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Original Research Article

Assessment of Enamel Colour Variations using Different Orthodontic Adhesives: An in Vitro Study

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Abstract

Introduction: Aesthetics is a crucial aspect of orthodontics, and color is a big part of it. The irreversible penetration of resin tags into the enamel structure at depths of up to 50 meters may cause enamel color changes. The goal of this study was to analyze enamel color changes in an in vitro investigation utilizing various orthodontic adhesives.

Methodology: Forty removed human premolar teeth were collected and they were divided into four equal groups and compared for color variation caused by photo aging for the various bonding agents. ANOVA and Post hoc analysis were used to compare significance.

Results: We observed a significant change in there was a significant variation in the E1 between the TRANSBOND XT, ORMCO, RELY A BOND, and BRACEPASTE. However there was no variation for the E2 and E3 between the groups.

Conclusion: After debonding and finishing, Ormco Enlight demonstrated the maximum enamel color change of E2 value 2.92. Rely A bond with an E2 value of 2.80 had the least enamel color change. There is a considerable color shift in the enamel in all of the groups investigated, however it is less than the minimum threshold value of E 3.7 units.

Keywords: Photo ageing, Orthodontic Bonding, Enamel Color

Introduction

Aesthetics is a crucial aspect of orthodontics, and color is a big part of it. Color is described using three objective variables: hue, value, and chroma. The color of your teeth varies a lot depending on the structure of your enamel and dentin. [1] Other elements that influence the appearance of the teeth include ambient

light, light dispersed from surrounding gingival and perioral tissues, and lip and gum color. Intrinsic, extrinsic, and internalized discoloration all affect tooth color in the oral environment. [2] In the past, orthodontic treatment was primarily focused on enhancing occlusal functions, but aesthetic concerns are now just as significant as functional demands. Color is one component that influences excellent dental esthetics. The human eye perceives tooth color as a result of the interplay between light and the enamel surface. [3] One of the main goals since the development of the acid-etch process for bonding orthodontic brackets has been to return the enamel surface to as close to its original form as feasible with the least amount of enamel loss after the end of fixed appliance therapy. [4] Enamel modifications such as microcracks and enamel fractures generated by aggressively removing brackets, as well as scratches and abrasions created by mechanical removal of the residual composite materials, may occur during bonding, debonding, and clean-up processes. [5] Enamel color factors are changed by enamel bonding and debonding techniques, according to a previous study. A small quantity of adhesive normally remains on the surface after orthodontic appliances are removed. [6] The irreversible penetration of resin tags into the enamel structure at depths of up to 50 m may cause enamel color changes. Because resin impregnation into the enamel structure cannot be undone with debonding and clean-up techniques, even after a layer of enamel is removed, some may remain. [7] Even after orthodontic treatment, enamel discoloration can occur due to direct absorption of food colorants and compounds resulting from the corrosion of the orthodontic appliance. Debonding and subsequent cleaning methods have also been found to influence the color of the enamel. [8] Changes in the color of enamel can be caused by discoloration of residual resin that has irreversibly infiltrated the surface despite cleaning operations, in addition to the impacts of iatrogenic surface roughness. [2] Resin residuals can modify tooth color due to both internal changes produced by the adhesive resin's physicochemical response and exterior changes caused by food pigment absorption. [9] Even under laboratory settings, however, removing the whole adhesive residue from the enamel surface without the use of extreme magnification is nearly impossible. [10] When employing fixed appliances for therapy, orthodontics is a unique science in dentistry since the workspace is set on the external surface of enamel. Because of e.g. diet, oral care, bonding materials and techniques, composites, appliances, debonding, and clean-up procedures, orthodontists or patients may experience unwanted changes on the enamel surface or structure, such as discoloration, white spots, microcracks, fractures, and abrasions during and after fixed orthodontic treatment. The most common causes of enamel color changes are bonding materials and composites used in fixed orthodontic treatment. [11]

Materials and Methods

A total of forty extracted premolar teeth were collected and cleansed properly with simple water before being preserved in normal saline to avoid drying. Eighty human premolar teeth were taken from orthodontic patients previously. Exclusion criteria included the following: 1. Buccal surface teeth with caries or restorations 2. On the buccal surface, teeth having enamel defects, hypocalcifications, or fluorosis 3. Teeth with evident buccal surface fractures 4. Teeth having a history of orthodontic treatment There are four groups of teeth.

