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The Influence of Adhesive Curing Mode (Light vs. Dual) on the Microtensile Bond Strength of CAD/CAM Composite Blocks to Human Dentin :(In-Vitro Study)

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ABSTRACT

Aim: To evaluate the effect of curing mode of adhesive (Light vs. Dual) on micro tensile bond strength (TBS) of CAD/CAM composite blocks to dentin. **Methods and Materials:** Total number of eighteen posterior molars were randomly assigned into 2 groups (n=9 per each group) according to the investigated variable the types of adhesive systems (light and dual cured). Each tooth placed in self-cured acrylic resin and then sectioned parallel to expose dentin. Following 2 groups were: -A) light cured adhesive (one coat universal adhesive), B) Dual cured adhesive (one coat universal adhesive with its activator). Composite blocks (Brilliant, Coltène) milled into 5 mm diameter blocks then cemented to teeth using dual cured (DUO-LINK: Dual cure resin cement). All specimens stored in distilled water at room temperature for 24 hours before thermo-cycling. All specimens thermal cycled in distilled water for 5,000 cycles at 5±2°C/55±2°C. After the approval of the Scientific Research Ethics Committee, Faculty of Dentistry, British University in Egypt. **Results:** Group I [light cured one coat 7 universal adhesive] (19.83 ± 1.25) demonstrated significantly higher micro tensile bond strength than Group II [Dual cured adhesive one coat 7 universal adhesive] (11.78 ± 1.25). **Conclusions:** Regarding of curing mode of adhesive system, light cured adhesives outperformed dual cured adhesives in bond strength.
are clinically reliable and can be chosen based on workflow needs without compromising restoration quality.

Keywords: *Self-etch, Microtensile bond strength, Light cure, dual-cure*

INTRODUCTION

Indirect tooth-colored restorations like resin composites and all-ceramics are popular due to their aesthetics, biocompatibility, and ability to restore severely damaged teeth. CAD/CAM technology allows for single-appointment fabrication of these restorations. (1) However, a strong and lasting bond to the underlying dentin is crucial for their success. (2) Dentin's heterogeneity and moisture make bonding challenging, and indirect restorations have more interfaces (tooth-adhesive, restoration-adhesive) compared to direct composites. (3)(4) The adhesion process is technique-sensitive, involving bonding agents and resin cements. To simplify procedures and reduce technique sensitivity, self-etch adhesives were introduced, but their enamel bond strength was insufficient, leading to the development of multimode/universal adhesives that can be used with different etching techniques (etch-and-rinse, self-etch, selective enamel etch). (5)(6)

Some light-cured adhesives can act as permeable membranes, leading to water diffusion and bond failure. (7) Dual-cure activators are used to address this. Microtensile bond strength (µTBS) is a common method to assess the bond strength between restorative materials and dentin. This study aimed to determine how different adhesive systems (light-cured and dual-cured) affect the micro-tensile bond strength of CAD/CAM composite blocks to dentin. The study's null hypothesis was that there will be no difference in the micro-tensile bond strength based on the different curing methods of the various adhesive systems.

Materials & Methods

The following materials were used in this study

I.1. One Coat 7.0 Universal Bond (Coltène Whaledent, Switzerland)
I.2. One Coat 7.0 Dual-Cure Activator (Coltène Whaledent, Switzerland)

I.3. Duo-link resin cement: Duo-link (Bisco, U.S.A)
I.4. Brillant Crios CAD/CAM Blocks (Coltène Whaledent, Switzerland)

All materials' specifications, compositions and manufacturers were written in Table (1).

The following devices were used in this study

Elipar™ Deep Cure- L: LED curing light unit (3M ESPE, Germany)

Aqua Care Twin Device: Air abrasion unit (Velopex , London)

Aluminum Oxide Particles: Air abrasion particles (Velopex International , London)Table 1: Materials' specifications, compositions, manufacturers.

