Case Report

AN IN VITRO COMPARISON OF ULTRAVIOLET VERSUS WHITE LIGHT IN THE DETECTION OF ADHESIVE REMNANTS DURING ORTHODONTIC DEBONDING

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Abstract:

Objectives: The purpose of this study is to compare ultraviolet (UV) illumination with traditional white light for locating fluorescent-tagged adhesive residues during orthodontic debonding, and to draw conclusions about whether kind of lighting is more successful and efficient.

Materials and Methods: The extracted human premolars were bonded to orthodontic brackets using one of two fluorescent bonding resins (Pad Lock, Reliance Orthodontics, Itasca, Ill.;). Opal Bond MV, Opal Orthodontics, South Jordan, Utah; $40 a pop)." After debonding, the operatory light was used to illuminate most of the teeth in each paste bundle (n = 20), while an ultraviolet (395 nm) light release diode (Drove) spotlight illuminated the remaining teeth. Cleaning one's teeth took a certain amount of time, which was recorded. The surface area of adhesive remains was determined by taking follow-up photographs with a dissecting microscope under UV light. The effectiveness of cement removal was also investigated using scanning electron microscopy. We used an ANOVA and a Kruskal-Wallis test to compare the two variables, time and adhesive residue.

Results: Using a dissecting microscope, researchers determined that there were considerably less adhesive remains in the UV light group compared to the white light group (P .01). Opal Bond MV glue removed in much less time (P .01) when exposed to UV light as opposed to white light. Scanning electron microscopy analysis revealed invisible to UV light, minute adhesive residues (2 m).

Conclusions: When it comes to spotting fluorescent adhesive during orthodontic debonding, ultraviolet light is both more effective and more efficient than white light. UV LED illumination is a useful tool for finding adhesives, despite its drawbacks.

Key-words: *Adhesive; Orthodontics; Debonding; UV light*

Introduction:

Metal or cosmetic brackets are often glued to teeth using a resin-based adhesive during orthodontic therapy [1]. The brackets and any remaining glue must be carefully removed when the necessary tooth movement has been accomplished [2]. It might be difficult to completely remove the bonding material without injuring the enamel because of the bonding substance's color similarity to the tooth [2, 3].It is important to learn how the adhesion technique might affect the bond outcomes before beginning the debonding process. The optimal bond strength may be seen in the stability of the brackets throughout orthodontic therapy. It's probable that a clean tooth surface, in addition to the entire or self-etching operation, might increase bond strength [4]. Several studies have examined the effectiveness of various approaches, such as enamel pretreatments such air abrasion [5] and abrasive pastes [4], in increasing bond strength. The etch pattern and the penetration of the

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resin tag may be affected by whether or not the etching is complete [6]. This may be significant for subsequent debonding and adhesive residue removal.

Through the process of fluorescence, a material may produce more outgoing light than it takes in. When teeth are exposed to ultraviolet (UV) light, they glow naturally, giving off an impression of health and vigor.Resins with fluorescent additives are more easily seen and better able to approximate the appearance of actual teeth. The difference between resin and enamel may be more easily seen in the right lighting [7].

This research set out to compare how well UV light and white (W) light work for finding fluorescent adhesive during orthodontic debonding.

Method:

The university's Ethics Committee has approved this kind of in vitro study. All experimental procedures were performed by a single researcher. In a preliminary analysis (Table 1), we compared seven orthodontic adhesives currently available. There were two prerequisites for inclusion: (1) the product be clearly labeled as a bracket adhesive for direct bonding, and (2) the product glow visibly under UV light. To test for fluorescence, we exposed the adhesives to light from a 5 LED UV lamp tuned to the 395 nm wavelength. One hundred teeth met the inclusion criteria, and sixty of them were assigned at random to each of the four groups.

