ORIGINAL RESEARCH

Assessment of effect of different irrigants on Microtensile Bond Strength of Adhesive Systems to Dentin

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ABSTRACT

Aim: The aim of this study was to determine the influence of various irrigants on bond strength of adhesive systems to dentin. **Material and methods:** This study utilized 60 intact human premolars to investigate the impact of different endodontic irrigants on the micro-tensile bond strength (μTBS) of a self-etch universal adhesive system for composite restoration. Data analysis was done using SSPS software. **Results:** The groups treated with EDTA followed by NaOCl showed significantly lower bond strength compared to the other two groups in the study. **Conclusion:** Considering the constraints of this study, the control group exhibited notably reduced bond strength in comparison to the groups under comparative conditions.

Keywords: Adhesive, NaOCl, EDTA

INTRODUCTION

Irrigation plays a crucial role in successful root canal treatments by fulfilling mechanical, chemical, and microbiological functions that mechanical instrumentation alone cannot achieve.[1] Effective root canal cleaning is essential for successful endodontic treatment, with irrigation playing a pivotal role in removing tissue remnants. Commonly used irrigants include sodium hypochlorite (NaOCl), ethylenediaminetetraacetic acid (EDTA), and chlorhexidine (CHX).[2] NaOCl serves multiple purposes such as lubrication, disinfection, and organic component removal, while EDTA demineralizes dentin and aids in cleaning canal walls. A combination of NaOCl and EDTA is often used to address both organic and inorganic debris.[3]

Additionally, grape seed extract (GSE) has been noted for providing enhanced stability at the interface of resin-based restorations, promoting dental structure remineralisation, and exhibiting antimicrobial properties. Several studies have highlighted GSE's efficacy, particularly when used alongside manual instrumentation of root canals, making it a viable option for irrigation in endodontic treatment.[4,5]

Also Hydroxyethylidene diphosphonate (HEDP) irrigation in endodontics has been explored for its potential benefits in root canal treatment.[6] While specific studies directly focusing on HEDP in this context are limited compared to other irrigants like NaOCl and EDTA, HEDP is recognized for its ability to chelate calcium ions and inhibit mineralization processes. This property suggests that HEDP may contribute to effective smear layer removal and can potentially aid in disinfection within the root canal system.[7]Therefore the interaction of these irrigants with dentin surfaces can influence the bonding of restorative materials.Hence the aim of the study was to determine the influence of various irrigants on bond strength of adhesive systems to dentin.

MATERIALS & METHODS

This study utilized 60 intact human premolars to investigate the impact of different endodontic irrigants on the micro-tensile bond strength (μTBS) of a self-etch universal adhesive system for composite

restoration. The teeth were divided into three groups based on the irrigants used:

1. Control Group (Group 1): Sodium hypochlorite (NaOCl) followed by ethylenediaminetetraacetic acid (EDTA) irrigation.
2. Group 2: Sodium hypochlorite followed by grape seed extract irrigation.
3. Group 3: Sodium hypochlorite followed by 18% hydroxyethylidene diphosphonate (HEDP) irrigation.

Resin composites were applied using the Universal adhesive system. The micro tensile bond strength was evaluated using a Universal Testing Machine.Data analysis was done using SSPS software.

RESULTS

The groups treated with EDTA followed by NaOCl showed significantly lower bond strength compared to the other two groups in the study.In table 1, micro-tensile bond strengths of three groups were compared using 20 samples per group. Group 1 showed a mean bond strength of 23.9 MPa, Group 2 exhibited the highest mean at 37.8 MPa, and Group 3 had a mean of 33.1 MPa. Statistical analysis indicated a significant difference between Group 1 and the other groups, highlighting distinct adhesive performance among the experimental conditions tested. Table 2 presents the intergroup comparison of micro-tensile bond strength among three experimental groups. The mean differences and corresponding p-values were calculated to assess the statistical significance between each pair of groups. While comparing between group 1 and group 2 and between group 1 and group 3, non-significant results were obtained.

