EFFECT OF HERBAL ANTIOXIDANT EXTRACT ON BONDING OF COMPOSITE RESIN TO BLEACHED ENAMEL – A PILOT STUDY

Shweta Jain [1], Mohan Gundappa [2], Anuradha Rani [3], Abhinay Agarwal [4]
Post Graduates Student [1], Professor & Head [2], Professor [3,4]
1-4 - Department of Conservative & Endodontics, Teerthanker Mahaveer Dental College and Research Centre, Moradabad

Abstract
Background: Application of bonding agent instant aneously following bleaching leads to reduction in bond strength of composite resin due to residual oxygen ions which interfere with the polymerization of resin. Use of different antioxidant agents which neutralize the residual oxygen ions may help in increasing the bond strength of the resin. Thus, this ex-vivo study was to commenced to assess the effectiveness of harmless herbal antioxidants such as strawberry and green tea on shear bond strength (SBS) of resin composite.
Materials & Method: Twenty-five maxillary and mandibular central and lateral incisors were selected and randomly allocated into subsequent five groups of five each: Group A (n=5): Bleached enamel + composite resin restoration; Group B (n=5): bleached enamel + 5% sodium ascorbate + composite restoration; Group C (n=5): bleached enamel + strawberry extract + composite restoration; Group D (n=5): bleached enamel + green tea extract + composite restoration and Group E (n=5): sound enamel + composite restoration. For bleaching, 35% hydrogen peroxide was used. SBS of the samples was evaluated under universal testing machine.
Results: The SBS values were found to be considerably greater in Group B and C (5% sodium ascorbate and strawberry extract respectively) compared to Group A(control). However, Group D (with green tea as an antioxidant) did not show any significant improvement in bond strength.
Conclusion: Herbal antioxidants like strawberry extract can be used as an adjunct to increase the SBS of composite resin to bleached enamel as it neutralizes the nascent produced during bleaching.
Keywords: Bonding agent, Resin composite, Bleaching, Antioxidant, Shear bond strength.

Introduction

A perfect smile helps gaining an individual a great amount of confidence and acceptance both personally and professionally. Esthetic dentistry has over the years gained popularity due to the increased demand of patients for that “Perfect white smile”. Studies have shown that more than one third of the populations are unhappy with their tooth color. [1] Tooth whitening or bleaching procedure has over the year gained popularity in the field of esthetic dentistry due to its role on improving the smile of an individual.

The dental professionals earlier in 1800, focused primarily on in-office bleaching on non-vital discolored teeth due to trauma or post endodontic restoration. In the late 1980s, new advances were presented like bleaching kits prescribed by dentist, tray bleaching (which can be applied by patient itself) and other bleaching kit products and procedures for vital tooth bleaching available for in-office and home bleaching use.

The agents used for bleaching decreases translucency of enamel; thus, less light would fall on dentin and less light from dentin would be reflected to the human eye. As a result, dentin color would pose less influence on the overall tooth color and the object would seem lighter.[2] Current techniques for bleaching non-vital or vital teeth employ oxidizing agents like peroxide releasing agents like hydrogen peroxide. Carbamide peroxide etc.[3] Carbamide peroxide and hydrogen peroxide function as oxidative agents by forming free radicals, oxygen reactive molecules, and hydrogen ions. These active molecules attack the pigments that are present in the teeth and remove them giving whitening effect to the tooth. [4,5,6] However, procedure of bleaching usually follows with pulp irritation, alterations in enamel structure like loss of prismatic enamel with increased porosity and an over - etched appearance, loss of calcium, decrease in micro hardness, micro leakage of restorations, and decrease in bond strength of composite to bleached enamel surface may be encountered. [7,8] Decrease in bond strength of composite to bleached enamel is one such complication usually seen clinically more when bonding is indicated instantaneously post the bleaching procedure due to interference in the polymerization process of resin composite caused by the residual oxygen released from the bleaching agent. [9] There are some techniques to improve the bond strength of resin composites following the bleaching process, like removal of the outer enamel surface and the application of adhesives containing organic solutions, alcohol or antioxidant agents on the bleached enamel surface. [10,11,12] In the past, studies have shown that use of antioxidants had positive effects on improving the SBS of bonded restoration to the bleached enamel by neutralizing the free radical reactions. [13] Vidhyaet al. and Lai et al first recommended that use of antioxidants like sodium ascorbate and proanthocyanidin increased the bond strength of composite resin [9,14,15] Lai et al. have presented that within 1hour following bleaching, bond strength of resin composite was increased after application of sodium hypochlorite or hydrogen peroxide. Turkun and Kaya studied the effect of sodium ascorbate by decreasing the time of application to 10 min, and established that application of sodium ascorbate for only 10 minutes was enough for increasing the reduced bond strength of resin composite. Therefore, restorative procedures are possible immediately after bleaching, with the use of antioxidants, which shortens the overall time needed for esthetic procedures. [7,9,14,15]

