Original Article

A comparative evaluation of different natural antioxidants treatment on the bond strength of composite resin to bleached enamel: an in-vitro study

Dr. Dipshi Ranjan [1], Dr. Sunil Kumar [2], Dr. Ajay Kumar Nagpal [3], Dr. Ishika Rastogi[4]

[1,2,3,4] Dr. B. R Ambedkar University, Agra

Email: dipshiranjan8@gmail.com [1], drskumar2009@gmail.com [2], drajayendodontist@gmail.com [3], ishikarastogi18@gmail.com [4]

DOI: 10.47750/pnr.2022.13.S01.182

Abstract

To compare and evaluate different natural antioxidants treatment on the bond strength of composite resin to bleached enamel: an in-vitro study.Eighty five maxillary incisors were taken. Divided in seven groups. Group 1(n=5)- negative control group, no bleaching, Group 2(n=5) bleaching with 37.5% hydrogen peroxide gel, Group 3 (n= 15)- bleaching, 10% sodium ascorbate, Group 4 (n=15)- bleaching, 10% green tea, Group5 (n= 15)- bleaching, 10% white tea, Group 6 (n=15)- bleaching, 10% proanthocynadin, Group 7 (n=15)- bleaching, 10% aloe vera. Groups were subdivided into three subgroups based on whether composite buildup was done immediately (Subgroup A), after delay of 1 week (Subgroup B) , after delay of 2 weeks (subgroup C). Shear bond strength of the specimens was tested under universal testing machine. Data were statistically analysed using One way analysis of variance and post hoc Tukey's test. Shear bond strength of negative control group was significantly higher (6.57+1.38). Immediate application of Group 6 (sub group A) proanthocyanidin (6.00+0.93) showed higher bond strength after bleaching ($P < 0.05$).It can be concluded that immediate application of antioxidants on bleached enamel before composite restoration reversed the bond strength of composite restoration. Proanthocyanidin proved superior.

Keywords: Antioxidants, Bleaching, Composite, Shear bond strength.

INTRODUCTION

The aetiology, appearance, localization, intensity, and adherence to dental structure of tooth discolouration vary. It can be categorised as intrinsic, extrinsic, or a hybrid of the two [1]. Tooth discolouration has received a great deal of attention due to the rising demand for "white smiles" [2]. Bleaching is regarded as a popular, conservative, and well-liked method for treating stained teeth. The lower bond strength of composite resin to enamel is a significant side effect of the bleaching operation. This could be as a result of oxygen ions, which prevent resin polymerization [3]. The oxidation-reduction events that lead to the release of oxygen free radicals provide the basis of the bleaching mechanism. Through the prisms and pores in enamel, these reactive radicals enter the tooth structure and travel to the dentin through chemical reactions that transform pigmented organic molecules with high molecular weight into less pigmented inorganic molecules with low molecular weight. [4] According to studies, waiting from 24 hours to three weeks before doing a restoration surgery can restore the bond strength that has been lost [6]-[7]-[8]. In light of this, several techniques have been proposed to prevent clinical issues due to weakened bond strength following bleaching, including:

• Alcohol pre-treatment for enamel that has been bleached.

• Making use of adhesives with organic solvents.

• The degraded bonding to bleached enamel surfaces can be reversed by using anti-oxidant chemicals prior to the bonding procedure.

Antioxidants are substances that can react with free radicals at various stages of their formation and can so neutralise them [9]. By neutralising the effect of the remaining oxygen layer and allowing free radical polymerization of resin components, sodium

ascorbate restores the damaged bonding [11]. Flavanols, commonly referred to as catechins, are found in green tea and have been demonstrated to be more potent antioxidants than vitamins C and E [12]. Proanthocyanidins are widely used as natural antioxidants and free-radical scavengers, and it has been demonstrated that they are safe for use in a variety of medicinal applications [13]. - [14] Aloe vera contains compounds known as polyphenols. The large class of substances known as polyphenols has several phenolic hydroxyl groups attached to ring structures, which enable its antioxidant activity.White tea, has antioxidant properties because of the presence of theaflavins, thearubigins, gallic acid and polyphenols.

MATERIALS AND METHOD

The study protocol was approved by the ethics committee of KD Dental College and Hospital, Mathura. Sample size was calculated to be 15 in each group. Eighty Five extracted maxillary incisors, with no any previous restorative or endodontic treatment, fractured teeth, attrition, abrasion, erosion and developmental defects were taken. After collection, the teeth were immersed in 0.1% thymol solution for disinfection. Soft tissue residues, debris, and calculus were removed. The teeth were then mounted in auto-polymerizing acrylic resin blocks(DPI cold cure) with 2 mm diameter up to cementoenamel junction **(Figure 1)**. The samples were divided into seven groups, of which 10 teeth served as control group. The remaining 80 specimens were bleached with 37.5% hydrogen peroxide (SDI Pola office plus, Australia) for 30 min according to the manufacturer's instructions. The bleach was rinsed off with water. Then, the specimens were divided into five groups of 15 teeth each, depending on the type of antioxidant used.

