HRÜ Uluslararası Diş Hekimliği ve Oral Araştırmalar Dergisi Coconut Oil Pulling and Enamel Bond Strength
HRU International Journal of Dentistry and Oral Research
Received date: 28 October 2024 / **Accept date:** 25 December 2024 Karadeniz et al.
DOI: 10.61139/ijdor.1575221

Evaluating the Influence of Coconut Oil Pulling and Adhesive Application Modes on Shear Bond Strength to Enamel

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Abstract

Backround: This study aims to evaluate the effects of coconut oil pulling and two different application modes of Clearfil™ Universal Bond Quick (etch-and-rinse vs. self-etch) on the shear bond strength of composite resins to bovine enamel.
Materials and Methods: Forty healthy bovine incisor teeth were selected, cleaned, and stored in a 0.1% thymol solution for one week. The crowns were separated from the roots and embedded in acrylic resin blocks. Oil pulling group: Samples were treated with coconut oil pulling prior to adhesive application. Non-oil pulling group: Samples did not undergo oil pulling. Two adhesive application modes of Clearfil™ Universal Bond Quick were tested: Etch-and-rinse mode. Self-etch mode. Composite resin was bonded to the enamel surface, and the shear bond strength was measured using a universal testing machine. The results were analyzed using ANOVA, with p-values set at <0.05 to determine statistical significance.
Results: Statistically significant differences were observed between the test groups (p< 0.001). The group treated with coconut oil pulling exhibited lower bond strength compared to the control group without oil pulling. Additionally, the etch-and-rinse application mode resulted in significantly higher bond strength compared to the self-etch mode, regardless of oil pulling treatment.
Conclusions: Coconut oil pulling was found to reduce the shear bond strength of composite resins to bovine enamel. Furthermore, the etch-and-rinse adhesive application mode outperformed the self-etch mode in terms of bond strength. These findings suggest that oil pulling may interfere with adhesive bonding, and the choice of adhesive mode plays a crucial role in optimizing bond strength.

Research Article (HRU Int J Dent Oral Res 2024; 4(3):102-107)

Keywords: Adhesive, oil pulling, shear bond strength.

Introduction

Shear bond strength between composite resins and enamel is crucial for the longevity and success of restorations in dentistry (1,2). Various factors influence bond strength, including the type of adhesive system used and surface pre-treatment methods. Among these, coconut oil pulling has gained significant attention as a traditional oral hygiene practice, particularly in Ayurvedic medicine (3). Oil pulling involves swishing oil, typically coconut oil, in the mouth for an extended period (around 15–20 minutes) with the goal of improving oral health by reducing bacterial load, preventing plaque formation, and promoting overall oral hygiene (4).

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Coconut oil is particularly popular for this practice due to its high lauric acid content, which has antimicrobial properties (5). Proponents of oil pulling claim it can help with a variety of oral health issues, including reducing bad breath, preventing tooth decay, and even improving gum health (6). However, despite its widespread popularity, the scientific evidence supporting these claims is limited and often anecdotal (7).

One area where oil pulling may have unintended consequences is in the bonding of dental materials to enamel. Since oil pulling involves prolonged exposure of teeth to an oil-based substance, it may leave a residue on the enamel surface. This residue could potentially interfere with the adhesion of restorative materials, such as composite resins, by hindering the bonding process or affecting the penetration of adhesive systems. In particular, the hydrophobic nature of oil might create a barrier, preventing optimal bonding between the adhesive and the enamel surface.

Clearfil™ Universal Bond Quick (CUB) is a versatile adhesive that can be applied using both etch-and-rinse and self-etch modes. Each mode has distinct mechanisms of bonding to enamel, and it is unknown how oil pulling prior to adhesive application might influence these bonding mechanisms. Etch-and-rinse adhesives typically involve the use of phosphoric acid to demineralize the enamel surface, providing a more defined bonding surface. On the other hand, self-etch adhesives do not require separate etching, as they etch and prime the surface simultaneously (8). These differences in bonding mechanisms could result in varying bond strengths depending on the presence of oil residues from oil pulling.

This study aims to evaluate how coconut oil pulling influences the bond strength of composite resins to enamel when different adhesive modes (etch-and-rinse and self-etch) are employed. Understanding these effects is important for clinicians to make informed decisions regarding the use of adhesives in patients who practice oil pulling regularly.

