

Comparative Evaluation of Herbal and Chemical Dentin Disinfectants on the Shear Bond Strength of Adhesive Restorative Systems: An in Vitro Study

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Abstract: ***Aim:** To evaluate and compare the effect of conventional chemical and herbal dentin disinfectants on the shear bond strength (SBS) of adhesive restorative systems. **Materials and Methods:** This in vitro study evaluated five groups: positive control, 2% chlorhexidine, hydrogen peroxide, ethanol extract of propolis (EEP), and 5% Triphala. Disinfectants were applied using a microbrush for 30 seconds, followed by rinsing and air drying. A dentin bonding agent was applied and light cured. Composite build-up was performed, and shear bond strength was tested using a universal testing machine at a crosshead speed of 0.5 mm/min. Statistical analysis was performed using one-way ANOVA and Tukey's post hoc test. **Results:** All groups showed a statistically significant difference ($p < 0.001$). The control group demonstrated the highest SBS (14.55 MPa), followed closely by Propolis (14.51 MPa). Hydrogen peroxide showed the lowest bond strength among the groups. **Conclusion:** All tested disinfectants reduced bond strength to varying extents. Propolis demonstrated bond strength comparable to control and may be considered a promising alternative. Chlorhexidine showed acceptable performance among chemical disinfectants.*

Keywords: Chlorhexidine, dentin disinfectants, hydrogen peroxide, propolis, shear bond strength, Triphala

1. Introduction

Successful management of dental caries involves complete removal of infected dentin and restoration of the tooth structure. However, even after meticulous cavity preparation, residual microorganisms may persist within dentinal tubules. These microorganisms can proliferate and pose a risk to pulpal health, potentially compromising the long-term success of restorative procedures.^{1,2}

To address this, cavity disinfectants are employed prior to adhesive procedures to reduce microbial load.³ Among conventional agents, chlorhexidine and hydrogen peroxide are widely used due to their broad-spectrum antimicrobial properties.^{3,4} However, concerns remain regarding their influence on dentin bonding, particularly their interaction with the collagen matrix and adhesive systems.^{4,5}

In recent years, there has been growing interest in herbal alternatives such as Propolis and Triphala, owing to their antimicrobial, antioxidant, and biocompatible properties.^{6,7} These agents have demonstrated promising results in inhibiting cariogenic microorganisms while potentially preserving dentin integrity.⁷

Despite their advantages, the effect of these disinfectants on the bond strength of adhesive restorative systems remains an area of active investigation.^{8,9}

Hence, the aim of this study is to compare the effects of various conventional and herbal cavity disinfectants on the shear bond strength of dentin.

2. Materials and Methodology

Seventy five extracted molars were sectioned horizontally from one-third of coronal crown to expose flat dentin surface and were embedded into cold cure acrylic. The specimens were randomly assigned to five groups each having fifteen specimens (n=15)

Group I served as the control group and received no disinfection treatment. Group II specimens were disinfected using 2% chlorhexidine, while Group III specimens were treated with 3% hydrogen peroxide. Group IV samples received Ethanol Extract of Propolis as the disinfecting agent, whereas Group V specimens were disinfected using 5% Triphala solution.

Cavity disinfectants were actively applied with a microbrush for 30 seconds and rinsed for 30 seconds. The dentin surfaces were air-dried for 15 seconds and the dentin bonding agent was actively applied with a microbrush and light cured for 20 seconds.

Following which the samples were restored using composite resin and stored at 37°C for 24 hours.

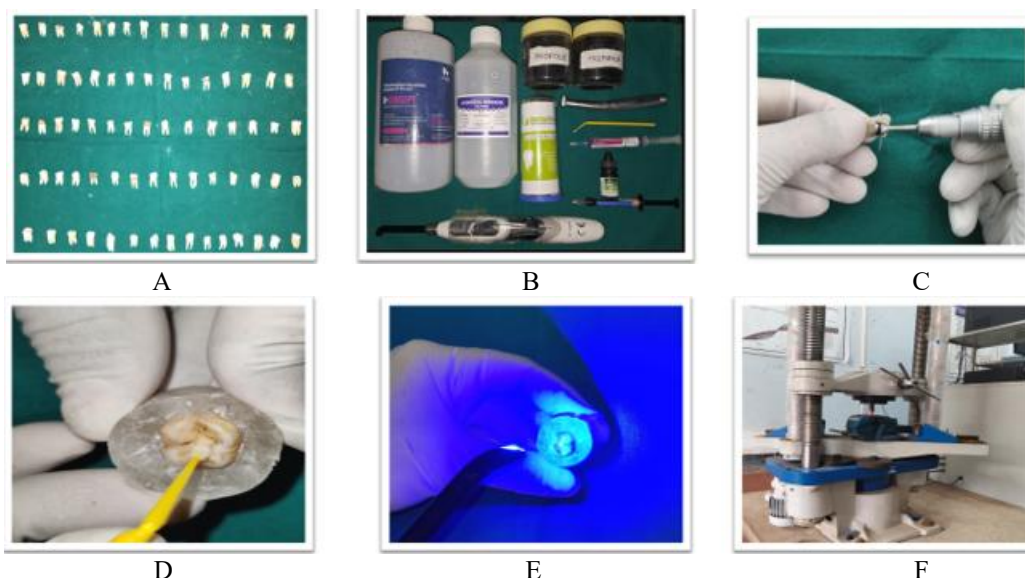
Shear bond Strength analysis

Samples were subjected to Shear Bond Strength under Universal Testing Machine. Shear bond strength was evaluated using a universal testing machine at a crosshead speed of 0.5 mm/min until bond failure occurred.