Trying It Out, First Expected to serve as a replacement for the main upper left molar, the teeth were anchored into a ModuPRO Endo module (Acadental, Oakland Park, Kansas). Each tooth was given a 10-second scrubbing with pumice and an elastic cup linked to a low-speed handpiece, after which the root surface and gum line were washed and dried with an air-water needle. Following a 30-second etch with 35% phosphoric acid (Ultra-Etch, Ultradent, South Jordan, Utah), 10-second washing with water, and 5-second drying period, we used a microbrush to apply Assure PLUS (Reliance Orthodontics, Itasca, Illinois) as a primer.

Half of the premolar teeth were cemented with plastic resin designated as P, and the other half were glued with orthodontic resin designated as O, in preparation for orthodontic brackets (Dentsply GAC, Islandia, N.Y.). Surplus glue was scraped off with an explorer, and then the adhesive was cured for three seconds from the occlusal, gingival, mesial, and distal sides using a VALO LED curing light (Ultradent) on the "extreme power" setting. After that, the teeth spent 24 hours in a 378°F, 100% humidity chamber. The brackets were bent and crushed using a specific tool (098; Orthopli, Philadelphia, Pa.) for removal. UV light and a stereomicroscope were used to quantify the amount of glue that was left, and a bespoke glue Remnant Inde was developed to rank the findings.

Adhesive Waste Disposal The gadget was fastened to the head of a mannequin to replicate a typodontist's work. With a high-speed handpiece and a 30-fluted, flame-shaped tungsten carbide bur (H48LF.31.010, Brasseler USA Dental, Savannah, Ga.), the adhesive was scraped off under dental loupes (2.5x).26 Each set of ten teeth required a fresh bur. To keep the handpiece from overheating, airflow was employed instead of a water spray. While the P-UV and O-UV groups used UV LED flashlights in lieu of the standard dental operatory light unit, the P-W and O-W groups solely used the W light.

Since UV radiation has been shown to be the most effective for curing most dental resins, it was chosen as the curing medium of choice. The operator was unrestricted in his or her movements thanks to the portability of the light source. The handpiece triggered the appearance of a W light in both banks whenever it was in operation. When the adhesive was no longer visible after the resin was removed, seconds were the unit of measurement used. Adhesive removal and debonding were followed by the acquisition of stereomicroscope pictures (Nikon SMZU, Nikon Metrology, Brighton, Mich.). A stereomicroscope fluorescent adapter (Nightsea, Lexington, Mass.) was used to shine light on the teeth in a typical arrangement. Scaled photos were used to calculate the leftover adhesive surface area in millimeters squared using Image J. The examinations were redone a week later. Results from many measurements performed at various times were averaged to calculate intra-rater reliability.

We took two samples from each adhesive kind, one with plenty of extra glue and one with none. Backscatter electron photographs were taken using a scanning electron microscope to compare the effectiveness of ultraviolet light and SEM in detecting adhesive residue. In this study, a scanning electron microscope (SEM) was used, with a granularity of 1 nanometer. The pictures were analyzed for the presence or absence of adhesive using scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (IXRF, Austin, Tex). At 20 kilovolts (kV), the SEM was able to reach a depth of 2 lm.27 Penetration depth might be used to estimate how much adhesive is still there. When doing statistical analysis, version 24 of SPSS (IBM, Armonk, NY) was utilized, and a.05 significant level was used.

The Shapiro-Wilk test and Levene's statistic were used to evaluate whether the data had a normal distribution, respectively.Kruskal-Wallis tests were run and post hoc paired Mann-Whitney tests were done when normality and homogeneity of variance were violated. The Pearson correlation coefficient was used to analyze the relationships between time and geography.

Results:

The Kruskal-Wallis test (Table 5) was used since there was insufficient data to rule out the possibility of a significant difference between the surface area of cement remnants in the three groups. Median adhesive coverage after removal varied significantly across groups statistically (P .001). Regardless of adhesive type, post hoc pairwise Mann-Whitney tests revealed statistically significant differences when comparing groups exposed to W light vs UV light (Table 6). When comparing pairs of groups, we observed no statistically significant changes between those who used the same kind of light but a different adhesive.

