced bond strengths of tooth coloured restoration after the bleaching procedure.^{11,12} There is paucity of studies investigating the effects of bleaching materials on bond strength and stability of pre-existing composite resin hence the results of this research would enlighten the clinicians and researchers about this topic.

Method

Sixty plastic mold block with standardized dimensions of $8.5 \times 5 \times 5 \text{ mm}^3$ were made using hybrid composite resin as per the manufacturer's instructions and ISO 4049 specifications. The specimens were stored in distilled water for 24 hrs. Afterwards, the specimens were polished on the four surfaces by using abrasive disks with medium, fine, and superfine roughness while rotating in one direction. The specimens were stored in distilled water till further use. The specimens were divided into four groups containing 15 specimens in each group.

Control group (Group 1): Immersed only in distilled water and no bleaching was performed.

In-office bleaching group (Group 2): Bleached by Whiteness HP Maxx IB bleaching agent for 20 min each 4 days.

Home bleaching group (Group 3) : Bleached by 24% Carat for 30 min per day for 4 days.

HIB group (Group 4) : Bleached by combination of group 2 and group 3 bleaching agent. 30 min per day for the HB agent and 20 min each 4 days for the IB agent.

The flexural strength of hybrid composite resin was measured by Universal Testing Machine(Figure 1).



Figure 1: Testing of flexural strength by Universal Testing Machine

Results

In the present study, the mean flexural strength of home bleach groups was found the highest followed by combined bleach group, control group and in office bleach showing the least (Home bleach group > combination group > control group > in office bleach group).

Comparing the mean flexural strength of four groups, ANOVA showed significantly different flexural strength among the groups ($F=21.90$, $P<0.001$)

Further, comparing the difference in mean flexural strength of control group with other groups, Tukey test

showed significantly different and higher flexural strength for both home bleach group (395.21 ± 12.95 vs. 490.78 ± 10.51 , mean diff= 95.57 , $q=7.55$, $p<0.001$) and least flexural strength in office bleach (395.21 ± 12.95 vs. 362.76 ± 11.59 , mean diff= 32.45 , $q=2.56$, $p>0.05$) results were found to be statistically

Discussion

In the present study, sixty blocks of hybrid composite with standardized dimension of $8.5 \times 5 \times 5 \text{ mm}^3$ were made as per the manufactures instructions and ISO 4049 specification. Hybrid composites resin was chosen for this study as it being the most demanding and commonly used esthetic restorative material with good physical properties. The increasing demand for attractive appearance and white teeth has led to the bleaching treatment being more and more frequently used and studied by professional.¹³

The samples were allocated in groups depending upon the expose of bleaching regimen on that group samples. The bleaching regimen was done and samples were evaluated for their flexural strength using three point bending test under universal testing machine. The three point bending flexural test used in the present study bears the advantage of ease of specimen fabrication and is more clinically realistic and recommended for the testing of flexural properties.¹⁴ The Flexural strength is known to be a mechanical property that can be related to clinical performance. Therefore the result of the flexural test enables some predication of the behaviour of the restorative material under the stress of functional and parafunctional biting forces.¹⁵

After the samples were subjected to universal testing machine test, the observations were laid down and were statistically analyzed. In the present study, the results showed that the carbamide peroxide used as home bleach group had highest flexural strength followed by

combination group, control group and least for in office group. The superior results shown by Carbamide peroxide in Home bleach Group can be explained as follows: According to Sun et al, Carbamide peroxide was broken down into hydrogen peroxide and urea. The urea further breakdown into ammonia and carbon dioxide, thus contributing to the maintenance of an alkaline pH, which potentiated the action of the bleaching agent.¹⁶

According to Price et al another contributing factor to the greater efficacy of carbamide peroxide relates to the relationship between pH and rate of reaction of the bleaching reaction. The higher the pH, the more free radicals are available for bleaching.¹⁷

In the present study, Group 4 (combination group) showed inferior flexural strength as compared to Group 3 (Home bleach) and superior than group 2 (in office bleach). This can be due to hydrogen peroxide(35%) has more concentration than carbamide peroxide (22%). According to Price et al, 35%hydrogen peroxide gel has a pH of 3.7 and 35% carbamide peroxide gel has pH of 6.5. ¹⁷ It could be optimal ionization occurs when hydrogen peroxide is buffered in the range of pH 9.5 to 10.8. In this range, the bleaching effects could be 50% better than when it is acidic.¹⁶

Group 2 showed least flexural strength among all the experimental groups. This can be explained due to the high concentration of hydrogen peroxide, morphological and chemical changes in substrate or the presence of residual oxygen in the inner dental tissues, which interferes with the polymerization reaction in adhesives system and composites resin by inhibiting the generation of free radicals.^{18,19}

According to Fatima et al, hydrogen peroxide act as an active oxidizing agents. It converts the carbon double bond compound which is usually yellow in colour, to

colourless hydroxyl group; or simply, a long yellow colour organic chain into a short colourless chain. The oxidizing reaction diffuses through the organic matrix of enamel because of its small molecular weight and may not only oxidize the chromogens but also cause destruction of enamel organic matrix and effects the morphology of enamel.²⁰

It was concluded from this study that At home bleach technique (Carbamide peroxide) is much better than In office bleach (Hydrogen peroxide) technique in terms of flexural strength tested for hybrid composite resin because of the Carbamide peroxide that less abraded the structure than hydrogen peroxide. It also released urea to maintain the alkaline pH during bleaching procedure.

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