ORIGINAL RESEARCH

Effect of Novel Herbal Products on the Bond Strength of Composite on Bleached Enamel

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ABSTRACT

Aim: To evaluate the effect of application of two newer antioxidants on the bond strength of composite resin to bleached enamel. **Materials and methods**: Eighty enamel surfaces were obtained from 40 human extracted premolars. Specimens were randomly divided into four groups (n=20). Group 1: no bleaching (control); Group 2A: Bleaching with 15% carbamide peroxide gel; Group 2B: Bleaching, followed by application of 2% Green tea extract; Group 2C: Bleaching, followed by application of 5% Proanthocyanidin agent. Surfaces were etched followed by application of total etch bonding system and composite resin cylinders were bonded. Specimens were tested for shear bond strength. **Statistical analysis used:** One way analysis of variance (ANOVA) was used for multiple group comparison and post hoc tukey's test for individual group wise comparison. **Results:** Significantly higher shear bond strength values were observed in Group 2B and Group 2C as compared with Group 1 and Group 2A ($p < 0.05$). Among the antioxidants, Group 2B showed significantly higher shear bond strength values than Group 2C ($p < 0.05$). **Conclusion:** It can be concluded that the use of antioxidant prior to bonding procedures on bleached enamel completely neutralizes the deleterious effects of bleaching and increases the bond strength significantly.

KEYWORDS: Antioxidants, Bleaching, composite, Green tea extract, Proanthocyanidin, shear bond strength.

INTRODUCTION

One of the most frequent reasons patients seek dental care is discolored anterior teeth. When teeth are discolored there is often a conscious effort to avoid smiling by covering up their teeth. Correction of this dental problems can produce dramatic changes in appearance, which often results in improved confidence, personality and social life. These improvements make conservative esthetic dentistry particularly gratifying for the dentist and represent a new dimension of dental treatment for patients. Treatment options for discolored teeth include removal of surface stains, bleaching, microabrasion, macroabrasion, veneering and placement of porcelain crowns. An increasing numbers of patients do not want their teeth "cut down" for crowns and are electing an alternative, conservative approach, such as veneers and bleaching which preserves as much of the natural tooth as possible.[1]

Tooth bleaching can be performed at home and in the dental office. Among bleaching agents, carbamide peroxide bleaching is a safe, well accepted and an increasingly popular procedure for the treatment of surface and intrinsic staining of teeth.[2] These bleaching agents despite having many advantages also have some disadvantages.[3] One of the most important complications of the use of bleaching agents is decreased composite resin bond strength to enamel immediately after bleaching procedure.[4] It has also been reported that the weakening of bond occurred both superficially and internally. This could be attributed to the presence of residual peroxide, which interferes with the resin tag formation and inhibits the resin polymerization.[2]

Studies have demonstrated that reduced bond strength can be reversed by the use of antioxidants such as sodium ascorbate, ascorbic acid, butylhydroxianisole, catalase, ethanol, acetone, glutathione peroxide, alpha-tocopherol, sodium bicarbonate, grape seed extract (proanthocyanidin) and green tea extract (*catechins* and *epigallocatechingallate)*.[5]

Since, there is a paucity of information available on the use of the newer antioxidant agents which increase the bond strength of composite resin to bleached enamel, this study was designed to evaluate the effect of application of 2% Green tea extract and 5% Proanthocyanidin agent on the bond strength of composite resin to bleached enamel.

MATERIALS AND METHODS

Forty intact human premolars extracted for orthodontic purpose were collected. All the teeth were thoroughly cleaned free of debris and calculus using scalers and were

How to cite this article:
Shashibhushan KK, Manoharan M , Poornima P, Reddy VVS. Effect of Novel Herbal Products on the Bond Strength of Composite on Bleached Enamel. Int J Dent Med Res 2015;1(5):20-23.

disc was used to remove roots at the level of cemento-enamel junction. Each crown was sectioned with carbide disc longitudinally to obtain non occlusal buccal and lingual enamel surface, and a total of eighty enamel specimens were obtained. All specimens were mounted in acrylic resin blocks such that only the enamel surfaces were exposed. Specimens were polished with 320 grit silicone carbide paper to prepare flat enamel surface for treatment and bonding.

The specimens were divided into following 4 groups. All the groups consisted of 20 specimens.

Group 1 (20) - No bleaching (control group).
Group 2A (20) - Bleaching with 15% carbamide peroxide only.
Group 2B (20) - Bleaching with 15% carbamide peroxide followed by application of 2% green tea extract.
Group 2C (20) – Bleaching with 15% carbamide peroxide followed by application of 5% Proanthocyanidin agent.

Bleaching procedure: Bleaching procedure was carried out on experimental group using 15% carbamide peroxide (opalescence PF, India) for 8 hours a day for 5 days according to manufacturer's instructions. Carbamide peroxide gel was applied using custom trays fabricated for each tooth specimen. After bleaching procedure, the specimens were thoroughly rinsed with an air water spray for 30 seconds and air dried.

