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Comparative Evaluation of Shear Bond Strength of 6th, 7th and 8th Generation Bonding Agent to Dentine: An In-Vitro Study

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ABSTRACT

Background: Adhesive dentistry has progressed through multiple generations; each designed to simplify bonding procedures and enhance strength.
Aim: To compare the shear bond strength (SBS) of 6th-generation (Adper SE Plus), 7th-generation (Adper Easy One), and 8th-generation (G-Premio Bond) bonding agents.
Materials and Methods: Sixty extracted human premolars were sectioned to expose flat dentin surfaces and randomly divided into three groups (n=20 each). Group I: 6th-generation Adper SE Plus, Group II: 7th-generation Adper Easy One, Group III: 8th-generation G-Premio Bond. Standard composite cylinders were bonded and subjected to SBS testing using a universal testing machine.
Results: G-Premio Bond (8th-gen) showed the highest SBS, followed by Adper SE Plus (6th-gen), while Adper Easy One (7th-gen) showed the lowest values. Differences were statistically significant ($p < 0.05$).
Conclusion: The newer 8th-generation adhesive demonstrated superior bond strength compared to 6th and 7th-generation systems.

Introduction

Adhesive dentistry has undergone continuous evolution over the past several decades, driven by the demand for predictable, durable, and minimally invasive restorative procedures. The ability to achieve a strong and long-lasting bond between tooth substrate and restorative

material is fundamental to the success of contemporary composite restorations. The earliest adhesive systems faced limitations such as poor enamel adhesion, lack of dentin bonding, and technique sensitivity. With major scientific advancements in dentin hybridization, monomer chemistry, solvent systems, and etching approaches, adhesive systems have progressed through successive generations—each focusing on improving clinical efficiency and bonding performance.[1-3]

Dentin, unlike enamel, presents significant challenges to bonding because of its intrinsic characteristics. Its tubular structure, fluid-filled environment, and organic content influence the penetration and polymerization of adhesive monomers. Ensuring a stable resin–dentin interface requires effective smear layer management, optimal demineralization, and adequate infiltration of resin into the exposed collagen network. Adhesive systems have evolved to address these complexities by modifying etching strategies and incorporating various functional monomers designed to improve chemical interaction with hydroxyapatite.[4,5]

The 6th-generation adhesives, also known as "two-step self-etch systems," incorporate separate self-etch primers and bonding agents. These systems reduce technique sensitivity compared to earlier etch-and-rinse adhesives by avoiding rinsing steps, thus maintaining collagen integrity and improving hybrid layer formation. Their moderate acidity facilitates simultaneous smear layer modification and dentin infiltration.[6]

7th-generation adhesives, or "all-in-one self-etch adhesives," combine etching, priming, and bonding into a single application. While they simplify clinical workflow and minimize procedural errors, these single-step systems tend to be more hydrophilic, which may lead to phase separation, water sorption, and reduced mechanical strength of the adhesive layer. This hydrophilicity may compromise long-term bonding stability, especially under functional stresses.[7]

8th-generation adhesives represent the latest advancement, incorporating universal application strategies, nanofillers, and functional monomers such as 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP). These innovations enhance chemical bonding with calcium ions in hydroxyapatite, leading to stronger and more hydrolytically stable bonds. Additionally, universal adhesives allow multiple bonding strategies—self-etch, selective-etch, or etch-and-rinse—making them more versatile across different clinical scenarios.[2,3]

Despite these developments, the literature still reports inconsistent findings regarding the relative bond strengths of different adhesive generations. Factors such as acidity level, solvent type, monomer composition, and application protocol vary widely among commercial products, influencing the resultant shear bond strength (SBS). Therefore, a direct comparative evaluation of 6th-, 7th-, and 8th-generation adhesives is essential to understand their performance and guide clinical decision-making.