Material and Methods

Extracted sound, forty bovine incisors teeth (*n* =40) were gathered, and the calculus, plaque, and remaining tissue were removed with scaling instruments and pumice using a rubber cup. The teeth were stored in 0.1% thymol for 1 week at room temperature and transferred to distilled water at 4°C until specimen preparation. A water-cooled diamond disc (Isomet, Buehler, Lake Bluff, IL, USA) was used to separate crowns from roots. After examination under a stereomicroscope (Leica, Meyer Instruments, Houston, TX, USA) for surface structural damage or defects, the crowns were embedded in a block of acrylic resin (Meliodent, Heraeus/Kulzer, Hanau, Germany) with the buccal surface positioned up for surface treatment and composite bonding. Enamel surfaces were polished with 200, 400, and 600 grit silicon carbide papers. The materials used in the study are presented in Table 1.

The specimens were then randomly divided into four groups (*n* = 10).

Group 1: Acid+ Clearfil™ Universal Bond Quick (CUB) was used with etch-and-rinse mode

Teeth were etched with 37% phosphoric acid for 15 sec, rinsed for 15 sec, and dried for a few seconds until the surface was chalky white.

Clearfil™ Universal Bond Quick (CUB) applied and light cured for 10 sec. with a LED device (3M ESPE Elipar TM S10).

Group 2: Clearfil™ Universal Bond Quick (CUB) was used with self-etch mode

Clearfil™ Universal Bond Quick (CUB)applied and light cured for 10 sec. with a LED device (3M ESPE Elipar TM S10).

Group 3: Coconut oil pulling+ Acid+ Clearfil™ Universal Bond Quick (CUB) was used with etch-and-rinse mode

The specimens were immersed in coconut oil (The Life Co., Istanbul, Turkey) for 15-20 min twice times a day for 2 week and stored in artificial saliva in intervals.

Teeth were etched with 37% phosphoric acid for 15 sec, rinsed for 15 sec, and dried for a few seconds until the surface was chalky white.

Clearfil™ Universal Bond Quick (CUB) applied and light cured for 10 sec. with a LED device (3M ESPE Elipar TM S10).

Group 4: Coconut oil pulling + Clearfil™ Universal Bond Quick (CUB) was used with self-etch mode

The specimens were immersed in coconut oil (The Life Co., Istanbul, Turkey) for 15-20 min twice times a day for 2 week and stored in artificial saliva in intervals.

Clearfil™ Universal Bond Quick (CUB) applied and light cured for 10 sec. with a LED device (3M ESPE Elipar TM S10).

Omnichroma composite resin was applied with a teflon mold (2mm in height, 3,75 mm in diameter) and light cured for 20 seconds. Shear bond strength were analysed by using universal testing machine (Instron,

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National Institute of Technology, Raipur, Chhattisgarh) at a crosshead speed of 1 mm/min. After 24 hr storage in water, Shear bond strengths were analysed by using universal testing machine. A knife-edged loading head which was loaded at the interface between the composite and enamel surface was used and the maximum load at failure was recorded in Newton (N) and converted into megapascal (MPa). After testing, modes of failure were examined using a stereomicroscope under 30x magnification and categorized as adhesive failure, cohesive failure and mixed failure.

Statistical Analysis

The data were analyzed using IBM SPSS V23 software. The normality of the data distribution was assessed using the Shapiro-Wilk test. Two-Way Analysis of Variance (ANOVA) was applied for the comparison of bond strength values according to oil pulling and different adhesive modes for normally distributed data. The Bonferroni test was used for multiple comparisons to identify specific group differences. The relationship between groups and fracture types was analyzed using the Fisher-Freeman-Halton test. Results are presented as mean ± standard deviation for quantitative variables and frequency (percentage) for categorical data. A significance level of $p < 0.050$ was considered statistically significant.

Results

This study evaluated the effects of oil pulling and different adhesive application modes on shear bond strength. The findings are summarized in Tables 2 and 3. Statistical analysis revealed a significant effect of oil pulling on mean bond strength values ($p < 0.001$). The group subjected to oil pulling had a mean bond strength of 18.71 MPa, while the non-oil pulling group exhibited a higher mean value of 20.92 MPa.