Group 1: Transbond XT

Group 2: Ormco

Group 3: Rely a Bond

Group 4: Ortho fix

All of the teeth were washed for 20 seconds on a slow speed contra angle hand piece (10,000 rpm) with a rubber cup and pumice

slurry, then rinsed completely with saline for 10 seconds and air-dried with moderate jets of oil-free compressed air. Only the root section of the teeth was immersed in the self-cure acrylic resin using L formers throughout the specimen preparation process. The teeth were then analyzed for color assessment after the sample preparation. The color of the teeth was evaluated using a spectrophotometer (Vita Easyshade) Compact (Vita Zahnfabrik Germany) before bonding, after debonding and finishing, and after photoaging. This tool allowed very exact color measuring. The color assessment used the Commission Internationale de l'Eclairage's system, which included three color parameters: lightness (L), red/green chromaticity (a), and yellow/blue chromaticity (b) (b). This approach is the most preferred for color measuring because it provides numeric information that is closely related to actual visual reaction. For each color parameter (L, a, b), three consecutive measurements were taken for all study teeth. L1, a1,b1 were the pretreatment values that were obtained. The average value of the three consecutive measures for each tooth was used to calculate the pretreatment and posttreatment hues of the teeth.

Analytical statistics

The data was analyzed using SPSS for Windows version 20.0, which is a statistical package for social sciences. For intragroup comparison, descriptive statistics, one-way ANOVA with repeated measures followed by Bonferroni's post hoc test, and one-way ANOVA followed by Tukey's HSD post hoc test were used. The 95% confidence interval was used. A statistically significant P value is less than 0.05.

Results

The comparison of E1 between various groups is shown in Table 1. TRANSBOND XT had a mean value of 0.910.43, ORMCO was 0.720.24, RELY A BOND was 1.320.61, and BRACEPASTE was 0.970.48. Between the four groups, there was a statistically significant difference (p=0.004). RELY A BOND (1.32 0.61) has a substantially greater value than ORMCO (0.72 0.24). The other groups showed no statistically significant differences.

The comparison of E2 between various groups is shown in Table 2. TRANSBOND XT had a mean value of 1.49.85, ORMCO was 1.88.83, RELY A BOND was 1.82.77, and BRACEPASTE was 2.22.65. Between the four groups, there was no statistically significant difference (p=0.08).

The comparison of E3 between various groups is shown in Table 3. TRANSBOND XT had a mean value of 0.81 0.51, ORMCO was.97 0.55, RELY A BOND was 1.19 0.84, and BRACEPASTE had a mean value of 0.71 0.25. RELY A BOND (1.19 0.84), on the other hand, was much greater than BRACEPASTE (0.71 0.25). Between the four groups, there was no statistically significant difference (p=0.10).

Table 1: Comparison of ΔE1 between various groups.

ΔE	Group	N	Mean	SD	P value	Post hoc analysis
	Transbond XT	10	0.90	0.42		Rely A Bond > Ormco
	Ormco	10	0.71	0.23		
ΔE1	Rely A Bond	10	1.31	0.60	**0.004**	
	BRACEPASTE	10	0.96	0.47		
	Total	40	0.97	0.49		

Table 2: Comparison of ΔE2 between various groups.

ΔE	Group	N	Mean	SD	P value	Post hoc analysis
	Transbond XT	10	1.48	0.84		
	ORMCO	10	1.87	0.82		
ΔE2	Rely A Bond	10	1.81	0.76	0.08	-
	BRACEPASTE	10	2.21	0.64		
	Total	40	1.85	0.79		

Table 3: Comparison of ΔE3 between various groups.