This study aims to compare the shear bond strength of three representative adhesive systems. By assessing their bonding efficiency on dentin under standardized in-vitro conditions, this research seeks to provide evidence-based insights into the effectiveness of contemporary adhesive formulations and to determine whether

newer-generation adhesives offer a significant advantage over their predecessors.

Materials and Methods:

This in-vitro experimental study was conducted using sixty freshly extracted human premolars obtained for orthodontic purposes, free from caries, cracks, or structural defects. After extraction, the teeth were disinfected in 0.1% thymol for 24 hours and subsequently stored in distilled water until testing. Each tooth was embedded in autopolymerizing acrylic resin blocks, and the buccal enamel surface was flattened using a diamond disc under water coolant to expose a standardized flat dentin surface, which was further refined using 600-grit silicon carbide paper to produce a uniform smear layer. The specimens were randomly divided into three groups (n=20) according to the adhesive system used: Group I—Adper SE Plus (6th generation), Group II—Adper Easy One (7th generation), and Group III—G-Premio Bond (8th generation). Bonding procedures were performed strictly according to manufacturers' guidelines: Group I received a two-step self-etch primer and adhesive application followed by light curing, Group II received a single-bottle all-in-one self-etch adhesive applied with active rubbing and cured, and Group III received the universal adhesive actively rubbed for 10 seconds, air-thinned, and cured. A cylindrical plastic mold (3 mm diameter × 3 mm height) was positioned on the treated dentin surface and filled with nano-hybrid composite resin (Filtek Z350 XT), which was light-cured for 20 seconds from the top and sides to ensure complete polymerization. After mold removal, all samples were stored in distilled water at 37°C for 24 hours. Shear bond strength testing was conducted using a Universal Testing Machine at a crosshead speed of 1 mm/min, applying shear load parallel to the bonding interface until failure occurred, with values recorded in Newtons and converted to MPa based on the bonded area. Data were analyzed using SPSS (Version 25), with normality confirmed using the Shapiro–Wilk test, followed by one-way ANOVA and Tukey's post-hoc test for intergroup comparisons, adopting a significance level of $p < 0.05$.

Result

The 8th-generation adhesive G-Premio Bond showed the highest shear bond strength, followed by the 6th-generation Adper SE Plus, while the 7th-generation Adper Easy One recorded the lowest values **(Table 1)**. All three groups showed statistically significant differences ($p < 0.05$) when compared pairwise. G-Premio Bond performed significantly better than both Adper SE Plus and Adper Easy One, and Adper SE Plus also significantly outperformed Adper Easy One. This confirms that adhesive generation and composition directly influence bond strength **(Table 2)**.

Table 1: Mean Shear Bond Strength (MPa) of the Three Adhesive Systems

Group	Adhesive System	*n*	Mean ± SD (MPa)
Group I	Adper SE Plus (6th Gen)	20	18.45 ± 2.10
Group II	Adper Easy One (7th Gen)	20	15.12 ± 1.85

Group III	G-Premio Bond (8th Gen)	20	22.68 ± 2.54

Table 2: Intergroup Comparison (ANOVA and Tukey Post-Hoc)

Comparison	p-value	Significance
Group I vs Group II	0.001	Significant
Group I vs Group III	0.003	Significant
Group II vs Group III	0.001	Significant

Discussion

The present in-vitro study compared the shear bond strength (SBS) of three different generations of dentin bonding agents—Adper SE Plus (6th generation), Adper Easy One (7th generation), and G-Premio Bond (8th generation)—and demonstrated significant differences among the groups, with the 8th-generation adhesive showing the highest bond strength and the 7th-generation system the lowest. These findings highlight the continued impact of adhesive evolution on bonding efficacy, and reinforce the importance of understanding material chemistry and clinical behavior when selecting adhesive systems.

