Effects of Bleaching on Bond Strength: An in vitro Study

Srinivasa K Rao, Ram Chetan Rai, MS Ravi, Vani K

ABSTRACT

Recent years have witnessed a drastic increase in the awareness towards cosmetic dentistry. Bleaching has become a common procedure in the field of cosmetic dentistry. Thus, it seems important to determine whether bleaching would significantly influence the bond strength of orthodontic adhesives to the enamel surface. The purpose of this study was to determine the effect of a 35% hydrogen peroxide containing in-office bleaching agent on the shear bond strength of adhesive to metallic orthodontic brackets.

Materials and methods: Sixty extracted, sound premolars were randomly divided into three groups of 20 each. Teeth in group A were etched with 37% phosphoric acid before bonding metallic premolar brackets using light cure composite resin. Teeth in the other two groups were bleached with a 35% hydrogen peroxide in-office bleaching agent according to the manufacturer’s recommendations. Twenty bleached teeth (group B) were bonded immediately with light cure composite resin, and the other 20 (group C) were stored in artificial saliva for 30 days before bonding. Shear bond strength of these brackets were measured using Instron universal testing machine, recorded in MPa and compared.

Results: Statistical analysis was done using ANOVA (Analysis of variances) by Fisher’s F-test. The intercomparison between the groups was calculated by Bonferroni t-test (Post-Hoc test). The shear bond strength values of groups A, B and C were 11.8850 ± 2.29651, 11.4750 ± 4.45477 and 12.7450 ± 3.82491 MPa respectively. Results of ANOVA showed no statistically significant differences in shear bond strengths between groups (p = 0.541).

Conclusion: This study showed that office bleaching with 35% hydrogen peroxide does not adversely affect the bond strengths of orthodontic adhesives used to bond brackets immediately after bleaching or 30 days after bleaching.

Keywords: Tooth bleaching, Shear bond strength, Bonding adhesive, Bond strength.

INTRODUCTION

People, today are increasingly aware of their facial esthetics in terms of the alignment as well as color. A large number of adult patients are opting for bleaching to improve the color of their teeth. Thus, it seems important to determine whether bleaching would significantly influence the bond strength of orthodontic bracket adhesive to the enamel surface.

Various whitening systems are currently being used to bleach enamel. Concentrated solutions of hydrogen peroxide are the most common agents used to bleach discolored teeth. Little is known of their biological and physical effects, particularly their effects on the shear bond strength of orthodontic adhesives to human tooth enamel. There is conflicting evidence regarding the effect of bleaching on shear bond strength of orthodontic brackets.1,2 Thus, the aim of this study was to know whether there is any significant change in the bond strength of the brackets bonded immediately to bleached teeth and bonded 30 days after bleaching, and to compare them with that of the nonbleached enamel surface.

METHODOLOGY

Sixty noncarious, sound extracted premolars without enamel defects were used for the study. No pretreatment with a chemical agent, such as alcohol, formalin, or hydrogen peroxide, or any other form of bleaching was allowed. The teeth were cleaned of blood and tissue debris and stored in artificial saliva after extraction. The saliva was changed daily to avoid bacterial contamination. The samples were divided randomly into three groups of 20 each, as group A, B and C.

Group A (control group): Teeth were etched and bonded with Transbond XT (3M Unitech) light cure adhesive.

Group B: Teeth were bleached with 35% hydrogen peroxide (Fig. 1) according to manufacturer’s instructions and immediately etched with 37% orthophosphoric acid and brackets bonded with Transbond XT (3M Unitech) light cure adhesive (Figs 2 and 3).
Group C: Teeth were subjected for bleaching and then stored in saliva for 30 days and bonded as done in group B.

The teeth in all the groups were mounted (Fig.4) in a jig using acrylic in such a way that the buccal surface were exposed as required for mounting in Instron universal testing machine (Figs 5 and 6).

