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COMPARATIVE EVALUATION OF MORINGA OLEIFERA ETHANOLIC EXTRACT AND SODIUM ASCORBATE SOLUTION AS ANTIOXIDANTS ON SHEAR BOND STRENGTH OF COMPOSITE TO BLEACHED ENAMEL

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ABSTRACT

Background: Due to the increased demand for aesthetics, bleaching is occasionally followed by composite restoration. The bond strength of composite resin to enamel has been observed to be reduced by the interaction of bleaching chemicals with tooth substrate. This is because the bleaching process releases free radicals that interfere with polymerization. The use of antioxidants can be highlighted since it seems to be a more effective alternative to reduce or remove the residual oxygen and immediate improvement in shear bond strength. Objective: The purpose of this study is to evaluate the effect of 10% sodium ascorbate, 80 % ethanolic extract of moringa oleifera extract on the shear bond strength of composite resin to bleached enamel. Materials and methods: Thirty extracted singlerooted anterior teeth were decoronated and crowns were embedded in acrylic resin block with labial surface exposed. They were randomly divided into three groups, (i) Group 1: control (bleaching only), (ii) Group 2: bleaching +80 % ethanolic extract of moringa oleifera (iii) Group 3: bleaching +10 % sodium ascorbate solution. Labial surfaces were then bleached with 37.5% hydrogen peroxide following manufacturer's instructions. After that, the experimental groups were treated with respective antioxidant solutions following which composite build up of 3 mm \times 3 mm were done. Shear bond strength of the specimens was tested under universal testing machine. Results: For Group II and Group III showed statistically significant increase in the shear bond strength (P- Value >0.05). However, group III (Sodium ascorbate) showed more increase in the shear bond strength than group II(moringa extract) and the least in the control group. Conclusion: Application of 10% ascorbic acid to the bleached dentin improved the shear bond strength of resin composite.

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KEYWORDS: Composite Resin, Shear bond strength, Sodium ascorbate, Moringa extract.

INTRODUCTION

Discolored anterior teeth are a common reason for seeking dental care, as it can significantly impact a patient's self-confidence and quality of life. As dental esthetics become increasingly important, more patients are motivated to address discolored teeth which can be treated by procedures like bleaching. While dental bleaching can significantly enhance the aesthetic appearance of teeth, it is crucial for clinicians to consider the broader implications of this treatment.^[1]

One of the mechanisms that may account for this reduction in bond strength is the presence of residual peroxide liberating oxygen, which interferes with the resin tag formation, inhibition of free-radical polymerization and subsequent failure of obtaining long term clinical success.^[2]

Several methods have been indicated to overcome these adverse effects related to the lower bond strength values that follow bleaching such as delaying of bonding procedures until 24h to 2 weeks after bleaching, flattening/removing 0.5–1.0 mm of the enamel surface after bleaching, and application of antioxidants such as sodium ascorbate (SA), ascorbic acid, and catalase on enamel surface after bleaching.^[3,4] When immediate esthetic corrections after bleaching is mandatory, antioxidant application become a must to trap the reactive oxygen species. Antioxidants stabilize collagen fibers, which are essential for a strong bond between the tooth and restorative materials. Antioxidants neutralize these free radicals, reduce oxidative stress on the tooth surface.^[5]

The objectives of this study are

• To assess the shear bond strength of bleached enamel

tooth surface treated with 10% Sodium Ascorbate solution.

- To assess the shear bond strength of bleached enamel tooth surface treated with 80% ethanolic extract of Moringa Oleifera.
- To compare the mean shear bond strength values between the two treatment groups.

METHODOLOGY SAMPLE PREPARATION

Thirty extracted intact non-carious single-rooted incisor were collected. Teeth with caries, cracks, fractures, wear or developmental enamel defects were excluded from this study. All the samples were decoronated by sectioning the roots 2 mm below the cementoenamel junction using carbide disc. All the specimens were embedded in autopolymerising acrylic resin block (3.0 cm \times 3.0 cm \times 3.0 cm) such that only the labial surface were exposed upward. The exposed flattened labial surfaces of enamel were polished using 600-grit silicon carbide paper to obtain flat and uniform enamel surfaces to facilitate bonding with composite.