Adhesive mode also significantly influenced bond strength ($p < 0.001$). The etch-and-rinse mode yielded a mean bond strength of 20.65 MPa, compared to 18.99 MPa in the self-etch groups.

A significant interaction was observed between oil pulling and adhesive modes ($p = 0.003$). For the oil pulling group, the etch-and-rinse mode produced a mean bond strength of 20.02 MPa, while the self-etch mode resulted in 17.41 MPa. In contrast, the non-oil pulling group showed a mean bond strength of 21.28 MPa with the etch-and-rinse mode and 20.56 MPa with the self-etch mode.

Interestingly, the bond strength in the non-oil pulling group with self-etch adhesive was similar to the values observed in the no-oil-pulling etch-and-rinse group and the oil-pulling etch-and-rinse group. However, it was significantly higher than the bond strength in the oil-pulling self-etch group.

Table 4 examines the relationship between fracture types and groups. No statistically significant correlation was found between fracture types and the groups ($p = 0.418$).

Table 1: Materials used in the Study

Material	**Product Name**	**Manufacturer**
Phosphoric Acid (37%)	Scotchbond™ Universal Etchant	3M, ESPE, ABD
Adhesive	Clearfil™ Universal Bond Quick (CUB)	Kuraray Noritake Dental Inc., Tokyo, Japan
Coconut Oil	The Life Co.	Istanbul, Turkey
Composite Resin	Omnichroma	Tokuyama Dental Corporation, Tokyo, Japan

Table 2: Main Effects

Main Effect	F	p	Partial Eta Squared
Presence of Application	54.579	**<0.001**	0.603
Type of Adhesive	30.984	**<0.001**	0.463
Application Adhesive Type	9.985	**0.003**	0.217

Table 3: Descriptive Statistics of Bond Strength

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Type of Adhesive	Application Present	Application Absent	Total
Total etch	20.02 ± 1[B]	21.28 ± 1.16[A]	20.65 ± 1.24
Self etch	17.41 ± 0.51[C]	20.56 ± 0.99[AB]	18.99 ± 1.79
Total	18.71 ± 1.55	20.92 ± 1.11	19.82 ± 1.74

"Mean ± Standard Deviation; A-C:Interactions with the same letter do not differ."

Table 4: Relationship Between Fracture Types and Groups

Fracture Type	Application Present Total etch	Application Present Self etch	Application Absent Total etch	Application Absent Self etch	Total
Adhesive	0 (0)	3 (30)	1 (10)	3 (30)	7 (17,5)
Cohesive	8 (80)	4 (40)	6 (60)	4 (40)	22 (55)
Mixed	2 (20)	3 (30)	3 (30)	3 (30)	11 (27,5)

P* 0.418 Test Statistic: 6.018

Discussion

The aim of this study was to evaluate the influence of coconut oil pulling and different adhesive application modes (etch-and-rinse and self-etch) on the shear bond strength of composite resins to bovine enamel. The results demonstrated a significant reduction in bond strength in the oil pulling groups and a higher bond strength when the etch-and-rinse mode was used compared to the self-etch mode. These findings provide important insights into the clinical relevance of oil pulling practices and the choice of adhesive systems.

The shear bond strength test is a key method used to evaluate the effectiveness of bonding at the tooth-restoration interface. Recently, the microshear bond strength test, which involves a bonded area of 1mm² or smaller, has become increasingly popular. This is because it is thought that a smaller bonding area results in a more even stress distribution, leading to more accurate measurements (9).

Coconut oil pulling, an ancient practice primarily rooted in Ayurvedic medicine, is believed to reduce oral bacteria and promote oral health (3,10). However, the results of this study suggest that coconut oil pulling may negatively affect the bonding process of restorative materials to enamel. The group subjected to oil pulling exhibited significantly lower bond strength compared to the non-oil pulling group. This finding is consistent with previous studies that suggest oil residues may form a hydrophobic layer on the enamel surface, which could interfere with the penetration and adhesion of hydrophilic adhesive systems (11).