**Statistical Method**

Statistical analysis was done by using ANOVA (analysis of variances) by Fisher’s F-test. The intercomparison between the groups was calculated by Bonferroni t-test (Post-Hoc test). Data was fed in the computer and statistical package SPSS version 11.5 was used for analysis.
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Table 1: Summary of mean shear bond strengths

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>Mean (MPa)</th>
<th>SD</th>
<th>Minimum bond strength (MPa)</th>
<th>Maximum bond strength (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>20</td>
<td>11.8850</td>
<td>2.29651</td>
<td>7.80</td>
<td>16.20</td>
</tr>
<tr>
<td>Group B</td>
<td>20</td>
<td>11.4750</td>
<td>4.54774</td>
<td>4.80</td>
<td>18.20</td>
</tr>
<tr>
<td>Group C</td>
<td>20</td>
<td>12.7450</td>
<td>3.82491</td>
<td>5.30</td>
<td>18.80</td>
</tr>
</tbody>
</table>

Table 2: Comparison of mean shear bond strength between the groups

<table>
<thead>
<tr>
<th></th>
<th>Mean difference (I-J)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A Group B</td>
<td>0.4100</td>
<td>1.000*</td>
</tr>
<tr>
<td>Group A Group C</td>
<td>–0.8600</td>
<td>1.000*</td>
</tr>
<tr>
<td>Group B Group C</td>
<td>–1.2700</td>
<td>0.838*</td>
</tr>
</tbody>
</table>

*Non significance

RESULTS

The mean shear bond strength, standard deviation and range are shown (Table 1). The differences between the groups are shown in Table 2.

The Fisher’s F-test (Table 1) revealed that group C had maximum mean shear bond strength of 12.7450 Mpa with standard deviation of 3.82491 followed by group A with mean shear bond strength of 11.8850 Mpa and standard deviation of 2.29651 and group B mean shear bond strength of 11.4750 Mpa and standard deviation of 4.54774. The p-value was 0.541 which was statistically nonsignificant.

Comparison of Mean Shear Bond Strength

Comparison of mean shear bond strength was done statistically using Bonferroni t-test. The intercomparison between the groups showed that there was no statistically significant difference in the mean shear bond strength of various groups.

DISCUSSION

Previous studies have shown changes in enamel structure, composition and bond strength when exposed to 35% hydrogen peroxide for in-office vital tooth bleaching. Some authors noted or found a substantial reduction in bond strengths to enamel shortly after exposure to concentrated aqueous solutions of hydrogen peroxide. Never the less, controversies exist in literature regarding the effect of bleaching on bond strength of the brackets.

In the present study, group C had the maximum mean bond strength of 12.7450 MPa followed by group A (11.8850 MPa) and group B (11.4750 MPa). However, these differences were statistically not significant. This suggests that bleaching of teeth did not have significant effect on the bond strength of orthodontic bracket adhesives. Even though the group B had the least bond strength; the mean value suggests that the bond strength was still above the clinical requirement as suggested by Reynolds and Lopez JI. According to Lopez JI, a minimum bond strength of 7 Mpa is adequate for successful clinical bonding. Thus, orthodontic brackets can be bonded immediately after bleaching without significant reduction in the bond strength.

In the immediately bonded bleaching group (B), the average bond strength values were lower, although not significantly so, than those of the acid-etched (A) and saliva-stored bleaching (C) groups. Josey et al suggested that under experimental conditions, hydrogen peroxide diffuses out of the teeth between 1 and 6 weeks, thus allowing a composite resin-luting cement bond that was not influenced by a reaction with hydrogen peroxide. This would account for an increase in bond strength up to 6 weeks after bleaching and consistent bond strength thereafter. However, this process might occur more quickly in vivo. It is accepted that etching untreated enamel with 37% phosphoric acid can involve prism core demineralization, prism-sheath demineralization, or both. Composite resin adheres to etched enamel by mechanical bonding, whereby unfilled resin penetrates and polymerizes in these surface irregularities. However, Josey et al suggested that acid-etched bleached teeth lose these regular prism boundaries, and such changes might affect the retentive qualities of dental restorations or adhesives applied to the enamel surface. The insignificant decrease in bond strength of the immediately bonded bleaching group could be related to the factors like surface modification and diffusion.
of residual hydrogen peroxide out of enamel. The highest bond strength values recorded were for the 30-day saliva-immersed group C; this confirms that any possible adverse effect of residual hydrogen peroxide was neutralized during this period. Further, clinical studies are required in this direction to assess the effect of these agents on the orthodontic bond adhesives. Similarly, studies are required to assess the topographic effect of various bleaching agents at electron microscopic level that can affect the orthodontic bracket adhesive so that bonding can be carried out without any complications.

CONCLUSION

This study concludes that office bleaching with 35% hydrogen peroxide does not adversely affect the bond strengths of orthodontic adhesives used to bond brackets immediately after bleaching or 30 days after bleaching.

REFERENCES