Table 2: Materials' specifications, compositions, manufacturers

Material	Specification	Composition	Manufacturer
One Coat 7	Light-cure Universal Adhesive	Methacrylate acid, other photo initiators, water, 10-MDP, polyacrylic methacrylates, ethanol.	Coltene, Whale Dent AG, Switzerland
One coat 7.0 DC Activator	Dual-cure Activator for One coat Adhesive	**DC activator**: Ethanol, water, activator	Coltene, Whale Dent AG, Switzerland.
Duo-link	Dual-cure resin cement Shade: Milky white	Base/catalyst: Bis-GMA 10-<15%, TEGDMA 5-<10%, zinc oxide coated 1-<5%, dibenzoyl peroxide <1%, sodium fluoride <1%	BISCO, Inc. 1100 W. Irving Park Road Schaumburg, IL 60193 U.S.A.
Abbreviations: MDP: MethacryloyloxyDecyldihydrogen Phosphate, Bis-GMA: Bis phenol A Glycidyl Methacrylate, TEGDMA: Triethylene Glycol Dimethacrylate and.			

Sample Size Calculation

To ensure the study could reliably detect differences in bond strength between groups, a power analysis was performed. This analysis determined that 18 samples were needed, based on a desired statistical power of 80%, a significance level of 0.05, and an expected effect size from previous research of **(Lurs et al 2013)** (8). To account for potential issues during testing, the sample size was increased by 30% to a total of 18 samples. G*Power software (version 3.1.9.7) was used for this calculation.

Teeth selection

Eighteen sound, recently extracted permanent molars from 25–35-year-olds were carefully selected. They were cleaned, checked for defects under magnification, and stored in cold distilled water. Teeth with any damage, decay, or previous treatments were excluded from the study.

Experimental Design

For the microtensile bond strength tests, 18 molars were randomly chosen, with one specimen prepared from each tooth, resulting in 18 specimens. These specimens were then randomly divided into two groups, with nine specimens per group (n=9). The type of adhesive system (light-cured and dual-cured). As followed: -

- ***Group 1*:** light Cured Adhesive.
- ***Group 2*:** Dual Cured Adhesive.
-

Mounting of teeth

Each selected tooth was embedded in a cylindrical block (1.5 cm diameter, 2 cm height) made of self-curing acrylic resin (Acrostone, Egypt). This was done using a mold that could create four blocks simultaneously. Each tooth was positioned upright with its chewing surface facing up while the acrylic was still pliable. The acrylic resin was then allowed to harden at room temperature. Once set, the blocks were removed from the mold and carefully inspected.

Specimen Preparation

A water-cooled diamond saw was used to make a horizontal cut, completely removing the enamel layer from the chewing surface of each tooth to expose the deep dentin. The removal of enamel was verified under a 20X microscope (ZEISS, Germany). The exposed dentin surface was then polished with #180 grit silicon carbide paper (Sic) (Struers, Denmark) to create a flat surface. Subsequently, a standardized smear layer was created by wet grinding the dentin surfaces with #600

Sic abrasive paper for 1 minute under constant water flow, mimicking the smear layer formed during clinical tooth preparation (9). All prepared molars were stored in distilled water at 4°C, with the water changed every five days, until the restorations were placed. (9)

CAD/CAM Restoration Preparation

Eighteen CAD/CAM composite blocks (size 14) were used in the study. Each block was cut into 5mm x 5mm square pieces using a slow-speed saw with a water-cooled diamond blade (Isomet 4000 Buehler, USA). After cutting, each restoration was inspected for any cracks or chipping and would have been replaced if defects were found. The cut blocks were then cleaned in an ultrasonic scaler (Acteon Satelec Newtron, UK) using three different solutions in sequence: distilled water, 95% ethanol, and distilled water, each for 3 minutes, to remove any contamination from the milling process.(10)

Dentin Surface Pretreatment and Adhesive Curing Mode

A consistent surface treatment was applied to all specimens using a universal adhesive in self-etch mode, following each manufacturer's instructions. A micro brush ensured even adhesive distribution, a 20-second conditioning period allowed for penetration, and a 10-second air-thinning step removed excess solvent.