Another type of antioxidant is green tea extract whose antioxidant activity is related to flanavols.[17,18] Sharafeddin et al. showed that the application of green tea solution on the bleached enamel by hydrogen peroxide increased the SBS of resin composite.[19] Another natural antioxidant, proanthocyanidin, a carotenoid found in strawberry extract, is known to have free radical scavenging ability.[20] But the effect of strawberry extracts on bleached enamel has not been examined so far. Hence, this study was undertaken to evaluate and compare the effect of herbal anti-oxidants (strawberry and green tea extract) on the shear bond strength of composite to bleached enamel.

Materials & Method:

This study was conducted in the Department of Conservative dentistry & Endodontics at Teerthanker Mahaveer Dental College and Research Centre, Moradabad.

A) Preparation of antioxidant solutions

The solutions of 5%sodium ascorbate, 10% strawberry extract and 5%green tea extracts were prepared in the laboratory of Teerthankar Mahaveer College of Pharmacy. (Figure 1A, 1B&1C)

Figure 1A: Strawberry extract

Figure 1B: Green Tea Extract

Figure 1C:Sodium ascorbate

B) Preparation of the specimen

Twenty-five recently extracted intact maxillary or mandibular anteriors were collected and stored in distilled water. Using a low speed diamond disk under constant water coolant the crown portionswere separated from their roots. The labial surface of the crown segment was mounted on self - curing resin using a hexagonal steel mold. After mounting, the surface of enamel of each sample was polished using sandpaper of 220 grit size (Figure 2). The prepared samples were then randomly allocated into five groups with each group containing five samples each according to the bleaching regimen followed (Table 1).

Figure 2: Prepared enamel surface

Groups	Bleaching agent	Antioxidant used	Composite restoration
Group A (Control)	35% Hydrogen peroxide	None	Done immediately
Group B	35% Hydrogen peroxide	5% Sodium Ascorbate	Done immediately
Group C	35% Hydrogen peroxide	10% Strawberry extracts	Done immediately
Group D	35% Hydrogen peroxide	5% Green tea extracts	Done immediately
Group E (Negative)	None	None	Done immediately

Table 1: Random allocation into five groups

Bleaching Procedure: The enamel surface of each specimen was bleached with 35% Hydrogen Peroxide Bleaching gel (WHITENESS HP MAX) in order to stimulate the in-office bleaching procedure for 8 minutes according to the manufacturer's instructions (Figure 3). Samples were then rinsed for 30 seconds using distilled water and air-dried. This procedure was repeated one more time for a total of 2 cycles of bleaching.

Application of Antioxidant: Following bleaching procedure, 10 ml of 5% sodium ascorbate solutions was applied on the labial surface of Group B. Similarly, 10 ml of the 10%strawberry extract solution and 5% of green tea solutions was applied on the labial surface of Groups C and D, respectively. The solutions were applied for 8minutes after which they were rinsed off using distilled water and air dried.