Adhesive Coverage as a Function of Time When comparing P and W light, a negative correlation (r = -140707, P .001) between duration and sticky surface area was detected (Table 8). There were no additional statistically significant associations between the remaining categories. UV Light's Sensitivity to Adhesive Detection SEM combined with energy-dispersive X-ray spectroscopy revealed areas of glue on teeth that were not visible under UV light. This held true for both glue manufacturers.

Discussion:

Fluorescent glue mixed with near UV light considerably decreased adhesive residual area after removal and process duration, enabling the null hypothesis to be rejected. This is consistent with other research [8,9] showing that enhanced visibility of adhesive remnants may facilitate more thorough removal. Caries prevention and long-term esthetic effects may suffer if adhesive residue is left behind. The leftovers are noticeable spots that may encourage the growth of biofilm and discoloration [10].The current results demonstrated that less adhesive was left behind when UV lighting was used as opposed to W light. These findings corroborated those of Ribeiro and colleagues [11], who discovered that UV light facilitated the removal of adhesive more successfully. Previous research did not specify the wavelength of the UV light used during adhesive removal, nor did it detail how the light was handled by the operators, both of which likely contributed to the divergent findings. The use of UV radiation at a wavelength of 395 nm is one possible restriction of the present investigation. While this was shown to be the sweet spot for a number of composite resins, the appropriate wavelength for every given orthodontic glue may vary. The median adhesive remnant ratings for Opal Bond MV were lower than those for Pad Lock in both lighting situations. The higher fluorescence intensity seen for Opal Bond MV under UV light may have contributed to this finding. It's possible that the discovery with W light was obscured by the reflecting characteristic of the enamel surface, which is also present in a thinner coating of Pad Lock. Opal Bond MV, on the other hand, was seen to have a matte, chalky look upon removal, setting it apart from enamel. Opal Bond MV with W light and Opal Bond MV with UV light, as well as Opal Bond MV with W light and Pad Lock with UV light, showed statistically significant variations in the efficacy of adhesive removal when compared with W light. Pad Lock with W light had the largest mean residual adhesive surface area while having the lowest mean removal times. Pad Lock's reflective properties may have given it a camouflage effect, making it seem as if it hadn't been removed at all. Pad Lock with W light had a comparable removal time as Pad Lock with UV and Opal Bond MV with UV, but without the UV light, the goal of removing all glue was not achieved.

Other researchers have looked at how different adhesive removal techniques compare in terms of effectiveness [12]. Mean evaluation times for a high-speed tungsten carbide bur varied from 5.26 to 10.18 seconds per tooth across four experiments [2]. In this analysis, mean times were much longer, ranging between 33.4 and 43.7 seconds. The glue Remnant Index just before glue removal, as well as variations in the adhesives and burs employed, are all potential contributors to this disparity. Differences in management philosophy also had a role.

To reduce the effects of operator bias, just one person performed all of the tasks in this research. Results using scanning electron microscopy (SEM)/energy-dispersive X-ray spectroscopy (EDXR) [12] showed that resin visible under a UV stereomicroscope was only.2 m thick. The evaluation also shown that resin-free seeming enamel may in fact contain trace amounts of adhesive present. This work is the first to show that the adhesive thickness threshold for UV light detection is 2 m. However, the effects of extraction on enamel were not examined in this research. The potential drawbacks of utilizing UV radiation to whiten teeth may outweigh the advantages if considerable amounts of enamel are lost during the process.Evaluating enamel wear is a topic that needs further investigation in the future. This study's results indicated that the alternative hypothesis was more likely to be correct, and the authors suggest using UV LED lighting in combination with fluorescent adhesives for more thorough removal. Extra benefits of UV LED lighting are its mobility, low cost, and simplicity of intraoral application.

Conclusion:

In order to remove fluorescent sticky resin from tooth surfaces, UV light was shown to be more successful than W light. When compared to W light, UV light halves the typical removal time of Opal Bond MV. None of the fluorescent adhesives changed significantly in effectiveness when exposed to UV light.Fluorescent adhesives thinner than 2 m may not be detectable in UV light. UV light at 395 nm is sensitive enough to identify adhesive even in thicker remnants.

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