- **Group I (Light-Cured, Pre-Cured):** One coat of One coat 7.0 adhesive was applied and then light-cured for 20 seconds using a specific LED curing unit (1470 mW/cm², 430-480 nm).
- **Group II (Dual-Cured):** One coat 7.0 adhesive was mixed with its dual-cure activator, applied, air-dried for 5 seconds, and then light-cured for 20 seconds using the same parameters as Group I.

Cementation Procedure

A thin layer of dual-cured resin cement (Duo-link, Bisco) was carefully applied to both the prepared dentin and the inner surface of the CAD/CAM composite restoration. The restoration was then precisely placed using sticky sticks. To allow for easy removal of extra cement, a brief 2-second light-curing was done on all external sides of the restoration. The excess cement was then removed with a hand scaler (Zeffiro, Italia) to create a clean margin. Glycerin gel was applied to the exposed cement edges to ensure proper hardening by preventing oxygen interference, as per the manufacturer's instructions. Final light-curing was done for 20 seconds on each side (proximal, buccal, lingual) using an Elipar™ LED curing light (3M ESPE, USA) for optimal material properties. Any remaining cement at the restoration edges after cementation was carefully removed with a sharp lancet to avoid issues. (11)

Storage of Specimens and Thermo Cycling

Bonded specimens were kept in distilled water at room temperature for 24 hours before undergoing thermal cycling. They were then subjected to 5,000 cycles of temperature changes between 5±2°C and 55±2°C in distilled water, with each temperature maintained for 50 seconds and a 10-second transfer time between baths, using a thermo cycling device (Julabo, Germany).(12)

Micro Tensile Bond Strength Testing

Bonded samples were cut into tiny beams (around 1mm² bond area) using a slow-speed diamond saw with water cooling. Several beams were taken from the center of each sample. Each beam was glued to a special testing device and pulled apart in a machine until it broke. The force needed to break it was recorded, and the bond strength was calculated by dividing this force by the beam's size. (13)

Data collection and Statistical Analysis

The study's results were recorded and analyzed using SPSS software. Averages and spreads of the data were calculated, and the data was checked to see if it followed a normal distribution. Two-way ANOVA was used to see how different factors and their combinations influenced bond strength. If overall differences were found, further tests (one-way ANOVA and post-hoc tests) compared specific groups. A Chi-square test was used to see if the way the samples broke differed between the groups.

Fracture-pattern analysis:

All specimens with fractured dentin and rod surfaces were examined under a stereomicroscope (SMZ 745T, Nikon, Japan) at 8x magnification. Images of each failed bonded area were captured using a digital camera (WAT221S, Japan) attached to the microscope.

The failure modes were categorized as follows:

1. **Adhesive Failure:** The fracture occurred at the interface between the CAD/CAM resin composite rod, the resin cement, or the resin cement and dentin.
2. **Mixed Failure:** The fracture occurred at the resin-dentin interface, with either a portion of the cement or the CAD/CAM resin composite rod still attached to the dentin surface.
3. **Cohesive Failure:** The fracture occurred within either the dentin structure itself or the CAD/CAM resin composite rod.

Results

<u>Micro-tensile bond strength</u>

Descriptive results of micro tensile bond strength in all groups (minimum, maximum, mean, and standard deviation) were presented in *Table (2)* and (*Figure 1).* Comparison between all groups was performed by using One Way ANOVA test which revealed that there was a significant difference between them as P<0.0001, followed by Tukey`s Post Hoc test for multiple comparisons *Table (3*) which revealed that: Group I [light-cured one coat 7 universal adhesive] (19.83 ± 1.25) demonstrated significantly higher micro tensile bond strength than Group II [Dual-cured one coat 7 universal adhesive] (11.78 ± 1.25).