Furthermore, the prolonged exposure of enamel to oil-based substances may hinder the proper etching of the enamel surface. Oil residues might prevent the adhesive from fully penetrating into the demineralized enamel prisms, reducing micromechanical retention. Similar findings were reported by Sood et al.(11) who observed that oil pulling may interfere with the bonding of dental materials by altering surface wettability.

In a study, it was shown that coconut oil pulling had no significant effect on the microshear bond strength of universal adhesive compared to other mouth rinses such as chlorhexidine and probiotic-based mouthwashes. However, in the oil pulling group, a significant difference in bond strength was observed between the etch-and-rinse and self-etch modes. The etch-and-rinse mode demonstrated significantly higher bond strength compared to the self-etch mode when oil pulling was performed (12). This difference was explained by the interaction of lauric acid in coconut oil with salivary components, forming a soap-like layer on the tooth surface (13,14).

The adhesive mode also played a crucial role in determining bond strength in this study. The etch-and-rinse mode produced significantly higher bond strength compared to the self-etch mode, both in the oil pulling and non-oil pulling groups. This result is consistent with existing literature that highlights the superior performance of etch-and-rinse adhesives, particularly when bonding to enamel. Etch-and-rinse systems, which involve the application of phosphoric acid, create a well-defined bonding surface by completely removing the

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smear layer and exposing enamel prisms, resulting in stronger micromechanical interlocking (1).

In contrast, self-etch adhesives rely on simultaneous etching and priming of the enamel surface without the use of separate phosphoric acid. While self-etch adhesives are known for their efficiency and reduced technique sensitivity, their ability to fully etch enamel is limited, which may result in weaker bonds (15). The reduced bond strength observed in the self-etch groups in this study aligns with these findings, particularly when oil residues were present. The oil pulling groups showed a further reduction in bond strength with the self-etch mode, suggesting that self-etch adhesives are more susceptible to surface contamination from hydrophobic substances like oil.

The results of this study have important implications for clinical practice, particularly when treating patients who regularly engage in oil pulling. Coconut oil pulling, while widely regarded for its potential oral health benefits (3), may compromise the adhesion of restorative materials to enamel. Clinicians should be aware of this potential interference, especially when performing restorative procedures in patients who practice oil pulling. Based on the findings of this study, it may be advisable to instruct patients to refrain from oil pulling prior to undergoing bonding procedures to reduce the risk of compromised adhesion.

Additionally, the superior performance of the etch-and-rinse mode in the presence of oil residues suggests that this adhesive system may be the preferred choice for patients who practice oil pulling. The more aggressive etching achieved with phosphoric acid appears to mitigate some of the negative effects of oil residues, resulting in stronger and more reliable bond strength. Future research could focus on developing protocols for cleaning or decontaminating enamel surfaces prior to bonding to remove oil residues effectively.

While this study provides valuable insights, several limitations should be considered. First, bovine enamel was used as a substitute for human enamel, which, while common in laboratory studies, may not fully replicate the conditions of human enamel in vivo (16). Differences in enamel composition, including mineral content and surface structure, could influence adhesion outcomes (17). Future studies should include human enamel specimens to confirm these findings under clinically relevant conditions.

Second, this study focused exclusively on coconut oil. Other oils commonly used in oil pulling, such as sesame or sunflower oil, may have different effects on bond strength. Investigating the effects of various oils and their interactions with different adhesive systems could provide a more comprehensive understanding of how oil pulling practices influence dental restorations. Additionally, future research could explore decontamination protocols or surface treatments to remove oil residues prior to bonding.

Lastly, the controlled laboratory conditions used in this study, including standardized enamel surfaces and adhesive application techniques, may not fully reflect the variability present in clinical settings. Moisture control, operator technique, and the presence of saliva or other contaminants could affect adhesion in a real-world environment. Incorporating thermocycling or long-term water storage into future studies could help simulate clinical conditions more accurately and assess the durability of adhesive bonds over time (18).

Contribution of the authors:
B.K.K.K. - general guidance, final approval for the publication of the manuscript- data collection, analysis and interpretation of the results - development of the concept and editing of the text, final approval for the publication of the manuscript – collection, analysis and processing of the material, writing the text, checking critical intellectual content. - collection, analysis and processing of material, writing text, checking critical intellectual content; – collection, analysis and processing of material, writing text, checking critical intellectual content

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DOI: 10.61139/ijdor.1575221

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