

Effect of Antioxidant on the Shear Bond Strength of Composite Resin to Bleached Enamel at Different Time Intervals: An In Vitro Study

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Abstract

AIM: To evaluate the effect of antioxidant on the shear bond strength of composite resin to bleached enamel at different time intervals.

Materials and methods: Labial enamel surfaces of 40 extracted human maxillary anterior teeth were used in this study. All samples were bleached with 35% hydrogen peroxide gel for 30 minutes. The samples were divided into two groups; Group I (n=20): bleaching and composite build-up. Group II (n=20): bleaching and application of antioxidant (green tea leaves extract) and composite build-up. Groups I and II were further subdivided into subgroup I a and I b and II a and II b according to testing time. Shear bond strength of the specimens was tested under universal testing machine whether the specimens were tested immediately or after one week.

Results: Significantly higher shear bond strength were observed in Group II b i.e. bleaching followed by

application of antioxidant and composite resin build up which is tested after 1 week.

Conclusion: It can be concluded that use of antioxidant after bleaching increases the shear bond strength of composite resin to bleached enamel after time interval of 1 week.

Keywords: Antioxidant; bleaching; composite; green tea leaves; shear bond strength.

Introduction

Aesthetic includes the appreciation and response to the beauty of art and nature ^[1]. The tooth discoloration is broadly classified as intrinsic discoloration and extrinsic discoloration. In many cases of discoloration, treatments of choice are Micro abrasion, Bleaching, Composite and Porcelain Veneers. Among all aesthetic dental treatments, bleaching is a non-invasive, relatively simple procedure to be performed ^[2].

Increase in the demand for aesthetic dentistry has resulted in widespread practice of vital bleaching. Vital tooth bleaching is considered as a safe, popular, conservative and well accepted treatment option for discoloured teeth^[1, 2]. Carbamide peroxide and hydrogen peroxide are most commonly used bleaching agents. One of the most common clinical complaints associated with bleaching is the sensitivity of teeth. The incidence of hypersensitivity was reported to be 10-90% with the in office bleaching procedure^[3].

Another important complication following bleaching procedure is decreased bond strength of composite resin to enamel^[1]. This decreased bond strength is due to the presence of oxygen ions which interfere with resin polymerization^[1,2,3]. It can be improved by delaying its placement after 1-3 weeks following the bleaching procedure^[3]. Several other techniques have also been proposed to remove the oxygen radical from the surface enamel.

Mukka, Komineni, et al suggested that There are a number of methods that have been projected to overturn the reduced shear bond strength which occurs due to bleaching, for example alcohol treatment of the bleached enamel surface before restoration, removal of the outermost layer of enamel, and the application of antioxidants^[1]. Among all the methods, the antioxidant treatment has shown immediate improvement in shear bond strength values.

Kimiayi, valizadeh et al compared the effect of two different sodium ascorbate (10% and 20%) on shear bond strength of resin to bleached enamel and stated that both the concentrations result in greater bond strength than the bleached group^[4].

In recent study, it has been reported that green tea leaves extract (*Camellia Sinensis*), a natural antioxidant, neutralize the harmful effects of bleaching agents on bond

strength of bleached enamel. It contains flavonols and high antioxidant property^[2,5].

Since, few studies on green tea leaves extract on bond strength of resin to bleached enamel have been found. So the aim of this study is to compare effect of antioxidant on the shear bond strength of composite resin to bleached enamel at different time intervals.

Aims and Objectives

The aim of this study was to compare the effect of antioxidant on the shear bond strength of composite resin to bleached enamel at different time intervals. (Immediate and after 7 days)

Materials and Method

Source of Data

Forty recently extracted human permanent maxillary anterior teeth were collected from the department of Oral and Maxillofacial surgery, CSMSS Dental College, Aurangabad.

Preparation of Antioxidant Solution

Fresh green tea leaves were taken and boiled in 100ml of water and filtered in filter paper and was used for application.