Figure 3: Bleaching agent used

Composite Restoration: All the samples were etched using 37% phosphoric acid gel for 15 seconds rinsed with distilled water for 20seconds and air dried. Bonding agent Prime & Bond NT) was applied and bonded. After bonding agent, composite restoration measuring 2mm × 2 mm in dimensions was done using a circular mold on the enamel surface.

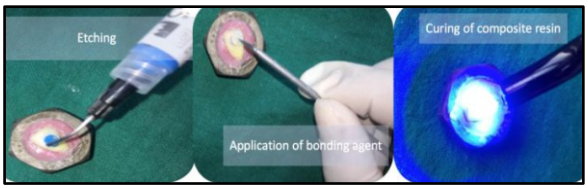


Figure 4: Composite Restoration

Figure 5: Restored tooth

c) Testing procedure

Each sample was tested in universal testing machine for shear bond strength by placing a chisel edged needle perpendicular to the long axis of the tooth at the interface of the composite restoration and the labial surface. The SBS was measured at a crosshead speed of 0.5 mm/min until fracture followed. The values obtained were statistically analyzed using one way ANOVA followed by post hoc Tukey test for comparison between the groups.

Results

The mean of shear bond strength values of the data obtained were as follows (Table 2) The mean of SBS values of different of groups were compared and it was observed that there was significant reduction in the shear bond strength in Group A following bleaching procedure compared to Group E(negative group) in which no bleaching was performed. The SBS was found to be increased following the use of strawberry extracts and sodium ascorbate as antioxidants in Group C and B, respectively.

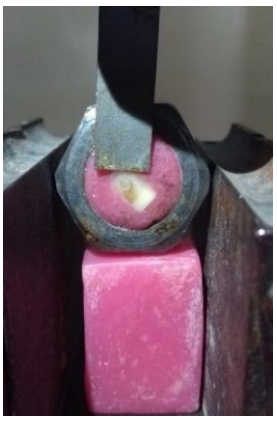
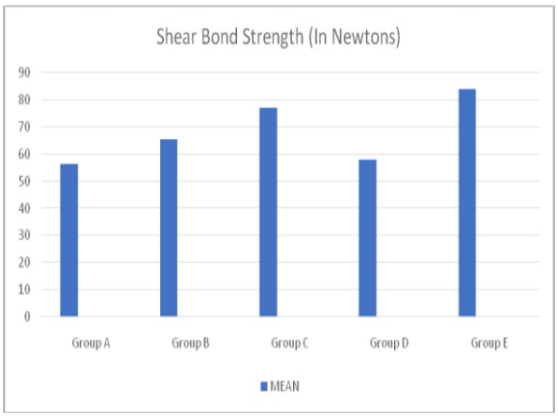


Figure 6: The samples under the SBS test in the universal testing machine

Group	Mean ± Standard deviation
Group A	(56.12 ±3.4) N
Group B	(65.4 ±4.72) N
Group C	(76.96±3.82) N
Group D	(57.76±4.41)N
Group E	(83.8±5.21) N

Table 2: Mean of shear bond strength

The values were significantly higher in group C in which strawberry extracts were compared to Group A and group D ($p<0.01$). No statistically significant difference was seen between Group A AND Group D. The graphical representation of the mean values of different groups has been depicted in graph 1 followed by representation of the statistical analysis in Table 3.



Graph 1: Mean SBS values of different groups

Source of Variation	Sum of Square	df	MS	F	P-value	F crit
Between Groups	2913.36	4	728.34	62.20	<0.01	2.867
Within Groups	234.17	20	11.70			

Table 3: Mean SBS values of different groups

Discussion

In the modern era, patients often may request of added esthetic procedures such as, re-restoration with composite, GIC or placing of laminate veneers following bleaching procedures to improve the visual outcome of the treatment. However, it may be difficult for the clinicians to accomplish adhesive restorations instantaneously following the bleaching procedure as indicated by various studies that have indicated decrease in bond strengths of adhesive restorations to tooth structures immediately after bleaching. Various studies have suggested that clinical importance of decrease in enamel bond strength after bleaching. The need for immediate bonding after bleaching may be required in patients with hectic schedules or lack of time.

