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Evaluating Curcumin and Bromelain as Dentin Biomodifiers for Enhancing Shear Bond Strength – An Invitro study

[1]Dr. Aju Anto Puthur; [2]Dr. Moksha Nayak; [3]Dr. Rohini B; [4]Dr. Gagan Gopal G.
Dept. of Conservative Dentistry and Endodontics's
KVGDC
Sullia, Dakshina Kannada, Karnataka, India

Abstract:-

- ***Aim***

To evaluate the effect of collagen stabilizing agents like Curcumin and Bromelain enzyme on the shear bond strength of restorative resin to dentin.

- ***Materials and Methods***

Thirty single rooted, non carious human mandibular premolars were selected and decoronation was done. The tooth was then mounted. Etchant was applied to the dentin samples and divided into 3 experimental groups. Group 1 (Control - Bonding agent + Composite); Group 2 (Pre-treatment with Curcumin for 30 sec + Rinsing + Bonding agent + Composite). Group 3(Pre-treatment with Bromelain enzyme for 30 sec + Rinsing + Bonding agent + Composite). Following this, total etch adhesive was applied and light. Nanohybrid composite restoration was done. Then the samples were subjected to shear bond strength. The load was applied to the bonded interface with a cross-head speed of 0.5 mm / minute until fracture occurred.

- ***Results***

The mean values Shear bond strength of dentin were slightly more in bromelain enzyme (48.49), seconded by curcumin (38.80), followed by control group (27.23). The difference was statistically significant among the three different remineralising agent used.

- ***Conclusion***

Bromelain enzyme showed the highest mean shear bond strength value when compared to the other experimental group.

Keywords:- *Decoronation, Etching, Shear Bond Strength.*

I. INTRODUCTION

Adhesive dentistry focuses on bonding resins to enamel and dentin, with dentin consisting of 70% inorganic material and 20% organic matter, predominantly made up of 90% type I collagen fibres and 10% non-collagenous proteins, such as phosphoproteins and proteoglycans. When a bonding agent is applied to etched, demineralized dentin rich in collagen, it forms a vital **hybrid layer** that facilitates adhesion to dentin. This layer, however, tends to degrade over time due to hydrolysis and leaching of the resin. To counter this breakdown and extend the durability of restorations, collagen cross-linking agents—both natural, like proanthocyanidin and genipin, and synthetic, such as glutaraldehyde and formaldehyde—are employed[1] Curcumin, a non-toxic polyphenol extracted from the rhizome of *Curcuma longa*, is known to act as a collagen cross-linker[2]. Bromelain, a proteolytic enzyme sourced from pineapple fruit or stem, also has collagen-degrading abilities. Research by Anil and Gold showed that using collagen stabilizers, such as proanthocyanidin and riboflavin, on etched dentin improved shear bond strength compared to untreated samples[1]. This study evaluates the effects of collagen stabilizing agents like curcumin and bromelain on the shear bond strength between composite resin and dentin.

II. MATERIALS AND METHODS

Thirty freshly extracted, non-carious, single-rooted human mandibular premolars, free of cracks or previous restorations, were chosen for the study. The crowns were sectioned 2 mm above the cemento-enamel junction using a flexible diamond disc under constant water irrigation. Each tooth was mounted in a cylindrical dental stone block. Dentin surfaces were etched with 37% phosphoric acid gel for 15 seconds, then rinsed and gently dried with absorbent paper. The teeth were divided into three experimental groups: Group 1 (Control - Bonding agent + Composite), Group 2 (Pre-treatment with Curcumin for 30 seconds, followed by rinsing, bonding agent, and composite), and Group 3 (Pre-treatment with Bromelain enzyme for 30 seconds, followed by rinsing, bonding agent, and composite). After pre-treatment, a total-etch adhesive was

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applied and light-cured for 20 seconds to penetrate the etched dentin. A nanohybrid composite restoration (Filtek Z350, 3M ESPE, USA) was placed with dimensions of 2 mm in height and 3.5 mm in diameter. Shear bond strength testing was conducted using a Universal Testing Machine, applying load at a 90-degree angle to the bonded surface at a crosshead speed of 0.5 mm/min until fracture occurred.