The superior performance of G-Premio Bond can be attributed primarily to its formulation, particularly the incorporation of the functional monomer 10-MDP (10-methacryloyloxydecyl dihydrogen phosphate).[9] MDP has been widely documented to form stable ionic bonds with residual hydroxyapatite in dentin, producing a nano-layered calcium–MDP complex that improves the durability and hydrolytic stability of the adhesive interface.[10] The universal nature of G-Premio Bond, which allows self-etch, selective-etch, or total-etch techniques, provides versatility, but even in the self-etch mode employed here, its low viscosity, effective solvent system, and nanofiller content contribute to enhanced penetration and mechanical reinforcement of the hybrid layer. These molecular interactions and structural improvements likely resulted in the highest SBS values observed in this study.

In contrast, Adper Easy One, representing the 7th-generation single-step self-etch system, exhibited the lowest SBS. One-step adhesives are known to be more hydrophilic due to the simultaneous presence of water, solvents, and functional monomers within a single bottle. This hydrophilicity can lead to phase separation, incomplete solvent evaporation, and formation of a weaker, permeable polymer network. High water content may also compromise the degree of conversion and increase nanoleakage, which weakens the resin–dentin interface. These drawbacks are frequently reported in the literature and support the present finding that 7th-generation adhesives may not consistently achieve high bond strengths.[10,11]

The moderate performance of Adper SE Plus, the 6th-generation two-step self-etch adhesive, aligns with its established clinical reputation. By separating the primer and bonding agent, these systems ensure better control over smear layer modification, monomer penetration, and solvent evaporation compared with single-step adhesives. The acidic primer effectively demineralizes the dentin surface while preserving some hydroxyapatite around collagen fibrils, allowing chemical bonding and micromechanical interlocking.

Although it does not incorporate advanced monomers like 10-MDP, Adper SE Plus still produced significantly higher SBS than the 7th-generation adhesive, demonstrating that two-step self-etch adhesives remain reliable and less technique-sensitive.

The present findings are consistent with numerous earlier studies comparing self-etch adhesives of different generations. Various researchers have reported that adhesives containing 10-MDP and nanofillers generally provide superior bond strength and long-term stability compared to traditional self-etch systems.[12] Similarly, the limitations of one-step adhesives—particularly their susceptibility to hydrolytic degradation and weaker polymer networks—have been frequently noted.[13] The results of this study further support these trends and emphasize the relevance of monomer chemistry and adhesive formulation over generational categorization alone.

The clinical implications of the present study are noteworthy. A strong adhesive interface is essential for minimizing microleakage, postoperative sensitivity, restoration failure, and secondary caries. The superior performance of the 8th-generation adhesive suggests that newer universal formulations may provide more durable restorations, especially in stress-bearing regions or in situations where moisture control is challenging. The comparatively lower performance of 7th-generation adhesives indicates that clinicians should exercise caution when selecting simplified, single-step systems—especially when long-term strength is a priority.

Despite its strengths, this study has certain limitations inherent to in-vitro testing. Laboratory conditions cannot fully mimic the complex oral environment, where factors such as thermal cycling, masticatory forces, saliva, and occlusal stresses influence bonding performance. Additionally, only one representative product from each generation was tested, and results may not generalize across all adhesives within that category. Future studies incorporating thermocycling, long-term water storage, microleakage evaluation, and comparison of multiple brands may provide more comprehensive insights.

Overall, the results of this study demonstrate that adhesive generation and formulation significantly influence shear bond strength. The enhanced chemical bonding, nanofiller reinforcement, and improved monomer composition of 8th-generation adhesives result in superior bonding performance compared to older systems. Clinicians may therefore benefit from adopting these advanced adhesives to achieve more predictable and long-lasting restorative outcomes.

Conclusion

Within the limitations of this in-vitro study, it may be concluded that the shear bond strength of dentin bonding agents varies significantly among different adhesive generations. The 8th-generation adhesive demonstrated the highest bond strength, followed by the 6th-generation, while the 7th-generation exhibited the lowest performance.

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