ORIGINAL RESEARCH ARTICLE

EFFECT OF IN-OFFICE BLEACHING ON SHEAR BOND STRENGTH OF NEWER UNIVERSAL BONDING AGENTS

ABSTRACT

Objective: To evaluate the effect of in office bleaching on the shear bond strength of a new universal bonding agent to enamel

Materials and methods: 30 human maxillary premolar teeth extracted for orthodontic purposes were selected. Roots of all teeth were embedded in acrylic resin block with only 3-4mm of the crown exposed. Specimens were randomly divided into two groups (n=15).Group I- positive control group, intact enamel, no bleaching done. Group II - experimental group-enamel surfaces were bleached with Pola office (35% Hydrogen Peroxide Gel, SDI). Each specimens of Group I and Group II were etched with 37% phosphoric acid (Scotchbond etchant gel, 3M ESPE) and bonded with Universal Bonding agent (3M™ Single Bond Universal Adhesive). This was followed by composite (Filtek Z350 XT, 3MESPE, Dental Products) build-up in incremental technique in 3 increments of 1mm each to a height of 3mm. All specimens were then stored in distilled water for 24 hours. Shear bond strength was tested using universal testing machine and vertically loaded at a crosshead speed of 1 mm/min in shear mode until fracture occurred and data were analysed using ANOVA.

Results: Results showed that there was a statistically significant difference in the bond strength between unbleached and bleached teeth (P<0.005). The mean bond strength of control group was seen to be significantly higher (25.01 ± 1.76) as compared to the experimental group (6.82 ± 0.53).

Conclusion: The bleaching significantly affects bond strength of universal bonding agent to enamel

Key words – universal bonding agent, in office bleaching, shear bond strength

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INTRODUCTION

Dental aesthetics has pronounced impact in our beauty-conscious society.[1] The appearance of the teeth is determined by socio-cultural values and individual preferences.[2]

As esthetics is attaining more attention, tooth discoloration is becoming a greater concern and its management is dependent on the diagnosis. Treatment choices include micro abrasion, Bleaching, Composite Resin Restorations, and Porcelain Veneers etc. Now a days people desire for more conservative methods of treatment. A safe, popular, conservative, well-accepted treatment modality for discolored teeth is vital bleaching.[3] In spite of excellent esthetic outcomes, the clinicians should be aware of the outcome of the bleaching treatment and the interactions with other dental treatments.[4]

On application of bleaching agent, hydrogen peroxide on tooth surface it undergoes ionic dissociation and gives rise to the formation of free radicals such as hydroxyl radical, per-hydroxyl, nascent oxygen, and superoxide anions, which are the most potent free radicals. These extremely reactive free radicals will react with the electron-rich regions of pigment within the tooth leading to dissociation of the larger pigmented molecules into smaller and less pigmented molecules.[5]

In some cases bleaching may be indicated prior to an aesthetic composite resin restoration to obtain a more pleasing final shade.[6] Bleaching procedures can result in chemical and morphological changes in enamel,[7] which has shown to result in reduction of shear bond strength values in composite resin restorations. This could be due to the release of residual oxygen from the bleaching agent, which interferes with resin infiltration into etched enamel and inhibits resin polymerization.[8]

Several studies have shown that bleaching enamel significantly compromises the composite-enamel bond strength achieved with total etch bonding systems[6] and with self-etching primers.[7]

The multi-step dental adhesives have been promoted since the early 1990s and can still today be considered as 'gold-standard' adhesives.[9]

The market-induced demand for simplified adhesive procedures has rapidly led to the development of the self-etch adhesives which follow a trend towards simplification.

A new class of bonding agent has been introduced in which manufacturer claim that it can be used in Total etch and self-etch and selective etch mode (Adper single Bond Universal).

Single Bond Universal adhesive utilizes the MDP (methacryloxydecyl phosphate) monomer, as well as incorporates silane into the chemistry. 10-MDP (10-methacryloyloxydecyl dihydrogen phosphate) has been identified as being capable of establishing a very intensive and stable chemical interaction with hydroxyapatite. The MDP-Ca water-insoluble salts contribute to the protection of the collagen fibers.[10] Literature have shown that Universal Dentin Bonding agent significantly improves the shear bond strength to enamel.[11] Chemical bonding in Single Bond Universal between 10-MDP and enamel may play an important role in forming stable and durable interfaces by providing acidity for its self-etch capability.[12] Although the literature revealed many studies comparing this new class of bonding agents, but the effect of in office bleaching on shear bond strength of universal bonding agent is not been investigated and it is crucial to evaluate the bonding ability of adhesive to bleached enamel as bleaching procedures have become popular. Hence, the aim of the present study is to evaluate and compare the effect of in-office bleaching on shear bond strength of newer universal bonding agent to enamel.

MATERIALS AND METHOD

Specimen Preparation: Thirty intact, non-carious human maxillary premolars extracted for orthodontic purposes were collected. The teeth with severe attrition, erosion, fractures, cracks were excluded. The roots of all teeth were embedded in acrylic resin block with only 3-4mm of the crown exposed and the specimens were randomly divided into two groups, each group containing 15 samples.

Group I- positive control group, intact enamel, no bleaching done.