Table 2: Micro tensile bond strength in all groups, comparison between them using One Way ANOVA test:

	Minimum	Maximum	Mean	Standard Deviation	p-value
Group I	18.30	21.80	19.83 a	1.25	**<0.0001***
Group II	10.60	14.20	11.78 b	1.25	

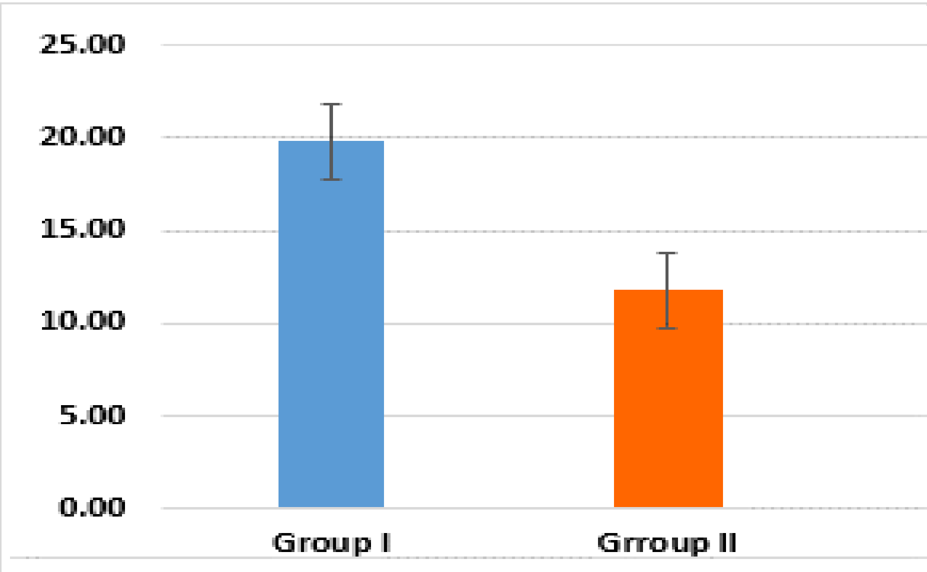

FIGURE 1: BAR CHART REPRESENTING COMPARISON BETWEEN GROUPS.

Table 3: Tukey's Post hoc test for multiple comparisons

Tukey's multiple comparisons test	Mean 1	Mean 2	Mean Diff.	SE of diff.	95.00% CI of diff.	P Value
Group I vs. Group II	19.83	11.78	8.049	0.4654	"6.720 to 9.378"	<0.0001

DISCUSSION

Indirect tooth-colored restorations are a common solution for extensively damaged teeth, and achieving a strong, lasting bond to the underlying dentin is crucial for their long-term success. This bond prevents leakage, provides support, and improves appearance. (14) However, dentin's complex and moisture-sensitive nature makes bonding more challenging than with enamel. While light-cured adhesives are widely used, some are not fully waterproof. This allows water to permeate the adhesive layer, potentially forming water droplets or "trees" at the adhesive-dentin interface. These water formations can significantly weaken the bond, leading to premature restoration failure like debonding or secondary cavities. (15) To address this water diffusion issue in light-cured adhesives, manufacturers have incorporated dual-cure activators, either within the system or as separate components. These activators trigger a secondary curing process that can reduce the adhesive's permeability and enhance its resistance to water. (16)

The most widely used universal adhesives incorporate10-methacryloyloxydecyl dihydrogen phosphate (MDP), a functional monomer that facilitates strong adhesion to tooth surfaces by forming insoluble calcium salts. This system often includes additional components such as Dipentaerythritol penta-acrylate phosphate ester and polyalkenoic acid, which further enhance the chemical bonding of the resin to the tooth structure. (17) In this study, one-coat universal adhesive containing 10-MDP was employed. It is light-cured adhesive and also used as dual-cured adhesive mixed with it is activator. The adhesive industry had tried to make bonding easier and more reliable. One way to do this is by adding chemical cure to a light-curing step. This would help with bonding restorations in cases where light cannot easily reach, such as in deep, inaccessible areas. (18)

Moreover, A study by **Yamauchi et al. in 2019. (19) demonstrated** the efficacy of universal adhesives in bonding to tooth structure regardless of the etching mode employed, suggesting that the underlying bonding mechanisms may vary between the two techniques. Given these considerations, a self-etch universal adhesive was selected for use in this study. (19)

This study aimed to investigate how different curing modes (light-cured and dual-cured) of universal adhesive systems affected the micro-tensile bond strength of CAD/CAM composite blocks to dentin. The study's null hypothesis proposed that the curing mode used with different adhesive systems will not impact the micro-tensile bond strength to dentin. The findings revealed a significant impact of curing modality on the resulting bond strength, leading to the rejection of the null hypothesis that there would be no difference in µTBS across the tested conditions.