Preparation of two antioxidant solutions: After bleaching procedure was completed two antioxidant materials namely 2% green tea extract (VISTA nutrition, MEDIZEN LABS, India) and 5% Proanthocyanidin solution (VISTA nutrition, MEDIZEN LABS, India) were prepared. 400 mg of green tea extract capsule in the form of powder was collected from the capsules and dissolved in 20 ml of distilled water to make 2% green tea solution. 5% Proanthocyanidin solution was prepared by dissolving 5g of grape seed extract in the form the capsules in 100ml of sterile water. Immediately after bleaching procedure 2% green tea extract was applied on group 2B specimen and 5% Proanthocyanidin agent was applied on the Group 2C specimens using a brush. After 10 minutes it was rinsed and dried.

Bonding procedure: After application of antioxidant solutions, acid etching procedure was carried out for all specimens according to manufacturer's instruction by using 35% phosphoric acid (3M ESPE scotch bond, U.S.A) for 15s, then specimens were washed and air dried.

A total adhesive (3M ESPE ADPER single bond 2, U.S.A) was applied to all specimens according to manufacturer's instruction. A plastic tube with internal diameter of 2mm and 2mm height was placed onto bonded specimens prior to curing the adhesive and then light cured for 30s. The plastic tube was filled with composite (3M ESPE FILTEK Z350 XT, U.S.A) and light cured for 40s, then tubes were removed.

Shear bond strength analysis: The shear bond strength assessment was done using Instron universal testing machine. The specimens were placed in the Instron universal testing machine such that the chisel model (fixture) of the machine would lie perpendicular to the composite cylinders. Force was then applied over the composite cylinders at a crosshead speed of 1mm/minute until the cylinders got detached from the enamel surface.

The amount of load needed to detach the composite cylinders was noted and the bond strength was calculated using the formula:

Bond strength = force in Kg needed to debond the composite cylinder x 9.8 / total surface area.

Statistical analysis: The results were tabulated and statistically analyzed using statistical product and service solutions (SPSS) version 17.0 software (SPSS Inc., Chicago, IL, USA). One way analysis of variance (ANOVA) for multiple group comparison and Post hoc tukey's test for individual group comparison were used. A P-value of 0.05 or less was considered for statistical significance.

RESULTS

Group 1 (no bleaching) showed significantly higher shear bond strength than Group 2A (Bleached, without antioxidant; 15.29±0.92 MPa). When compared to Group 1 (no bleaching), Group 2B (2% Green tea extract; 34.65±0.76MPa) and Group 2C (5% Proanthocyanidin; 30.97±0.57 MPa) showed significantly higher shear bond strength values. (Table 1, Graph 1).

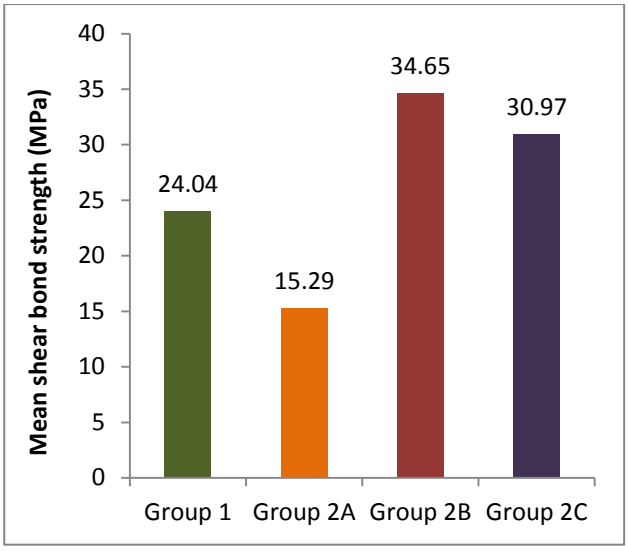
Among experimental groups, Group 2A (Bleached, without antioxidant) showed the lowest mean shear bond strength values compared to all other experimental Groups (P<0.05). Group 2B (2% Green tea extract) showed significantly higher shear bond strength (34.65±0.76 MPa) than Group 2A (Bleached, without antioxidant). When Group 2C and Group 2A were compared, Group 2C showed significantly higher shear bond strength values (30.97±0.57 MPa). Group 2B (2% Green tea extract) showed significantly higher shear bond strength than Group 2C (5% Proanthocyanidin) (Table 1).

Group	Shear bond strength (MPa)		
	Mean	Std. Deviation	Range
Group 1	24.04	0.55	23.78 - 24.29
Group 2A	15.29	0.92	14.86 - 15.72
Group 2B	34.65	0.76	34.29 - 35.00
Group 2C	30.97	0.57	30.70 - 31.23

TABLE: 1- Comparison between control Group and experimental Group

GroupWise comparison	
Groups compared	P value
1 v/s 2 A	0.001
1 v/s 2 B	0.001
1 v/s 2 C	0.001
2 A v/s 2 B	0.001
2 A v/s 2 C	0.001
2 B v/s 2 C	0.001

