

Assessment of Bond Strength of Different Dentin Bonding Agents

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Keywords

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Abstract

Objectives: To assess the shear bond strength of the fifth, sixth, seventh and eighth generations of bonding agents.

Materials and method: 40 newly extracted premolars were chosen, categorised into 4 categories of 10 samples each, and assigned as follows: Group A includes the fifth-generation bonding agent Prime and Bond NT from Dentsply, Group B includes Adper SE Plus from 3M ESPE, Group C includes Xeno V from Dentsply India, and Group D includes the 8th-generation bonding agent (One Coat 7 Universal). An air rotor was used to reveal the coronal dentin. After applying the dentin bonding agents, the composite was then placed on the previously exposed surface. Then, to test the shear bond strength a universal testing machine was used. Statistics were used to analyse the data.

Results: The eighth generation of bonding agent had the highest shear bond strength, subsequently the fifth, seventh, and lowest with the 6th generation (p 0.05).

Conclusion: The eighth generation of dentin bonding agents showed the strongest shear bond strength to dentin and required fewer steps in the process than other generations.

1. Introduction

Today, composite resins are used more frequently as an aesthetic substitute for dental amalgam. The cavities are first prepped with an adhesive system before the placement of composite restorations. The field of adhesive dentistry is developing quickly. The Latin word "adherence," which denotes to stick, is where the word "adhesion" derives from.¹ Over many generations, dental adhesive systems have undergone numerous changes to their chemistry, mode of operation, and number of steps. Dentin bonding is the

micromechanical attachment of dental restorations, especially composites, to human dentin through a layer of intermediary adhesive resin. Dentin bonding generations starting at 5, 6, 7, and 8th are available.^{1,2}

Dentin adhesives can be applied to the tooth surface in a variety of ways, including three-, two-, or one-step method. This all based on how to do the steps of etching, priming, and bonding.¹

Journal of Coastal Life Medicine

Simpler solutions were required because the fourth generation of dentin bonding type was so difficult to use and time-consuming. The 5th generation of bonding agents, systems in which the primer and adhesives were combined and available as a single system, represented the first simplification. Despite the fact that they were once regarded as the clinical gold standard for dental bonding, three-step etch-and-rinse adhesives.¹

The concept of "self-etch" adhesives has recently gained popularity. The 6th-generation bonding agents composed of an acidic primer and a bonding resin independently, while the seventh-generation bonding agents are self-etch adhesives that combine an etchant, primer, and bonding agent in one constituent and are applied in one step. In conjunction with bifunctional or multifunctional monomers, HEMA monomer is used in self-etch adhesive systems to enhance the wettability of the dentin surface. They propose some benefits compared to conventional etch-and-rinse type, such as a technique that is less sensitive and a decrease in postoperative sensibility.¹ The conditioner, primer, and resin are all in a solution and are applied to enamel and dentine simultaneously in the self-etching system (6th, 7th, and 8th generation).³

The creation of a resin-impregnated layer, also known as a hybrid layer, heavily influences the bonding. The smear layer removal which is attached to the dentine is a crucial step in this process.¹ Two crucial aspects of dentin bonding systems that contribute to the stability of composite restorations are shear bond strength and microleakage. Along with some research, the bonding rate in single stage systems (sixth, seventh, and eighth generations) is 26–27 MPa and between 5–32 MPa in multistage systems (fourth and fifth generations).³

The goal of the current research was to compare and analyse the bond strengths of various generations of bonding agents.

2. Materials And Method

For the study, 40 recently extracted, healthy human teeth were chosen, and 10 samples

were evenly distributed among 4 groups, with each group. With the aid of a 1 cm 1 cm 1 cm custom modelling wax mould, the teeth were inserted perpendicularly in cold-cure acrylic resin. To reveal a flat dentin surface, the occlusal surfaces of the teeth were adjusted with the aid of a carbide bur while being continuously misted with water.

The following four experimental groups of various bonding agents were created from the prepared samples: Group A includes the 5th-generation bonding agent Prime and Bond NT from Dentsply, Group B includes Adper SE Plus from 3M ESPE, Group C includes Xeno V from Dentsply India, and Group D includes the 8th-generation bonding agent (One Coat 7 Universal).

Following the manufacturer's directions, the bonding agent was applied to the surface in each group and light-cured. Using a plastic mould with dimensions of 2 mm in diameter and 3 mm in height, the composite was applied in increments of two. The composite underwent a 20-second light cure. Shear bond strength analysis was done on each sample. Later, to test the shear bond strength a universal testing device was used. The amount of shear force needed to break the specimen's bond was noted. Calculated in kgf and then converted to N, the bond strength.

SPSS edition 23 was applied to tabulate the data and perform statistical analysis on it. A one-way ANOVA and t test were used to compare the variable among groups.

3. Result

Sixth generation bonding agents had the lowest shear bond strength, followed by 5th, 7th, and 7th generation bonding agents (Table 1). The intergroup comparison is shown in Table 2, and the statistical significance of the force difference (measured in Newtons) is determined to be 0.05 (p 0.05). On comparison to the 5th, 7th, and 6th generations, correspondingly, the shear bond strength of the eighth-generation adhesives to dentin was significantly higher.

4. Discussion

By offering good marginal adaptation, the strength of the bond among dentin and resin adhesive systems is crucial to its success in clinical dentistry.² Bond strength is influenced by the type of tooth, the dentin surface, the type of bonding agent used, the storage medium, the composite restorative material, and the testing procedure. Shear and tensile bonds are the two types of bonds that are tested.¹

The four bonding agents under test were examined in the current *in vitro* study. In this study, eighth-generation dentin adhesives One Coat 7 indicated the maximum average shear bond strength (Universal).