Effect of Curing Modalities: The study demonstrated that a light cure of universal adhesive (Group I: 19.83 ± 1.25 MPa). The results of the present study were in agreement with **Kamel et al. in 2022 (16), Bayindir and Ölçer in 2023. (20)**

The superior performance of the light-cured adhesive (One Coat 7) likely attributed to the presence of the functional monomer 10-methacryloxidecyl dihydrogen phosphate (10-MDP). 10-MDP forms strong chemical bonds with calcium ions in dentin's hydroxyapatite, creating stable MDP-Ca salts that enhance the mechanical resistance of the adhesive interface and establish a robust chemical interaction. Furthermore, the water-insoluble nature of MDP-Ca salts contributes to the preservation of collagen fibers within the dentin structure. (21) The adsorption-induced dissolution of the hydroxyapatite surface by 10-MDP, followed by the deposition of these insoluble salts, facilitates an intense chemical interaction. The hydrophobic nature of 10-MDP also allows for deeper penetration into dentin tubules, improving micromechanical retention. Additionally, light-cured adhesives generally exhibit lower polymerization shrinkage compared to dual-cured adhesives, minimizing stress on the bond interface. (22)

The observation of consistently lower microtensile bond strength (µTBS) with the dual-cured adhesive (One Coat 7 + Activator) when compared to its light-cured counterparts underscored the delicate interplay of chemical components and activation mechanisms in achieving optimal adhesion to tooth structure. The necessity of an activator to initiate the chemical curing pathway in the dual-cured system introduced several potential drawbacks that could compromise the integrity of the adhesive interface. One primary concern revolved around the **impact of the activator's constituents, specifically ethanol and water, on the carefully balanced composition of the original adhesive**. The addition of these solvents could significantly disturbed the established **solvent/water ratio**, which is critical for facilitating proper monomer penetration into the etched dentin and the subsequent diffusion of resin within the collagen fibril network. An altered solvent environment might hinder the effective interaction of the adhesive monomers with the tooth substrate, ultimately leading to a less intimate and weaker bond. (23) Furthermore, the mere volumetric addition of the activator inevitably results in the **dilution of the functional monomer concentration**, including the pivotal 10-MDP. A reduced presence of these key bonding agents directly translated to a decrease in the number of available reactive sites for chemical interaction with the calcium ions in hydroxyapatite, thus diminishing the potential for strong, durable chemical bonds. Beyond the immediate impact on monomer concentration and penetration, the **elevated solvent/water content** introduced by the activator could also detrimentally affected the crucial processes of **solvent evaporation and resin polymerization**. (15) Residual solvents trapped within the adhesive layer could acted as plasticizers, leading to a softer, more flexible, and ultimately weaker bond that was more susceptible to degradation over time. Moreover, an excess of water could interfere directly with the polymerization reaction of the resin monomers, potentially resulting in an **incompletely cured polymer network**. Such a compromised network would lack the inherent strength and stability required to withstand the complex biomechanical forces within the oral cavity, increasing the risk of bond failure and microleakage. (24)

The observation regarding **dual-cured adhesives used in self-etching mode exhibited a lack of dense hybrid layer formation** (22) further elucidated a critical limitation. The formation of a well-defined and densely infiltrated hybrid layer – the micromechanical interlock zone created by resin embedding within the demineralized collagen fibril network – is a fundamental prerequisite for durable dentin bonding. Self-etching adhesives aimed to simplify the bonding procedure by combining etching and priming steps. However, the specific chemical environment created by the dual-cured system, particularly with the introduction of the activator, might not optimally conditioned the dentin surface to facilitate thorough resin infiltration. This could lead to **superficial demineralization** and a **poorly formed, less resilient hybrid layer**, which represents a significant weak point at the adhesive-dentin interface. (20) (23)