Group 1 (negative control): No bleaching

Group 2 (positive control): Bleaching only, no antioxidants

Group 3: Bleaching followed by treatment with 10% SA for 10 min.

Group 4: Bleaching followed by treatment with 10% green tea for 10 min

Group 5: Bleaching followed by treatment with 10% white tea for 10 min.

Group 6: Bleaching followed by treatment with 10% proanthocynadin for 10 min.

Group 7: Bleaching followed by treatment with 10% aloe vera for 10 min.

Fig 1

PREPARATION OF THE ANTIOXIDANT SOLUTION

- Ten grams of sodium ascorbate (Molychem, Mumbai, India), green tea (Best source nutrition,india), white tea(TGL Co.bai mudan, India),proanthocynadin (Best Source Nutrition, India) and aloe vera (Bixa Botanical,India) powder was dissolved in 100 ml of distilled water to obtain 10% sodium ascorbate, green tea, white tea, proanthocynadin, aloe vera. It was filtered using Whatman filter paper no. 1 and obtained solution (50%) was used.

The Groups 3–7 were further subdivided into subgroup based on the application period before composite buildup.

- **Subgroup A: Immediate (*n* = 5)**
- **Subgroup B: Delay of 7 days (*n* = 5)**
- **Subgroup C: Delay of 2 weeks (*n* = 5)**

The samples were etched with 37% phosphoric acid (3M ESPE Scotchbond ™ multipurpose etchant) for 15 s, rinsed with water for 20 s, and bonded, followed by composite (3M ESPE, Filtek ™ Z350XT) buildup **(Figure 2**). All the samples were placed in an incubator (Teknik universal incubator model-JEQ-4) at 37°C till testing procedure. To measure the SBS, the teeth were placed in a universal testing machine (Instron, USA). The load was applied to the bonding interface at a crosshead speed of 0.5 mm/min until debonding **(Figure 3)**. The bond strength of all groups was recorded in Newton (N) and converted into megapascal (MPa) using formula shear bond strength (Mpa) = F (N)/πr^2. The data were statistically analyzed using computer SPSS version 22. One-way analysis of variance was used for multiple group comparison and post hoc Tukey's test for individual group-wise comparison $P \leq 0.05$ was considered statistical significance.

Fig 2 Fig 3

RESULTS

Table 1 shows the mean SBS of composite restoration after immediate placement Group 1 yielded highest bond strength(6.57±1.38 MPa)and showed significant difference with other groups while Group 2(1.64±0.41 MPa) yielded lowest bond strength.Table 2 and Table 3 presents comparison of Bond strength among different antioxidants after a delay of 7day and 2 weeks respectively . Group 6 (5.69±1.42 Mpa) (4.14±0.92) showed the highest bond strength and showed significant difference with Group 5 and Group 7, Group 3 and Group 4 showed non significant difference between them respectively.

Table 1 Comparison of Bond strength among different antioxidants after immediate placement.

Group	Antioxidant	N	Mean	Std. Deviation	Std. Error	F value	P Value
1	Negative control	5	6.57	1.38	0.62	17.15	0.001
2	Positive control	5	1.64	0.41	0.18		
3	Green tea	5	5.74	0.73	0.33		
4	White tea	5	5.82	0.73	0.33		
5	Sodium ascorbate	5	3.33	0.62	0.28		
6	Proanthocynadin	5	6.00	0.93	0.42		
7	Aloevera	5	4.61	1.33	0.59		

Table 2 Comparison of Bond strength among different antioxidants after 7th day.

Group	Antioxidants	N	Mean	Std. Dev	Std. Error	F value	P value
3	Green tea	5	4.92	0.77	0.35	5.04	0.006*
4	White tea	5	5.00	0.77	0.35		
5	Sodium ascorbate	5	2.86	0.15	0.07		
6	Proanthocynadin	5	5.69	1.42	0.63		
7	Aloevera	5	4.03	1.64	0.73		

Table 3 Comparison of Bond strength among different antioxidants after 2 weeks.