Statistical Analysis

Data were analyzed using one-way ANOVA for multiple group comparisons, followed by Tukey's post hoc test for

intergroup comparison. A p-value of <0.05 was considered statistically significant.



A: Seventy five extracted mandibular molars, B: Armamentarium, C: Samples sectioned horizontally from one third of the coronal crown to expose flat dentin surface, D: Cavity disinfectant applied, E: Light curing, F: Subjected to UTM for assessing SBS.

3. Results

The control group (Group I) demonstrated the highest mean shear bond strength, representing optimal bonding in the absence of any disinfectant treatment. Among the experimental groups, Ethanol Extract of Propolis (Group IV) that were comparable to the control group, suggesting minimal adverse effect on dentin bonding.

The Chlorhexidine group (Group II) showed a slight reduction in bond strength when compared to the control group. Similarly, the Triphala group (Group V) demonstrated moderate SBS values, indicating a mild influence on bonding performance.

The hydrogen peroxide group (Group III) recorded the lowest mean shear bond strength among all groups, suggesting a comparatively greater reduction in bonding efficacy (Table 1).

Statistical analysis using one-way ANOVA revealed a highly significant difference among the groups ($p < 0.001$), indicating that the type of cavity disinfectant had a statistically significant effect on shear bond strength.

Further intergroup comparison using Tukey’s post hoc test demonstrated that the Control group and Propolis group showed no statistically significant difference, indicating similar bonding performance. Hydrogen peroxide differed significantly from the control group, reflecting reduced and least bond strength. Chlorhexidine and Triphala groups showed intermediate values, with no marked deviation compared to other experimental groups (Table 2).

Table 1: The shear bond strength (SBS) values obtained for all groups

Group	Shear Bond Strength (Mpa)	Standard Deviation (SD)
Positive Control	14.55	1.67
Chlorhexidine	13.76	1.31
Hydrogen Peroxide	13.17	1.35
Ethanol Extract of Propolis	14.51	1.63
5% Triphala	13.32	1.48

Table 2: Intergroup comparison using Tukey’s Post Hoc Test

Comparison Groups	Mean Difference	Standard Error	p-value
Positive Control vs Chlorhexidine	0.79	0.53	0.532
Positive Control vs Hydrogen Peroxide	1.38	0.53	0.078
Positive Control vs Ethanol Extract of Propolis	0.04	0.53	1.000
Positive Control vs 5% Triphala	1.23	0.53	0.136

4. Discussion

Residual bacterial contamination in prepared cavities can compromise restorative success, making cavity disinfection an important step in clinical practice. However, the interaction of disinfectants with dentin and adhesive systems plays a critical role in determining bond strength.¹

In this study, it was found that the cavity disinfectants used, i.e- Chlorhexidine, Hydrogen Peroxide, Ethanol Extract of Propolis and 5% *Triphala* had no adverse effects on the SBS.

Most disinfectants showed a reduction in shear bond strength compared to the control group, indicating that pretreatment of dentin influences adhesive bonding.⁸

Chlorhexidine is one of the bis-biguanide compounds with its broad-spectrum antibacterial effect and is effective in reducing cariogenic bacteria. Active against wide range of microorganisms, especially against *Streptococcus mutans*-known to reduce the levels from occlusal caries.

Chlorhexidine demonstrated a slight reduction in bond strength, which may be attributed to its effect on dentin wettability and resin infiltration. Despite this, its antimicrobial efficacy makes it a widely accepted disinfectant. This result is in accordance with studies conducted by Reddy et al and Arslan et al.^{14,15}

Hydrogen Peroxide is active against virus, bacteria, yeasts and bacterial spores. It acts by the release of free hydroxyl radicals (oxidation property) that acts in the cell components of bacteria such as proteins and DNA. Hydrogen peroxide exhibited the lowest bond strength. This may be due to oxygen release, which interferes with polymerization of resin adhesives and affects hybrid layer formation. Another reason proposed is due to the residual solution in the collagen matrix and dentinal tubules which breaks down into water and oxygen.¹⁰ Previous studies conducted by Ercan et al., and Soares et al also showed similar results.^{9,16}

Antimicrobial efficacy of Propolis has been mentioned through several studies. Propolis showed bond strength comparable to the control group, indicating minimal interference with bonding. Its antioxidant and antimicrobial properties may help preserve dentin structure and enhance bonding performance.¹¹ Study conducted by Kumari et al showed better bond strength.¹³

Triphala is a blend of *Terminalia chebula*, *T. bellerica* and *Emblica officinalis* inhibits bacterial adhesion and growth especially against *S. mutans*. It acts by release of tannic acid, gallic acid and ellagic, which disrupts the bacterial cell structures and scavenge the free radicals, thus providing antibacterial effects. Many recent studies show the inhibitory concentrations of EEP against virulence factors such as lipase and coagulase enzymes such as - *S aureus* and *S mutans*.⁶ Triphala demonstrated moderate bond strength values, likely due to its bioactive compounds that provide antimicrobial action without significantly altering dentin.

The desired outcome clinically would be the complete elimination of all microorganisms from the cavity preparation before the placement of a definitive restoration.

But all the disinfectants used are known to decrease the bond strength when cavity disinfectant are being used prior to bonding.^{8,9}

Hence, it is essential to choose a disinfectant that must have least effect on bond strength and also achieves the desirable goal.

5. Conclusion

Within the limitations of this study:

- All the tested disinfectants in the current study significantly reduced the bond strength of dentin.

- Amongst the chemical agents, 2% Chlorhexidine has performed **better** as a cavity disinfectant as well as an effective antimicrobial agent.
- Among the herbal agent, Propolis has provided with promising results in terms as a cavity disinfectant with **comparable** dentin bond strength to the control group.
- Further studies are indicated to determine the efficacy of propolis as a cavity disinfectant.

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