Finally, while the **dual-cure mechanism offered the theoretical advantage of ensuring adequate polymerization even in areas with limited light access**, it also introduced the potential for complications related to the chemical activation pathway. In situations where **light penetration was insufficient** to effectively initiate and control the polymerization process, the **chemical activation takes precedence**. However, this chemically driven polymerization could be more **spontaneous and less controlled** than light-curing. This rapid, uncontrolled hardening of the adhesive could lead to the development of higher internal stresses within the resin, potentially compromising the adaptation of the adhesive to the tooth surface and resulting in a weaker, more brittle bond. Light-curing, on the other hand, allowed for a more gradual and often incremental polymerization, which could help to minimize the development of such detrimental stresses at the bonding interface (16) (24).

Failure Mode Analysis: The study's failure mode analysis revealed a correlation between bond strength and failure type. Group with higher bond strengths (Group I) predominantly exhibited mixed failures (adhesive and cohesive within dentin or composite), suggesting a strong adhesive interface where failure occurred within the surrounding substrates. Conversely, group II with lower bond strengths showed a predominance of adhesive failures at the adhesive-dentin interface, indicating a weaker bond. High cohesive dentin failures, while indicative of a strong bond, can be influenced by specimen preparation techniques, potentially complicating the interpretation of failure modes. (25)

Conclusion:

Under the limitations of the current study, the following conclusions were ascertained:

1. The bond strength of CAD/CAM Resin composite blocks to dentin was highly affected by the curing modality of adhesive.
2. Regarding of curing mode of adhesive system, light cured adhesives outperformed dual cured adhesives in bond strength of CAD/CAM composite blocks to dentin.

REFERENCES

1. Roperto R, Akkus A, Akkus O, Lang L, Sousa-Neto MD, Teich S. Effect of different adhesive strategies on microtensile bond strength of computer aided design/computer aided manufacturing blocks bonded to dentin. Dent Res J (Isfahan). 2016 Mar-Apr;13(2):117–123.