Group	Antioxidants	N	Mean	Std. Dev	Std. Error	F value	P value
3	Green tea	5	3.53	.96	.42	4.30	0.011*
4	White tea	5	3.65	.97	.43		
5	Sodium ascorbate	5	2.41	.23	.10		
6	Proanthocynadin	5	4.14	.92	.41		
7	Aloevera	5	2.74	.31	.14		

DISCUSSION

Direct composite restorations and teeth whitening techniques are frequently used together to produce aesthetic clinical results. The bond strength of composite to acid-etched enamel is negatively impacted by 10 percent to 35 percent carbamide or hydrogen peroxide immediately following bleaching, according to a study by Arumugam et al. [16]. In this investigation, HP gel containing 37.5 percent hydrogen peroxide (Pola Office Plus, SDI) was applied twice for 20 minutes each. The gel needs to be renewed because hydrogen peroxide quickly degrades and a major amount of the active components are only present for the first 15-20 minutes. Two treatments of 20 minutes each were utilised for bleaching in order to maintain the same level of bleaching achieved in the first 15 minutes. By returning one of the free radicals' electrons, antioxidants neutralise them, putting an end to the electron-stolen reaction, and altering the bleached surface's redox capacity [17]. In recent years, it has been observed that natural antioxidants, such as plant extracts, can serve as a viable alternative to chemical and synthetic antioxidants. In order to restore the damaged binding strength of composite resin to bleached enamel, focus was placed in this study on the use of green tea, white tea, sodium ascorbate, proanthocynadin, and aloe vera extract as antioxidants immediately, 7 days, and 14 days after the bleaching operation. All five of these antioxidants were able to reverse the decreased SBS that resulted from bleaching. Group 1 (Negative Control) in the current investigation displayed the strongest bond strength following the initial installation of composite restoration. This might be because there aren't any free radicals or leftover oxygen on the enamel surface when it's not treated, which happens throughout the bleaching procedure. Therefore, polymerization is unaffected. This was in accordance with other studies carried out by Dabas D et al [18] and Kimyai S et al [18]. As opposed to what was found in our analysis, Manimaran et al. [19] found that applying antioxidants improved the binding strength of root enamel and dentin when compared to the untreated surface. When compared to the other Groups, Group 2 had the lowest bond strength. This could be because of the residual oxygen layer that was left behind after the bleaching procedure, which might have hampered resin entry into etched enamel and prevented resin from polymerizing. According to studies conducted by Schwertner et al. and Kimyai et al. [18], this was the case. The fact that Groups 3 and 4 were non-significant when compared after 7 and 14 days, but had less SBS than Group 6 and higher bond strength than Groups 5 and 7, may be explained by the discovery that green tea catechins have powerful antioxidant activity that is many times greater than that of SA and aloe vera [20]. Because SA has an unsuitable pH of about 1.8 for clinical usage, group 5 demonstrated the lowest bond strength among the other antioxidant groups, which is important. Garcia et al. [20] assessed the amount of antioxidant activity in other compounds and 10% SA. Contrary to the study, they discovered that SA, both as a solution and a gel, had the highest antioxidant activity. According to

Berger et al. [20], the bond strength values were statistically higher when GT was applied after enamel bleaching for 60 minutes. Group 6 demonstrated the highest shear bond strength when compared to Groups 3, 4, 5, and 7. This result may be explained by the following factors: High molecular weight polymers called proanthocyanidins are made up of the monomeric flavan-3-ols catechin and epicatechin. In accordance with the study, Vidhya et al [21] evaluated the neutralising effect of 5% grape seed solution on the bond strength of enamel bleached with 38% hydrogen peroxide. They came to the conclusion that using this solution for 10 minutes could completely neutralise the effect of bleaching agents. However, a statistically significant difference was found in this study between the groups that applied immediately and those that waited for 7 days, as well as for 14 days between the groups that applied immediately and those that waited. It is consistent with the research conducted by Nair et al. This demonstrates that there was no clinical importance to the restoration being delayed after the antioxidant administration at 7 and 2 weeks.

CONCLUSION

Shear bond decreases severely after bleaching if antioxidant was not used as shown in Group 2.Shear bond strength was maximum in Proanthocynadin Group. Antioxidants should be used immediately following the bleaching procedure to reverse the compromised bond strength of composite resin to bleached enamel without waiting for a period of 7 days to 21 days.