The reduction in the SBS of a bleached tooth is credited to the release of residual peroxides ions which interfere with the resin tag formation by continuously altering the enamel structure thus, decreasing the adhesion of resin to the tooth, and consequently inhibiting the polymerization of resin monomers. In 1996, Rostein et al. reported that following bleaching there is loss of calcium, sulfate, phosphorus, and potassium occurs owing to pH of the bleaching agents which leads to changes in the structure of prismatic enamel. In 1999, Hedeges et al. reported that in addition to the reduction in mineral content of the bleached enamel, such losses lead to structural alterations in the enamel, reducing the bond strength of the composite resin to the tooth. [21] A similar result supporting this claim has been obtained in this study showing significant decrease in bond strength of Group A compared to Group E.

The present study was designed to evaluate the effect of antioxidant treatment after immediate bonding on the shear bond strength of composites bonded to bleached enamel. An antioxidant agent was tested to investigate as an alternative for immediate bonding after bleaching. Among all the agents used, the antioxidant treatment using strawberry extract has shown significant immediate improvement in bond strength of resin composite. Sodium ascorbate also showed improvement in bond strength which was used in the form of solution in the concentration of 5%. However, in our study application of green tea solution for 8minutes did not show any significant increase in the SBS of resin composite restoration to bleached enamel surface with 35% hydrogen peroxide.

Vidhya et al. assessed the neutralizing effect of 5% grape seed solution on the bond strength of enamel bleached with 38% hydrogen peroxide. They concluded that using this solution for 10 minutes could completely neutralize the effect of bleaching agents. [9] In the present study, 35% hydrogen peroxide and strawberry extract solutions were used for 8 minutes showing decreasing the application time from 10 to 8 minutes may also show significant improvement.

Arumugam et al. reported that application of 600, 800 and 1000 µmol of green tea solution for 10 and 20 minutes did not increase the SBS of composite resin to enamel bleached with 30% hydrogen peroxide. [18] In our study, similar results were obtained with 35% hydrogen peroxide and 5% green tea solution applied for 8 minutes. However, increasing the concentration or application time may could showed better results.

Another study showed that application of pomegranate peel extract, grape seed extract, green tea, and sodium ascorbate on enamel bleached with 40% hydrogen peroxide neutralized the effect of residual oxygen molecules on the bleached enamel surface, and increased the SBS of composite resin.[19]

The statistical analysis in our study revealed that antioxidant treatment of hydrogen peroxide-bleached enamel did affect the SBS of composite resin restoration.

Conclusion

Within the limitations of this pilot study following conclusions were drawn:

1. Treating bleached enamel surface with antioxidants results in significantly higher SBS with resin composite.
2. Strawberry extract followed by sodium ascorbate were effective as antioxidants. Green tea was found to be least effective.

References

1. Grifths CE, Bailey JR, Jarad FD, Youngson CC. An investigation into most effective method of treating stained teeth: An in vitro study. J Dent. 2008; 36: 54–62.
2. Ma X, Li R, Sa Y, Liang S, Sun L, Jiang T, et al. Separate contribution of enamel and dentine to overall tooth colour change in tooth bleaching. J Dent. 2011; 39: 739–45.
3. Chen HP, Chang CH, Liu JK, Chuang SF, Yang JY (2008) Effect of fluoride containing bleaching agents on enamel surface properties. Journal of Dentistry 36: 718-725.
4. Khoroushi M,Mazaheri H, Manoochehri A. Effect of CPP-ACP application on flexural strength of bleached enamel and dentin complex. Oper Dent. 2011; 36: 372–379.