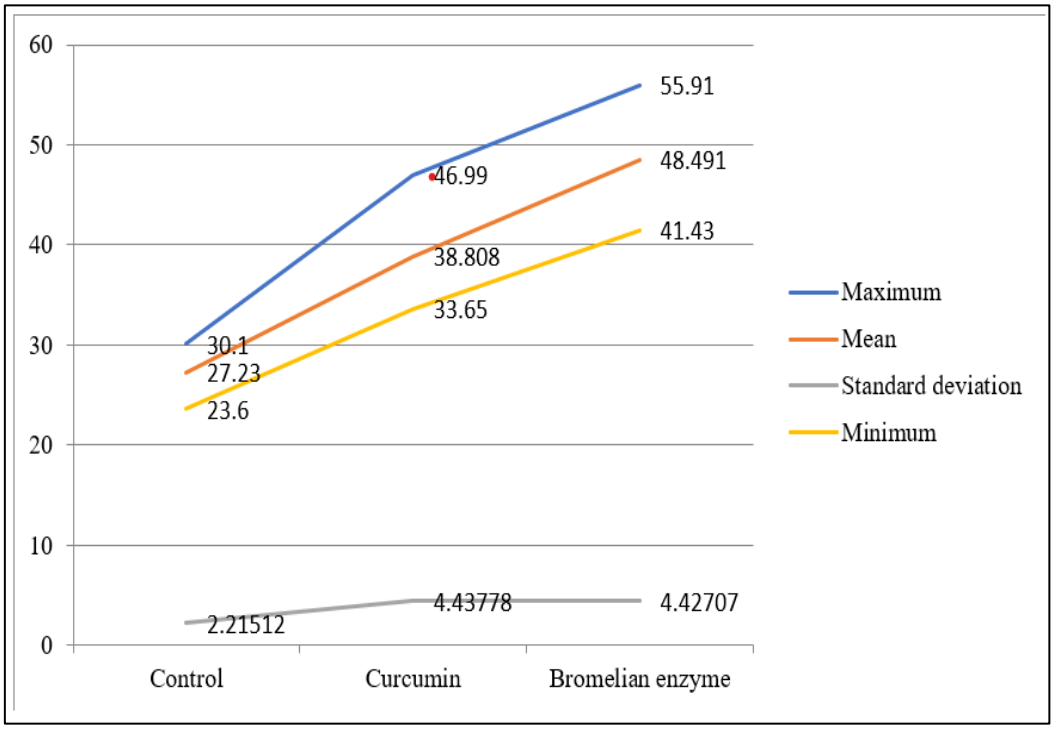
III. RESULTS

Table No. 1: Descriptive Values Shear Bond Strength of Dentin among Studied Groups.

Groups	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	*p value
					Lower Bound	Upper Bound			
Control	10	27.2300	2.21512	.70048	25.6454	28.8146	23.60	30.10	<0.001**
Curcumin	10	38.8080	4.43778	1.40335	35.6334	41.9826	33.65	46.99	
Bromelian enzyme	10	48.4910	4.42707	1.39996	45.3241	51.6579	41.43	55.91	
Total	30	38.1763	9.58435	1.74985	34.5975	41.7552	23.60	55.91	

One way Anova test

* p value <0.001 was considered statistically very significant.



Graph 1a: Descriptive Values of Shear Bond Strength of the Studied Groups.

IV. DISCUSSION

The hybrid layer is made up of collagen fibrils and adhesive resins that form an interwoven structure, serving as the foundation for bonding the adhesive to the intact dentin beneath. Degradation of the resin-dentin bond can result from the breakdown of either the polymer phase or collagen fibrils, as well as the activation of matrix metalloproteinases (MMPs).[3] Exposure to acids, whether from caries or etching, can dissolve dentin minerals, weakening the organic matrix and collagen fibrils through collagen-degrading enzymes and bacterial proteases. Collagen fibrils that lack hydroxyapatite (HA) or resin protection become vulnerable to hydrolysis, further weakening the bond.[4]

The methodology applied in this study is consistent with previous research, reinforcing the demonstrated impact of biomodifiers on enhancing shear bond strength between composite resin and dentin. Pre-treatment of dentin collagen with external biomodifiers before bonding agent application helps to stabilize the hybrid layer both mechanically and biologically through intermolecular cross-linking.

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➢ *Curcumin*

Curcumin, a well-known non-toxic polyphenol, functions as a collagen cross-linker by inhibiting MMP activity[2]. It achieves this by binding to Zn^{2+} ions, which are critical for MMP function. Curcumin also has antioxidant and anti-inflammatory properties, contributing to resin-dentin interface stabilization. Research shows that its anti-inflammatory effects may reduce post-operative sensitivity by modulating inflammation in dentinal tubules, leading to better long-term results. Additionally, curcumin's ability to reduce oxidative stress can further protect collagen fibrils from degradation caused by free radicals, thus extending the lifespan of the hybrid layer.

➢ *Bromelain*

Bromelain, a group of protein-digesting enzymes derived primarily from pineapple stems, also offers anti-inflammatory and antimicrobial benefits. These properties help limit bacterial colonization at the adhesive interface, thereby reducing the likelihood of secondary caries. Bromelain's proteolytic action selectively removes degraded collagen while preserving structurally sound fibrils, providing a more stable foundation for the adhesive resin. Moreover, bromelain's deeper protein-digesting ability can create a thinner hybrid layer, which has been associated with improved bonding performance and reduced nano-leakage. A study by Dayem and Tameesh found that bromelain-treated samples exhibited lower nano-leakage due to the removal of unsupported collagen.[5]

The study results showed that Group III (Bromelain Extract) had the highest shear bond strength (48.49 MPa), followed by Group II (Curcumin) at 38.80 MPa, and Group I (Control) at 27.30 MPa. Statistically significant differences were observed between Group III and Group II, as well as between Group III and Group I, indicating that pre-treatment with bromelain led to greater bond strength compared to curcumin and the control group. The higher bond strength associated with bromelain is likely due to its ability to remove unsupported collagen after acid etching, creating a more stable hybrid layer with a solid foundation free of minerals or resins.

V. CONCLUSION

Within the limitations of this in-vitro study, it can be concluded that,

- Bromelain enzyme showed the highest mean shear bond strength value when compared to the other experimental group.
- Application of Bromelain Enzyme and Curcumin improved the shear bond strength to dentin when compared to the control group.

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