PREPARATION OF THE ANTIOXIDANT SOLUTIONS MORINGA OLEIFERA EXTRACT PREPARATION

The Moringa Oleifera powder were extracted in solvent (80% ethanol) by cold maceration technique. The powder was placed in a Stoppard container with the solvent and allowed to stand at room temperature for 1 day until the soluble matter had dissolved.

ASCORBIC ACID SOLUTION PREPARATION

Ascorbic Acid powder (10 grams) was dissolved in 100 ml distilled water to obtain 10% Ascorbic acid solution.

BLEACHING PROCEDURE

All specimens were bleached with 37.5% hydrogen peroxide (SDI Pola office plus) bleaching kit according to manufacturer instructions for 20 min. The bleaching gel was completely rinsed off with water spray for 60 seconds, and the process was repeated one more time for a total of 2 cycles of bleaching. In group (I), after bleaching procedure, the labial enamel surface of each tooth was immediately subjected to bonding procedures without antioxidant treatment. Regarding the other two groups, immediately after bleaching procedure, 10 ml of 80 % ethanol extract of Moringa Oleifera was applied for 10 minutes and on Group (III) specimens, 10 ml 10% Sodium ascorbate solution was applied for 10 minutes using micro-brushes. Afterward, the labial surfaces were rinsed with distilled water for 30 seconds then air dried for 15 seconds.

BONDING PROCEDURE AND COMPOSITE RESIN APPLICATION

Labial enamel surfaces of all specimens of all groups were acid-etched using 37 % phosphoric acid (Total Etch etching gel, Ivoclar Vivadent) for 15 seconds, rinsed with distilled water for 20 seconds and air dried for 15

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seconds. Three consecutive coats of bonding agent (Ivoclar vivadent Te -Econom) were applied to the labial enamel surfaces with agitation using microbrush, then gently air dried. Finally, the applied bonding agent was light cured for 20 seconds using Light Emitting Diode curing unit (LED) (Woodpecker Medical Instrument) at a light intensity of 1200 mW/ cm². This process was followed by resin composite build-up of 3mmx 3mm. Then, the specimens were stored in distilled water at 37°C for 24 hours. After 24 hours, the specimens were removed from distilled water and jet dried. The samples were mounted on Universal Testing Machine (INSTRON 3369, UK) with a knife edge loading head. The shear stress rate was 1 mm/min. The maximum load at failure was recorded and converted to megapascals.

Statistical Analysis

Data that were obtained from the universal testing machine were analysed using the statistical software SPSS version 27. A parametric Analysis of variance (ANOVA) was used for comparing more than two groups followed by post-hoc Tuckey test for in-between groups comparisons, and independent t-test for comparing two quantitative data. The level of significance was set at P<0.05.

RESULTS

GRAPH I	
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Table 1 presents the comparison of mean shear strength among three groups: Control Group, Moringa Extract, and Sodium Ascorbate. The Analysis of Variance (ANOVA) revealed a highly significant difference among the groups, with a p-value of less than 0.001. This indicates that the differences in mean shear strength among the groups are statistically significant.

Table 1: Comparison of mean shear strength among the three groups. Table 1: Comparison of mean shear strength among the three groups.

0	Shear Strength	Strength	
Group	$Mean \pm SD$	P-value	
Control Group	24.58 ± 4.061		
Moringa extract	37.07 ± 3.61	<0.001*	
Sodium ascorbate	42.96 ± 4.35		

The table 2 shows the results of Tukey's post hoc test, which was performed to determine the specific differences in mean shear strength between the three groups. The mean shear strength for the Sodium Ascorbate group is significantly higher than that of the Moringa Extract group, with a mean difference of



5.89000 (p = 0.008) and control group with a mean difference of 18.37300 (p < 0.001). The mean shear strength for the Moringa Extract group is significantly higher than that of the Control Group, with a mean difference of 12.48300 (p < 0.001).