5. Sharafeddin F, VarachehreMY. Evaluation of microleakage in composite restoration by using self-etch adhesive agents after using 35% carbamide peroxide bleaching gel. J Dent Isfahan Dent Scho. 2008; 4: 67–7
6. Dabas D, Patil AC, Uppin VM. Evaluation of the effect of concentration and duration of application of sodium ascorbate hydrogel on the bond strength of composite resin to bleached enamel. J Conserv Dent. 2011; 14: 356–360.
7. Turkun M, Kaya AD. Effect of 10% sodium ascorbate on the shear bond strength of composite resin to bleached bovine enamel. J Oral Rehabil2004;31:1184 - 91.
8. Attin T, Vollmer D, Wiegand A, Attin R, Betke H. Subsurface microhardness of enamel and dentin after different external bleaching procedures. Am J Dent 2005;18:8 –11
9. Vidhya S, Srinivasulu S, Sujatha M, Mahalaxmi S. Effect of grape seed extract on the bond strength of bleached enamel. Oper Dent. 2011; 36: 433–438.
10. Ismail T, Sestili P, Akhtar S. Pomegranate peel and fruit extracts: a review of potential anti-inflammatory and anti-infective effects. J Ethnopharmacol. 2012;143:397–405.
11. Kaya AD, Türkün M, Arici M. Reversal of compromised bonding in bleached enamel using antioxidant gel. Oper Dent. 2008; 33:441–447.
12. Bulut H, Kaya AD, Turkun M. Tensile bond strength of brackets after antioxidant treatment on bleached teeth. Eur J Orthod. 2005;27:466–471.
13. Sasaki RT Flório FM. Effect of 10% sodium ascorbate and 10% alpha-tocopherol in different formulations on the shear bond strength of enamel and dentin submitted to a home-use bleaching treatment. Oper Dent. 2009;34:746–752.
14. Carlos RG, Kand FA, Alessandra BB. The effects of antioxidant agents as neutralizers of bleaching agents on enamel bond strength. Braz J Oral Sci. 2006;5:971–6.
15. Gökçe B , Cömlekoğlu ME, Ozpinar B, Türkün M, Kaya AD. Effect of antioxidant treatment on bond strength of a luting resin to bleached enamel. J Deny. 2008;36:780–5.
16. Bornhoeft J, Castaneda D, Nemoseck T, et al. The protective effects of green tea polyphenols:lipid profile, inflammation, and antioxidant capacity in rats fed an atherogenic diet and dextran sodium sulfate. J Med Food. 2012;15:726–732. Van Nederkassel AM, Daszykowski M, Massart DL, et al. Prediction of total green tea antioxidant capacity from chromatograms by multivariate modeling. J Chromatogr A. 2005;1096:177–186.
17. Arumugam MT, Nesamani R, Kittappa K, et al. Effect of various antioxidants on the shear bond strength of composite resin to bleached enamel: An in vito study. J Conserv Dent. 2014;17:22–26
18. Sharafeddin F, Motamedi M, Modiri SH. Effect of Immediate Application of Pomegranate Peel, Grape Seed and Green Tea Extracts on Composite Shear Bond Strength of In-Office Bleached Enamel. Res J Biol Sci. 2013;8:83–87.
19. Fine AM Oligomeric Proanthocyanidin Complexes: History, Structure, and Phytopharmaceutical applications. Altern Med Rev. 2010;5:144–51.
20. Bittencourt ME, Trentin MS, Linden MS, de Oliveira Lima Arsati YB, França FM, Flório FM, et al. Influence of *in situ* post bleaching times on shear bond strength of resin based composite restoration. J Am Dent Assoc. 2010; 41:300–6.

Corresponding Author
Dr. Shweta Jain
PG Student
Department of Conservative & Endodontics
TMDCRC, Moradabad
Email: shwetajain@gmail.com

How to cite this article: Jain S, Gundappa M, Rani A, Agarwal A. Effect of Herbal Antioxidant Extract on Bonding of Composite Resin to Bleached Enamel –A Pilot Study.TMU J Dent 2017; 4(4):128-132.