Specimen Preparation

Forty human, single-rooted, caries-free, maxillary anterior teeth, extracted for some reasons, were taken for the study and stored in normal saline until further use. Exclusion criteria include fractured, cracked, and dried teeth. The roots were embedded in self-cure acrylic resin block till cemento-enamel junction, keeping only the coronal portion exposed.

Bleaching Gel Preparation

The whitening gels used in this study were experimental and manipulated in our laboratory, resulting from the mixture of 50% hydrogen peroxide solution, aloe vera gel and glycerin. They were manually mixed immediately

before application in the proportion as shown in table below:

H2O2 gel	H2O2	Aloevera gel	Glycerin
35%	14ml	6gm	6ml

The pH of 35% H2O2 gel is 5.5. A 1 mm layer of whitening gel was applied over the enamel surface of each specimen for 10 minutes and repeated three times, totaling 30 minutes of application. Bleaching light was used for curing the samples for every 10 minutes. After application, the specimens were washed with distilled water.

40 samples were divided into two groups (n=20) with application of antioxidants and without application of antioxidants. After bleaching, the antioxidant i.e. Green tea leaves extract was applied on 20 samples.

After washing the samples with distilled water, it was dried and then the samples were etched with 37% phosphoric acid, washed and dried & then bonding agent was applied for bonding and then cured with light curing unit for 15 sec.

The material used for composite build up was microhybrid composite resin (VOCO PROFIL SUPRA), etchant 37% phosphoric acid ECO-ETCH (ivoclar vivadent) and bonding agent of 6th generation Te-Econom Bond (ivoclar vivadent). Finally composite build up was done on the labial surfaces of the teeth and cured.

Group I (n=20): Bleaching followed by composite build up.

Group II (n=20): Bleaching followed by application of antioxidant and composite build up.

These samples are again subdivided into 4 groups on the basis of time intervals:

Group I a (n=10): Bleaching followed by composite build up tested immediately.

Group I b (n=10): Bleaching followed by composite build up tested after 1 week.

Group II a (n=10): Bleaching followed by application of antioxidant and composite build up tested immediately.

Group II b (n=10): Bleaching followed by application of antioxidant and composite build up tested after 1 week.

Specimen Testing

Each specimen was loaded in UNIVERSAL TESTING MACHINE (TUF-C-1000) for shear bond strength testing. The long axis of the specimen was perpendicular to the direction of the applied forces. The knife edge was loaded at the interface between the composite and dentin surface. The shear bond strength was measured inshear mode at a crosshead speed of 0.5 mm/min until fracture occurred. The statistical methods used in this study are one way ANOVA and Tukeys comparison test.



Fig. Universal Testing Machine

Results

Among the experimental groups, mean shear bond strength of Group II b (52.42) was significantly higher than all the other groups.

Group 1 a (no antioxidant used, composite build-up and immediate testing) had least shear bond strength value (22.28) of all the groups.

The *p*-value between Group I a and Group II b is < .00001. The result is significant at *p*< .05.

The *p*-value between Group I b and Group II b is .643673. The result is *not* significant at *p*< .05.

Table 1: Comparison of mean bond strengths of different study groups

Groups	Mean	Standard Deviation (SD)
Group I a	22.28	1.11
Group II a	31.92	1.24
Group I b	52.15	2.08
Group II b	52.42	1.75

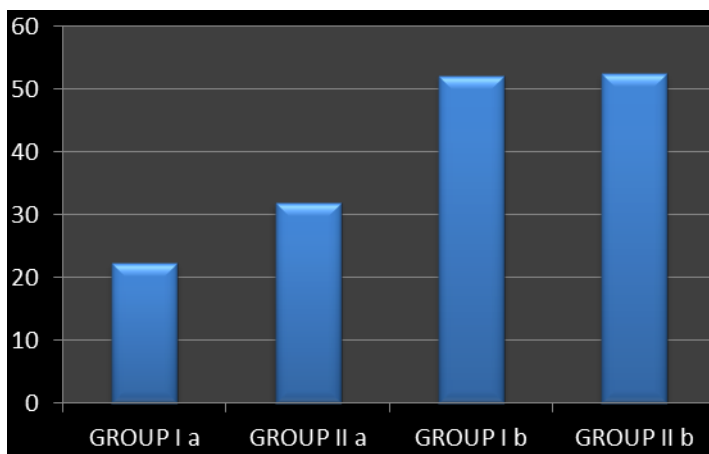


Figure 1: Bar diagram showing the comparison of mean shear bond strength (Mpa) among the groups.