Cable 2: Inter- Group Comparison Between Groups	Using Post Hoc Tuckey.
Table 2: Tukey's Post hoc test	

Table 2: Tukey's Post hoc test				SHEAR STRENGTH
Group	Comparison Group	Mean Difference (I-J)	P-value	Control D Moringa extract D Sodium Ascorbate
Control Group	Moringa extract	-12.48300*	.000	40
	Sodium ascorbate	-18.37300*	.000	30
Moringa extract	Control Group	12.48300*	.000	25
	Sodium ascorbate	-5.89000*	.008	15
Sodium ascorbate	Control Group	18.37300*	.000	5
	Moringa extract	5.89000*	.008	0 Shear strength

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DISCUSSION

Tooth discoloration can be efficaciously treated by bleaching. However, bleaching alone does not suffice for the correction of diastemas, malposed teeth, spacing which necessitates additional esthetic techniques such as composite restorations, veneers, laminates. Teeth restored after bleaching exhibit a more natural translucent appearance as they require lighter composite shades with lowered incorporation of opacifier.^[2] Literature has revealed that bleaching with peroxides significantly reduces enamel bond strength as compared to tooth surface not bleached owing to free residual oxygen layer formed during bleaching that interferes with polymerization.^[4] Loss of calcium, decreased microhardness, altered organic substance, loss of prismatic structure, and increased enamel porosity are the deleterious effects seen after carbamide peroxide bleaching.^[5]

Majority of the patients require composite restorations following the bleaching procedure for further esthetic correction, and hence, this initial decrease in enamel

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bond strength becomes an important clinical challenge. Waiting for 24 h–3 weeks before undertaking composite restoration which helps regain the lost bond strength, might not be acceptable to patients with immediate esthetic demands. Immediate improvement in the SBS to bleached enamel can be achieved by alcohol treatment of enamel postbleaching, removing superficial layer of enamel, using organic solvent adhesives, and by using antioxidants.^[6]

Synthetic antioxidants such as sodium ascorbate regain the SBS of composite resin to enamel by neutralizing peroxide layer.^[6] Organic solvents such as acetone and ethanol cause water displacement from bleached enamel surface by interacting with residual oxygen and thus increase the bond strength.^[7] However, it was found that sodium ascorbate was mutagenic for mammelian somatic cells, needed multiple applications thereby raising economic and treatment times concerns and was not totally effective in improvising the bond strength. Naturally occurring antioxidants are found to have better antioxidant properties than the synthetic antioxidants and are cost effective too. These natural antioxidant extracts containing flavonoids, vitamin C etc used in various studies revealed effective reversal of SBS of composite to enamel surface postbleaching.^[7]

There are lack of sufficient studies reporting comparison between antioxidants moringa extract and sodium ascorbate solution in effective reversal of the SBS after bleaching. In the present study, ethanol extract of moringa was selected and was compared with sodium ascorbate solution.

Sodium ascorbate is a buffered form of vitamin C which consists of 90% ascorbic acid bound to 10% sodium. Sodium ascorbate is a commonly used antioxidant that has been reported with capability of quenching the reactive free radicals. It neutralizes the effect on the residual oxygen layer, thus reversing the compromised bonding. So in this study, 10% solution of sodium ascorbate was used as it is considered as gold standard oxidizing agent.^[8]

According to Razis et al, Moringa Oleifera is a plant that contains natural antioxidants which can be used to reverse the compromised bond strength of resin composite to extra-coronally bleached enamel. This is attributed to free radical scavenging activity of phenolic compounds, flavonoids, Vitamin C etc. in the leaves of moringa plant. Thus this study clearly emphasizes that that Moringa Extract effectively increases shear strength, suggesting its potent antioxidant properties whereas Sodium Ascorbate exhibits a superior effect, higher shear strength compared to Moringa Extract with enhanced bond durability.^[8] The moringa oleifera ethanol extract treatment resulted in a moderate bond strength indicating some improvement over the untreated bleached tooth surface, but falling short of the effectiveness of Sodium ascorbate solution which is in accordance with the study conducted on bovine teeth by Shabaan et al.

The present study also had some limitations such as only single concentration of antioxidants was used. Moreover, this study being an in vitro study did not exactly simulate the oral environment. The oral conditions, especially the periodontal status, gingival conditions, and oral hygiene status may also alter the prognosis of the treatment. Therefore, the clinical application requires more in vitro studies and further long-term clinical studies to evaluate the effect of herbal antioxidants at different time intervals.

CONCLUSION

In conclusion, the study demonstrates that both Moringa Extract and Sodium Ascorbate are effective in enhancing shear strength, with both treatments showing a significant improvement compared to the Control Group. Thus, Sodium Ascorbate could be used as a pre-treatment by clinicians to improve the longevity of dental restorations when immediate restorations are mandatory.

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Further research with larger samples and longer followup is needed to fully understand long-term success and improve clinical outcomes for patients.

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