2. Araoka D, Hosaka K, Nakajima M, Foxton R, Thanatvarakorn O, Prasansuttiporn T. The strategies used for curing universal adhesives affect the micro-bond strength of resin cement used to lute indirect resin composites to human dentin. Dent Mater J. 2018 September;37(3):506–14.
3. Kim JY, Cho GY, Roh BD, Shin Y. Effect of curing mode on shear bond strength of self-adhesive cement to composite blocks. Materials (Basel). 2016 March;9(3):1–10.
4. Abad-Coronel C, Naranjo B, Valdiviezo P. Adhesive systems used in indirect restorations cementation: Review of the literature. J Dent. 2019 July;7(3): 71.
5. Elsayed AE, Kamel MA, El-Askary FS. Adhesion strategy and curing mode of a universal adhesive influence the bonding of dual-cured core build-up resin composite to dentin. J Adhes Sci Technol. 2020 June;35(1):52–62.
6. Muñoz MA, Luque I, Hass V, Reis A, Loguercio AD, Bombarda NHC. Immediate bonding properties of universal adhesives to dentine. J Dent. 2013 May;41(5):404–11.
7. Muñoz MA, Luque-Martinez I, Malaquias P, Hass V, Reis A, Campanha NH, et al. In vitro longevity of bonding properties of universal adhesives to dentin. Oper Dent. 2015 May;40(3):282–92.
8. Lührs AK, Pongprueksa P, De Munck J, Geurtsen W, Van Meerbeek B. Curing mode affects bond strength of adhesively luted composite CAD/CAM restorations to dentin. Dent Mater J. 2013 November;30(3):281-291.
9. Samy L, Samaha A, El-Askary F. CAD/CAM Surface Treatment And Type Of Adhesive Affect CAD/CAM Composite Bonding To Dentin. Egyptian Dent J. 2021 July;67(3):2711–23.
10. Muhammed HA, Mahmoud EM, Fahmy AE, Nasr DM. The effect of sandblasting versus acid etching on the surface roughness and biaxial flexural strength of CAD/CAM resin-matrix ceramics (In vitro study). BMC Oral Health. 2023 Dec 1;23(1).
11. Meda EM, Rached RN, Ignácio SA, Fornazari IA, Souza EM. Effect of different adhesive strategies and time on microtensile bond strength of a CAD/CAM composite to dentin. Oper Dent. 2019;44(3):262–72.
12. Eliasson ST, Dahl JE. Effect of thermal cycling on temperature changes and bond strength in different test specimens. Biomater Investig Dent. 2020 Jan 1;7(1):16–24.
13. Sano H, Chowdhury AFMA, Saikaew P, Matsumoto M, Hoshika S, Yamauti M. The microtensile bond strength test: Its historical background and application to bond testing. Vol. 56, Japanese Dental Science Review. Elsevier Ltd; 2020. p. 24–31.
14. Miura S, Fujisawa M. Current status and perspective of CAD/CAM-produced resin composite crowns: a review of clinical effectiveness. Japanese Dental Science Review; 2020 October;56(1):184–9.
15. Tang C, Mercelis B, Ahmed MH, Yoshihara K, Peumans M, Van Meerbeek B. Adhesive Performance Assessment of Universal Adhesives and Universal Adhesive/Composite Cement Combinations. J Adhes Dent. 2023 November 2;25(1):241–56.
16. Kamel M, Mehena M, Soliman Z. The impact of application mode of three universal adhesives with different chemical compositions and curing techniques on their micro shear bond strength to dentin. Egypt Dent J. 2022 October;68(4):3783–91.
17. Santander-Rengifo F, Carreras-Presas CM, Aroste-Andía R, Hernández-Huamaní E, Gavilán-Chávez P, Cervantes-Ganoza L, et al. Microtensile Bond Strength and Failure Mode of Different Universal Adhesives on Human Dentin. Int Dent J. 2024 April;74(6):1239-1247.
18. Vidal CMP, Teixeira EC, Armstrong SR, Qian F. Comparison of Adhesion Performance of a Self-curing and a Light-curing Universal Adhesive to Various Dental Substrates and CAD/CAM Materials. J Adhes Dent. 2024 January;26(26):31–40.
19. Yamauchi K, Tsujimoto A, Jurado CA, Shimatani Y, Nagura Y, Takamizawa T, et al. Etch-and-rinse vs self-etch mode for dentin bonding effectiveness of universal adhesives. J Oral Sci. 2019 February;61(4):549–53.
20. Bayindir YZ, Ölçer E. Effect of dual-cure activators on dentin bond strengths of universal adhesives. Int J Appl Dent Sci. 2023 September;9(4):88–95.
21. Da Rosa WLDO, Piva E, Da Silva AF. Bond strength of universal adhesives: A systematic review and meta-analysis. J Dent. 2015 April;43(7):765–776.
22. Michaud PL, Brown M. Effect of universal adhesive etching modes on bond strength to dual-polymerizing composite resins. J Prosthet Dent. 2018 April;119(4):657–62.
23. Rathke A, Balz U, Muche R, Haller B. Effects of self-curing activator and curing protocol on the bond strength of composite core buildups. J Adhes Dent. 2012 January;14(1):39–46.
24. Gureztiér MF, Sutil E, Malaquias P, de Paris Matos T, de Souza LM, Reis A. Effect of self-curing activators and curing protocols on adhesive properties of universal adhesives bonded to dual-cured composites. Dent Mater J . 2017 July;33(7):775–87.

25. Osorio R, Pisani-Proenca J, Erhardt MCG, Osorio E, Aguilera FS, Tay FR, Toledano M. Resistance of ten contemporary adhesives to resin-dentine bond degradation. J Dent. 2008 February;36(2):163–9.