Unpaired t test, P < 0.05, HS



Graph 1: Comparison Between Control Group And Experimental Group

DISCUSSION

The mechanism of action of bleaching agents is based on a complex oxidation reaction, which releases oxygen free radicals that penetrate through the porosities of the enamel prism to the dentin, possibly due to the low molecular weight (about 30 g/mol) of these substances.[5] The Nightguard vital bleaching introduced by Haywood and Heymann in 1989 is simple, apparently safe, and comparatively inexpensive. Products currently available in the market for nightgaurd vital bleaching technique use 10% carbamide peroxide with a pH close to neutral. This solution being unstable, degrades into 3% hydrogen peroxide (active ingredient) and 7% urea on contact with tissue or saliva. Furthermore, hydrogen peroxide further degrades into oxygen and water, while urea degrades into ammonia and carbon dioxide, elevating the pH of the solution. The oxidizers remove some unattached organic matter from the tooth by diffusion without affecting the enamel matrix, leading to bleaching.[6,7] Although bleaching could be successfully attained in few cases, their color is not clinically acceptable with the color attained by the natural teeth in few others. These cases would require esthetic restorations, which mandate the use of a bonding technique. However, it is unknown whether immediate bonding of resin after bleaching procedures decreases the bond strength of some of these restorative materials.[8,9,10] This is likely to be caused by delayed release of oxygen that could interfere with resin infiltration into etched enamel or inhibit polymerization of resins that cure via free radical polymerization. If the oxygen-rich surface layer of enamel is removed, the composite to enamel bond strength returns to near normal.[11]

To reduce the clinical problems related to post bleaching compromised bond strength various techniques have been suggested. Barghi and Godwin treated bleached enamel with alcohol before restoration,[12] Cvitko and others proposed removal of the superficial layer of enamel,[11] and Sung and others suggested the use of adhesives containing organic solvents.[13] However, the general approach is to postpone any bonding procedure for a period after bleaching, because the reduction in bond strength has been shown to be temporary.[14] The waiting period for bonding procedures after bleaching has been reported to vary from 24 hours to 4 weeks.[15,16] The present study was an in vitro study conducted to evaluate the efficacy of two antioxidant agents viz. Green tea extract and Proanthocyanidin (grape seed extract) in reversing the compromised bonding to bleached enamel surface by measuring the shear bond strength at the resin-enamel interface.

The cardinal antioxidative ingredient in the green tea extract is green tea catechins (GTC), which comprise four major epicatechin derivatives; namely, epicatechin (EC 6.4%), epigallocatechin (EGC - 19%), epicatechin gallate (ECG-13.6%), and epigallocatechin gallate (EGCG – 59%). Studies have shown that green tea polyphenols exhibit some important properties like antioxidant, anticarcinogenic, anti-inflammatory, probiotic and antimicrobial activity.[17] In the literature for antioxidant activity the tea dose used is in the range of 0.6 –2 g of tea per 100 ml of water. The concentration used in this study was 2% green tea extract solution (2g of tea per 100 ml of water).

This study shows that treatment with 2 % green tea extract (Group 2B) increases bond strength significantly compared with Group 1, Group 2A, and Group 2C. This could be attributed to the Green tea polyphenols antioxidant potential and is directly related to its structure, from the hydroxyl groups which cause the binding and neutralization of free radicals.[17,18]

In this study other antioxidant used was Proanthocyanidin (PA) which was found in high concentrations from natural sources such as grape seed extract, cocoa beans, pine bark extract, cranberries and lemon tree bark. In the present study grape seed extract was selected as an antioxidant, because it yields a 10% higher concentration of PAs. Oligomeric proanthocyanidin complex (OPC) contains multiple electron donor sites (hydroxyl sites) that allow it to bind to unstable molecules called free radicals by donating its hydrogen atoms. It also recycles other antioxidants such as Vitamin C and glutathione by removing the free radicals.[19] Various studies have shown that the free radical scavenging ability and the antioxidant potential of OPCs are 50 times more than vitamin C and 20 times more than vitamin E.[19, 20]

In our study treatment with grape seed extract (Group 2C) has shown significant increase in bond strength compared to Group 1. This could be due to: the specificity of Oligomeric proanthocyanidin complexes (OPCs) for hydroxyl free radicals; the presence of multiple donor sites on OPCs that trap superoxide radicals and also because of the presence of gallic acid in OPCs, which increases the free radical scavenging ability by esterification of epicatechin.[21,22]

The present study showed that the shear bond strength of Group 1 (unbleached group) is significantly greater than

that of Group 2A (bleached group). This finding is in accordance with study performed by various other authors such as Titley KC et al,[23] Stokes AN et al[20] and Spyrides GM et al.[24] The present study indicated that the shear bond strength of the antioxidant group 2B is higher than all the other three groups. Also the shear bond strength of the bleached group (Group 2A) is significantly lower than all the other three groups. This implies that the use of antioxidants increases the bond strength to bleached enamel.

CONCLUSION

Within the limits of this study, the following conclusions were drawn:

- Bleaching of enamel reduced the shear bond strength.
- Application of antioxidants immediately after bleaching showed significantly increased bond strength.
- Amongst the antioxidants tested in this study, Green tea extract was the most effective antioxidant in reversing the bond strength hence it may be an innovative option for esthetic treatment after bleaching.

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Source of Support: Nil
Conflict of Interest: Nil