Group II -experimental group -enamel surfaces

were bleached with 35% Hydrogen Peroxide Gel (Pola office, SDI)

Each specimens of Group I and Group II were etched with 37% phosphoric acid, Scotchbond etchant gel (3M ESPE, USA) and bonded with Universal Bonding agent, Single Bond Universal Adhesive (3M ESPE, USA). This was followed by composite build up using Filtek Z350 XT (3M ESPE,USA) in incremental technique in 3 increments of 1mm each to a height of 3mm.[13] All specimens were then stored in distilled water for 24 hours as it appeared to restore bond strength but not to a point that was statistically significant.[7]

Shear Bond Strength testing: The SBS was tested using universal testing machine (Instron, UK) and vertically loaded at a crosshead speed of 1mm/min in shear mode until fracture occurred.

RESULTS

The values obtained were statistically analyzed using computer software Statistical Package for Social Sciences (SPSS) version 16.0. One-way analysis of variance (ANOVA) was used to analyze the data. Significance was established at $p< 0.05$ level.

As shown in **table 1**, there was a statistically significant difference between the control and the experimental group ($P <0.005$). The mean bond strength of control group was seen to be significantly higher (25.01 ± 1.76) as compared to the experimental group (6.82 ± 0.53).

Table 1. Comparison of mean SBS values of different groups (MPa).

GROUP	N	MEAN	STANDARD DEVIATION	ANOVA
CONTROL	15	25.0130	1.76806	F= 355.62
BLEACHED TOOTH	15	6.8252	0.53461	P< 0.005

DISCUSSION

Tooth whitening is a well tolerated, completely safe, and well accepted procedure for the removal of extrinsic stains of the teeth. Vital tooth bleaching proposed by Haywood and Heymann in 1989 is the most commonly used method.[14] In-office bleaching technique is faster and more effective treatment which involves using high concentrations of carbamide or hydrogen peroxide.[15]

In most cases, tooth bleaching is done before esthetic restorative procedures.[16] Bleaching procedure is an oxidation reaction that releases free radicals.[17] A decrease in bond strength immediately after bleaching of teeth is a concern and is of great clinical significance.[15] In addition, bonding process immediately after tooth bleaching affects the marginal seal of composite resin restorations as it causes deleterious effects on organic and inorganic components of enamel causing micro to nano morphological changes leading to cracks and craters[17], also the residual peroxide radicals interfere with the polymerization of composite resin reducing the penetrating ability of resin adhesives into enamel.[18] This results in microleakage, which can lead to marginal discoloration, recurrent caries and pulp inflammation after composite resin restorations.[19,20] It has been postulated that a delay in bonding procedure from 24 hours to 2 weeks after the bleaching procedure restores the bond strength.[15]

The present study showed that the means of shear bond strength values with the adhesive system in both the study groups were significantly different. It also found that the unbleached enamel exhibited a higher bond strength when compared to bleached enamel.

A decrease in bond strength subsequent to bleaching might be attributed to the presence of oxygen in enamel, which is an inhibitory factor for polymerization reactions of free radicals. Oxygen reacts with the free radicals and oxidizes them and has a low affinity to react with monomers.[21] Whereas Perdigao et al reported that this decrease in bond strength after bleaching might not be attributed to the

presence of oxygen in enamel; rather, dentin might function as a reservoir and pooling of oxygen in dentin might be a factor for a decrease in bond strength.[22]

Moreover, some researchers have studied on the morphological and organic alternations in enamel structures, the loss of calcium, and decrease in micro hardness as important factors resulting in reduced enamel bond strength. In another study where SEM observations has shown that the interfaces between resin and bleached enamel has large areas of enamel surface which were free of resin or the present tags were fragmented, poorly defined, and penetrated to a lesser depth than in the unbleached controls.[21]

Potocniket al. studied the effect of carbamide peroxide bleaching gel and it showed that bleached enamel had eroded prism cores and striae of Retzius which were similar to structural changes seen in caries. Also the concentrations of calcium and phosphorous were lowered in bleached enamel due to the demineralizing effect of the bleaching gel, which thereby reduced the surface energy and bond strength. Furthermore, for the bonding procedure, when the bleached enamel was etched, the usual keyhole appearance was not seen, rather an over etched appearance with loss of prismatic structure was observed. Numerous voids and bubble like structures were seen inside the adhesive layer which suggested that the oxygen released by the decomposition of hydrogen peroxide was trapped within the adhesive during light activation.[14] These findings might be the reason for the reduced bond strength of composite to bleached enamel obtained in this study.

Previous studies suggested the subsurface enamel organic matrix was altered by the oxidizing effect of hydrogen peroxide.[23,24] These are not permanent structural alterations, but reversible changes in redox potential of the organic components.[25] The antioxidant can restores the altered redox potential of the oxidized bonding substrate. Thus the compromised bonding of composite resin to acid etched-bleached enamel can be reversed by sodium ascorbate, an antioxidant.[21]

The data from the present study and previous experiments suggest that immediate bonding of composite may result in less compromised composite bond strength when restorative work is to be completed immediately after bleaching. If elective dental treatment may be postponed for several days, the choice of the bonding agent becomes less critical. Further studies are required to evaluate longevity of bond strength between universal adhesives and bleached surface over time.

CONCLUSION

Within the limitations of this study, it was concluded that bonding of composite to unbleached enamel was found to be better when universal adhesive agent was used.

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