Discussion

Now a days there is great demand for various modalities in treating discolored teeth. Tooth bleaching has been an option since late 1870s [1]. It permits a successful esthetic outcome at minimal expense while conserving the tooth

structure. Tooth discoloration has always been a factor of utmost concern as more emphasis is being placed on esthetics. Vital tooth bleaching procedures are the most commonly used conservative and effective treatment options to treat discoloured teeth [2, 5]. The conditions where we use bleaching and composite resin restoration are enamel hypoplasia where there is pitting of enamel, white spot lesions, etc.

In spite of the constructive results obtained with the bleaching agents like carbamide peroxide and hydrogen peroxide, there are many studies that have observed morphological alterations of teeth, increased surface irregularities, roughness and reduced microhardness of enamel. Another important complication is decreased bond strength of composite resin to enamel [6, 7].

Hydrogen peroxide, a biological oxidant, is still the most commonly used bleaching agent which releases free radicals in the form of nascent oxygen and hydroxyl or perhydroxyl ions, when applied to the dental structure [7, 8, 9]. After bleaching the shear bond strength is due to the fact that the bleaching agent leaves behind a free residual oxygen layer which inhibits the polymerization of composite resin and interferes with the resin infiltration into etched enamel [6, 9, 11].

Use of natural antioxidants like plant extracts as a viable alternative to chemical and synthetic antioxidants have been reported in recent years [12]. Hence, in this study, emphasis was placed on the use of green tea leaves extract as antioxidants immediately following the bleaching procedure to overcome the compromised bond strength of composite resin to bleached enamel.

Mukka and Pola et al used pomegranate peel, grape seed and pine bark extract as antioxidants immediately following the bleaching procedure to reverse the compromised bond strength of composite resin to bleached enamel [1]. Sharafeddin and Motamedi et al

suggested that green tea leaves extract is one of the antioxidant used in this study is a potent antioxidant capable of quenching reactive free radicals in biological systems^[13]. This antioxidant is a widely used in food technologies and it has no adverse biological effect on the dental hard tissues. Green tea leaves extract was effective in reversing the compromised bonding to the oxidized enamel and dentin^[5, 13].

Therefore, the present study was designed to evaluate the neutralizing effects of various antioxidants on the shear bond strength of composite resins to bleached enamel. Hydrogen peroxide, being a low-molecular-weight substance, permeates into the dental hard tissues and breaks down into free radicals, so surface treatment done with any antioxidant to remove these free radicals should have low molecular weight for efficient scavenging action^[7, 8, 10, 11].

Result of the present study showed that, mean shear bond strength of Group II b (52.42) was significantly higher and Group 1 a (no antioxidant used, composite build-up and immediate testing) had least shear bond strength value (22.28) of all the groups. In the present study, the decreased bond strength of group I a could be resulted due to residual free radicals of oxygen on the tooth surface.

According to Kaya AD, Turkun CD et al the liberation of oxygen free radicals interferes with the resin infiltration to the etched enamel and inhibits polymerization of the resin that cured via free radical mechanism^[13, 14]. The results of present study corroborates with studies of Hedegset al.(1999), Rostein et al (1996) they stated that 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^[15, 16, 19].

Conclusion

Use of antioxidant (GREEN TEA LEAVES EXTRACT) after bleaching increases the shear bond strength of composite resin to bleached enamel after time interval of 1 week.

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