Table 1: Comparison of Micro-Tensile Bond Strength among three experimental groups

Group	Sample size (N)	Mean	SD	p-value
Group 1	20	23.9	2.76	<0.002*
Group 2	20	37.8	3.55	
Group 3	20	33.1	4.21	

*Statistically Significant Difference

Table 2: Intergroup Comparison of Micro-Tensile Bond Strength among Three Experimental Groups

Group Comparison	Mean difference	P-value
Group 1 vs Group 2	8.7	<0.001*
Group 1 vs Group 3	7.1	<0.002*
Group 2 vs Group 3	2.2	0.210

*Statistically Significant Difference (P-value<0.05)

DISCUSSION

Endodontic irrigation solutions and protocols play a critical role in disinfecting the intricate areas of the root canal system that cannot be reached by mechanical instruments alone.[8] However, these solutions also inevitably come into contact with the dentin surrounding the root canal, influencing its properties. Ensuring a reliable coronal seal with an adhesive restoration is essential to prevent bacteria from re-entering the root canal system.[9,10]

In our study, groups treated with EDTA followed by NaOCl consistently showed lower bond strengths compared to other treatment groups, which is consistent with previous research findings. Wattanawongpitak et al.[11] demonstrated dentin erosion following the application of both EDTA and NaOCl. Additionally, the oxidizing effect of NaOCl may contribute to decreased bond strength across different adhesive systems. Contrarily, Yurdagüven et al. [12] reported that the bond strength of adhesives after applying NaOCl + EDTA was similar to that of control groups, suggesting no significant reduction in bond strength compared to untreated conditions.Dikmen B et al determined the influence of irrigants on bond strength of adhesive systems.Superficial dentin surfaces of 60 extracted molars were divided into 15 groups, according to irrigants and adhesives. In the control groups, surfaces were irrigated with distilled water. In experimental groups, sodium hypochlorite (NaOCl), ethylenediaminetetraacetic acid (EDTA) + NaOCl, chlorhexidine (CHX), and NaOCl + sodium ascorbate were used as irrigants. Resin composites were then built up using Single Bond, Clearfil SE Bond, and Xeno 3 as adhesives. The microtensile bond strength of groups was determined. NaOCl reduced bond strength of Single Bond and Clearfil SE Bond ($P < 0.01$). For all adhesive systems, EDTA + NaOCl-treated groups exhibited lower bond strength than control groups ($P < 0.01$). CHX decreased bond strength of Single Bond ($P < 0.01$). Application of sodium ascorbate improved compromised bond strength to NaOCl-treated dentin ($P < 0.01$). Different irrigants had several effects on bonding of different adhesives. Sodium ascorbate after NaOCl could restore compromised bond strengths.[13]Galafassi D et al evaluated the influence of long-term water storage and thermocycling on the microtensile bond strength of adhesive systems to dentin irrigated with endodontic solutions.Sixty human molars were used after removal of the occlusal portion and exposure of the dentin by grinding. The specimens were irrigated with 2.5% NaOCl for 30 minutes and then 17% EDTA for 5 minutes and assigned to six groups according to the adhesive system (n=10): G1 and G2–Clearfil SE Bond; G3 and G4–Single Bond 2; and G5 and G6–XP Bond. The teeth were restored with composite and were subjected to water storage for different time periods. G1, G3 and G5 were stored for 24 h; G2, G4 and G6 were stored for 6 months and were subjected to thermocycling (12,000 cycles, 5°C to 55°C, 500 cycles per week for 6 months). Significant differences were observed among the adhesives ($p<0.01$). No significant differences were observed in the microtensile bond strength between samples after 24

hours of storage without thermocycling and after 6-month storage with 12,000 cycles ($p<0.05$).The bond strengths of G5 and G6 after irrigation with 2.5% NaOCl and 17% EDTA were significantly different from those of other groups.[14]

CONCLUSION

Considering the constraints of this study, the control group exhibited notably reduced bond strength in comparison to the groups under comparative conditions.

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