ΔE	Group	N	Mean	SD	P value	Post hoc analysis
	Transbond XT	10	0.80	0.50		
	ORMCO	10	0.96	0.54		
ΔE2	Rely A Bond	10	1.18	0.83	0.10	-
	BRACEPASTE	10	0.70	0.24		
	Total	40	0.91	0.58		

Discussion

The hypothesis explored in this study was that the bonding and debonding techniques could change the color variables of the enamel surface. As a result, the goal of this study was to see how enamel color changes when orthodontic brackets are bonded with an orthodontic resin and a glass-ionomer adhesive. T. Eliades and colleagues [12] Trakya et al investigated the effects of five different orthodontic bonding adhesives on enamel color.2 In their investigation, the mean color difference before treatment, debonding, and finishing & polishing (E1) in the transbond XT group was 0.56±0.53. The discrepancy in values can be related to the polishing procedure. This suggests that the burs used to remove the adhesive has an impact on the color change in the teeth. In vivo investigations on tooth color assessment after orthodontic treatment were undertaken by Karamouzos et al. He discovered that the color of the mean difference after debonding, finishing, and photoageing (E3) was 2.59±0.75 in his investigation. [5] Findings from the current investigation of debonding, finishing, polishing, and photoaging in the Transbond XT group 1.48± 0.84. This disparity in values could be related to the fact that their investigation was conducted in vivo. This was an in vitro experiment. Faltermeier et al studied the color stability of adhesives when exposed to UV light and food colorants. [13]

In this study, the mean difference after debonding, finishing, and photoageing (E3) was 0.80±0.50, whereas in their study, it was 3.27 ±0.57 in the Transbond XT group. This disparity in results could be attributable to the length of photoaging in both trials. This demonstrates that the duration of photoaging has an impact on tooth color alteration. Food dyes and ultraviolet light produced discoloration of orthodontic adhesives, according to Faltermeier et al. [13] In his research, he looked at the color stability of adhesives when exposed to ultraviolet light and food colorants.

In this study, the mean difference after debonding, finishing, and photoageing (E3) was 0.96±0.54, whereas in their study, it was 4.87± 0.77 in the ormco group. This disparity in results could be attributable to the length of photoaging in both trials. This demonstrates that the duration of photoaging has an impact on tooth color alteration. Eliades et al investigated the color change of adhesive throughout treatment and after debonding in their investigation. Photoaging, he claimed, caused color changes in the debonded surfaces over the threshold. The amount of

color modifications in older bonding systems may lead to enamel discolouration after treatment. [14] A similar conclusion was reached in the current investigation, which found that photoaging influenced tooth color alterations. In their investigation, the mean color change in the Ormco group was 8.35± 1.45, whereas it was 1.87±0.82 in the current study. This discrepancy could be related to one-time photoaging in our study versus two-time photoaging in theirs. This demonstrates that the amount of photogeing has an effect on color change. In their investigation on the effects of contemporary orthodontic composites on tooth color following short-term fixed orthodontic treatment, Corecki et al. found that while the color of teeth was influenced by treatment, there were no significant alterations in the color of enamel. [15] In their investigation, the mean total color differences (E) between all assessed teeth before and after orthodontic treatment in the Rely A bond group was 2.36± 1.21, whereas it was determined to be 1.31±0.60 in the current study. This discrepancy in the values could be due to the use of different types of teeth in both studies (mandibular incisors in their study versus premolars in ours), as well as the method of polishing (composite bur in our study versus aluminum oxide disc bur in theirs), implying that the type of polishing system used affects the color change in the teeth. [16]

Conclusion

After debonding and polishing, Ormco Enlight demonstrated the maximum enamel color shift of E2 value 2.91. Rely A bond with an E2 value of 2.79 had the least enamel color change. There is a considerable color shift in the enamel in all of the groups investigated, however it is less than the minimum threshold value of E 3.6 units. Because the photoaging process causes considerable color changes in the enamel, doctors must consider the treatment's duration. After debonding, finishing and polishing methods have a considerable impact on enamel color changes, so finishing and polishing must be done carefully.

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