REFERENCES

1. Hattab FN, Qudeimat MA, al-Rimawi HS. Dental discoloration; an overview. J Esthet Dent, vol.11, pp. 291-310, 1999.
2. Mortazavi V, Fathi MH, Ataei E, Khodaeian N. The effect of 15% carbamide peroxide bleaching on the shear bond strength of composite to enamel. Shiraz Univ Dent J, vol. 9, pp 24-30, 2009.
3. Sasaki RT, Florio FM, Basting RT. 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, vol. 34, pp. 746-752, 2009.
4. Joiner A. Tooth colour: a review of the literature. J Dent., vol, 32, pp. 3-12, 2004.
5. Suneetha R, Pavithra S, Thomas J, Nanga GSP, Shiromany A, Shivrayan A. An In Vitro Comparative Study of Shear Bond Strength of Composite Resin to Bleached Enamel using Synthetic and Herbal Antioxidants. J Int Oral Health, vol. 6, pp. 77-81, 2014.
6. Borges A, Rodrigues JR, Borgues AL, Marsilio AL. The influence of bleaching agents on enamel bond strength of a composite resin according to the storage time. Rev Odontal UNESP, vol. 36, pp. 77-83, 2007.
7. Stokes AN, Hood JA, Dhariwal D, Patel K. Effect of peroxide bleaches on resin-enamel bonds. Quintessence Int, vol. 23, pp. 769-771, 1992.
8. Sung EC, Chan SM, Mito R, Caputo AA. Effect of carbamide peroxide bleaching on the shear bond strength of composite to dental bonding agent enhanced enamel. J Prosthet Dent, vol. 82, pp. 595-599, 1999.
9. Sharafeddin F, Farshad F. The effect of aloe vera, pomegranate peel, grape seed extract, green tea and sodium ascorbate as antioxidants on the shear bond strength of composite resin to home-bleached enamel. Dent Shiraz Univ Med Sci, vol.16, pp. 296-301, 2015.
10. Nair R, Bandhe S, Ganorkar OK, Saha S, Sial S, Nair A. A comparative evaluation of the three different antioxidant treatments on the bond strength of composite resin to bleached enamel: An in vitro study. J Conserv Dent., vol. 22, pp 82- 86, 2019.
11. Subramonian R, Mathai V, Christaine Angelo JB, Ravi J. Effect of three different antioxidants on the shear bond strength of composite resin to bleached enamel: An in vitro study. J Conserv Dent, vol. 18, pp. 144-148, 2015.
12. Bansal M, Kaur P, Cyriac AR, Kadian N, Jaiswal P, Rathee K. Impact of Different Antioxidants on the Bond Strength of Resin-Based Composite on Bleached Enamel—An In Vitro Study. J Contemp Dent Pract, vol. 20, pp. 64-70, 2019.
13. Fujii H, Sun B, Nishioka H, Hirose A, Aruoma OI. Evaluation of the safety and toxicity of the oligomerized polyphenol oligonol. Food Chem. Toxicol, vol. 45, pp. 378–387, 2007.
14. Yamakoshi J, Saito M, Kataoka S, Kikuchi M. Safety evaluation of proanthocyanidin-rich extract from grape seeds. Food Chem. Toxicol, vol. 40, pp. 599–607, 2002.
15. Vidic, D, Taric E., Alagic J, Maksimovic M. Determination of total phenolic content and antioxidant activity of ethanol extracts from Aloe spp. Glas. hem. tehnol. Bosne Herceg, vol. 42, pp. 5-10, 2014.
16. Arumugam MT, Nesamani R, Kittappa K, Sanjeev K, Sekar M. Effect of various antioxidants on the shear bond strength of composite resin to bleached enamel: An in vitro study. J Conserv Dent, vol. 17, pp. 22-26, 2014.
17. Mukka PK, Komineni NK, Pola S, Soujanya E, Karne AR, Nenavath B, et al. An in vitro Comparative study of shear bond strength of composite resin to bleached enamel using three herbal antioxidants. J Clin Diag Res, vol. 10, pp. 89-92, 2016.
18. Bansal M, Kaur P, Cyriac AR, Kadian N, Jaiswal P, Rathee K. Impact of Different Antioxidants on the Bond Strength of Resin-Based Composite on Bleached Enamel—An In Vitro Study. J Contemp Dent Pract, vol. 20, pp. 64-70, 2019.
19. Manimaran V S, Srinivasulu S, Ebenezar A V R, Mahalaxmi S, Srinivasan N. Application of a proanthocyanidin agent to improve the bond strength of root dentin treated with sodium hypochlorite. J Conserv Dent, vol. 14, pp. 306-308, 2011.
20. Ozelin AA, Guiraldo RD, Rodrigo Lopes MB, Berger SB. Effects of Green Tea Application Time on Bond Strength after Enamel Bleaching .Braz. Dent.J, vol. 5, pp. 399-403, 2014.
21. Sharafeddin F, Motamed M, Modiri S. Effect of immediate appli¬cation of promaganate peel, grape seed and green tea extracts on com-posite shear bond strength of in-office bleached enamel. Res J Biol Sci, vol. 8, pp. 83-87, 2013.
22. Nair R, Bandhe S, Ganorkar OK, Saha S, Sial S, Nair A. A comparative evaluation of the three different antioxidant treatments on the bond strength of composite resin to bleached enamel: An in vitro study. J Conserv Dent, vol. 22, pp. 82- 86, 2019.
23. Perchyonok VT, Grobler SR. Tooth-bleaching: Mechanism, Biological Aspects and Antioxidants. Int J Dent Oral Healt, vol. 3, pp. 2378-2384, 2015.