The shear bond strength of the 5th, 6th, 7th, and 8th generations of bonding agents was assessed by Chauhan et al. They came to the conclusion that the eighth generation of dentin bonding agents, which had the advantage of requiring fewer steps in the process than earlier generations of dentin bonding agents, had the strongest shear bond strength to dentin.¹ These results concur with our own.

Nair et al. compared the shear bond strengths of 6th generation and 7th generation bonding agents to dentin. They came to the conclusion that seventh generation adhesives are preferable to 6th generation adhesives for bonding dentin because they require less time, fewer steps, and have stronger bonds.²

After comparing the shear bond strengths of 3 various 5th generation dentin bonding agents, Gangurde et al. came to the conclusion that Single Bond and Prime and Bond NT showed the highest number of adhesive bond failures.⁴ According to Cheema and Choudhary, Xeno V+, single bond universal, and Clearfil SE delivered the highest shear bond strength values. Compared to one-step, two step self-etch recorded higher shear bond strength values.⁵

According to Meshki et al., the 8th generation bonding system had a stronger push-out bond than the other groups. Therefore, composite

posts can be bonded to the intracanal dentin of primary anterior teeth using bonding agents of the eighth generation. Additionally, self-etch (8th generation) has a stronger bond than total-etch.⁶ The bond strength was found to be highest when using the fifth-generation bonding agent, followed by the sixth and eighth. Thanikachalam et al. investigated how different bonding techniques affected the retention of fibre posts in the coronal, middle, and apical dentin regions.⁷ According to Adyanthaya et al., bond strength values are a good way to gauge how well restorative bonding materials adhere to dentin. Due to its less technique-dependent nature, the shear bond strength will also highlight the strength at the bonded interface.⁸ According to Kamble et al., the 8th generation dentine adhesive (Futura DC, Voco, Germany) produced the maximum tensile bond strength in contrast to the 6th (Adper SE plus, 3M ESPE) and 7th generation (G-Bond) dentin bonding agents.⁹ The 7th generation bonding agent had the maximum shear bond strength, which was followed by the 5th, 7th, and least with the 6th generation bonding agent. The findings need to be confirmed by additional research.

5. Conclusion

The 7th generation bonding agent had the maximum shear bond strength, subsequently the 5th, 7th, and least with the 6th generation bonding agent. This facilitates choosing bonding agents.

References

- [1] Chauhan U, Dewan R, Goyal NG. Comparative Evaluation of Bond Strength of Fifth, Sixth, Seventh, and Eighth Generations of Dentin Bonding Agents: An *In Vitro* Study. *J Oper Dent Endod*. 2020;5(2):69–73.
- [2] Nair M, Paul J, Kumar S, Chakravarthy Y, Krishna V, S. Comparative evaluation of the bonding efficacy of sixth and seventh generation bonding agents: An *In-Vitro* study. *J Conserv Dent*. 2014;17:27-30.
- [3] Shafiqh, E., Mahdavi, M. R., Nasiri, R. Evaluation and Comparison of Micro Shear of 5th, 7th and 8th Generation Bonding Agents in Dentin (*In Vitro* Study). *Arch Pharma Pract*. 2020;11(S1):145-50.

Journal of Coastal Life Medicine

- [4] Gangurde LB, Pawar MG, Shenoy vU, Margasahayam SV. A Comparative Evaluation of the Shear Bond Strength of Three Different Fifth Generation Dentin Bonding Agents: An *in vitro* Study. J Contemp Dent. 2014;4(1):1-5.
- [5] Cheema R, Choudhary E. An in-vitro comparative evaluation of shear bond strength of different self-etch dentin bonding agents. International Journal of Contemporary Medical Research. 2016;3(2):473-478.
- [6] Meshki R, Khataminia M, Beigi S, Salehi Veisi M. Comparison of the Push-Out Bond Strength of 5th, 6th,7th and 8th Generation Bonding Agents to Intracanal Dentin of Primary Anterior Teeth. Journal of Babol University of Medical Sciences. 2023; 25(1): 26-35.
- [7] Thanikachalam Y, Kadandale S, Ilango S, Parthasarathy R, Vishwanath S, Srinivasan S. Comparative evaluation of retention of fiber posts in different dentin regions using various bonding techniques: An In Vitro Study. Cureus. 2023; 15(1): 1-8. e33971. DOI 10.7759/cureus.33971
- [8] Adyanthaya BR, Gazal S, Mathur M, Srivastava A, Meena SK. To Compare and Evaluate the Shear Bond strength of Sixth and Seventh-generation Bonding Agents. Int J Clin Pediatr Dent. 2022;15(5):525-528.
- [9] Kamble SS, Kandasamy B, Thillaigovindan R, Goyal NK, Talukdar P, Seal M. In vitro Comparative Evaluation of Tensile Bond Strength of 6th, 7th and 8th Generation Dentin Bonding Agents. Journal of International Oral Health. 2015; 7(5):41-43

Tables

Table 1: Mean bond strength for all the groups in Newtons

Bonding agent type	Mean \pm SD (Force in Newtons)
Group A: 5h-generation bonding agent	24.2310 \pm 7.04785
Group B: 6th-generation bonding agent	15.4567 \pm 8.00645
Group C: 7th-generation bonding agent	20.3216 \pm 5.76312
Group D: 8th-generation bonding agent	38.3278 \pm 12.34521

Test used- ANOVA test , $p < 0.05$

Table 2: Intergroup comparison for bond strength

Group comparison	Mean \pm SD	<i>p</i>
Group A vs B	8.7743	0.42
Group A vs C	3.9094	0.05
Group A vs D	-14.0968	0.01
Group B vs C	-4.8649	0.01
Group C vs D	-18.0062	0.001

Test used- t test , $p < 0.05$