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COMPARATIVE ANALYSIS OF SHEAR BOND STRENGTH IN ORTHODONTIC BRACKETS FOLLOWING EXPOSURE TO ARTIFICIAL SALIVA, ALCOHOL AND GUTKA SOLUTIONS: AN IN VITRO STUDY

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ABSTRACT:

Aim: The aim of the study was to evaluate the shear bond strength (SBS) of orthodontic brackets after exposure to artificial saliva, alcohol and gutka solutions.

Materials and methods: Thirty extracted premolars extracted for orthodontic treatment were used in this study. Each tooth was embedded into clear acrylic resin and stored in distilled water. Later, the buccal surfaces of all the teeth were bonded with orthodontic brackets. All the teeth were randomly divided into three groups (Group I: Artificial saliva, Group II: Alcohol solution, and Group III: Gutka solution) and stored in each solution for 24 hours. Each tooth was then subjected to Shear bond strength (SBS) testing using universal testing machine (UTM). Statistical analysis of obtained data was done using SPSS Version 22. The comparison between various study groups was done using analysis of variance (ANOVA) test and Chi-square test with significance of $p < 0.05$.

Results: Highest mean SBS was observed in artificial saliva control group (10.7MPa), followed by alcohol group (8.68MPa), and least was found in Gutka group of (7.40MPa) ($p < 0.001$).

Conclusion: Consumption of gutka and alcohol should be avoided in patients during fixed orthodontic treatment because it affects the bond strength.

Keywords: Orthodontics, Shear bond strength, Brackets, Artificial saliva, Alcohol, Gutka.

INTRODUCTION

The bonding of orthodontic brackets on tooth surface is a key step in any orthodontic therapy, as strong bonding between tooth and bracket is one of the keys for any orthodontic therapy to be called as successful and efficient. ⁽¹⁾

It's important to understand how a patient's diet might affect the effectiveness of dental adhesives used in treatments. While research exists on the impact of diet on tooth enamel, there's a need for more studies specifically examining how food choices influence the strength of the bond between dental materials and teeth. ⁽²⁾

There are numerous problems for obtaining and preserving adhesion to dental structure. The oral cavity is a wet environment, teeth have different types of tissue, and some tissues are harder to work with than others. Plus, there are limits on what materials can be used in the body. ⁽³⁾ On the other hand, many factors affect bracket retention during orthodontic treatment such as the enamel surface. ⁽⁴⁾

Maintaining proper oral hygiene during orthodontic treatment is challenging, and patients may inadvertently expose their appliances to various substances, including components of saliva, alcohol, and tobacco products like gutka. These substances could weaken the bond between the braces and teeth, making treatment less effective and potentially longer. These substances can potentially affect the shear bond strength (SBS) of orthodontic brackets, impacting treatment efficacy and duration. Braces that repeatedly come loose mean longer treatment times, higher costs, and patients who are less likely to stick with the treatment plan ⁽⁵⁻⁶⁾ A strong bond between the bracket and the tooth surface is crucial for effective force transmission and predictable tooth movement.

This study aims to comparatively analyze the shear bond strength of orthodontic brackets after exposure to artificial saliva, alcohol, and gutka solutions, providing valuable insights into the potential effects of these substances on the clinical performance of orthodontic appliances. Understanding these interactions is essential for optimizing bonding protocols and ensuring successful orthodontic outcomes.

MATERIALS AND METHODS

Thirty orthodontically extracted maxillary premolar teeth were used in the present study. Immediately after extraction teeth were cleaned from blood and stained with nonfluoridated pumice with rubber cups for 10 seconds and rinsed under water. Later teeth were stored in 1% thymol (which acts as an antibacterial agent) solution in room temperature and were used within 4 weeks after extraction. All the teeth were then mounted in clear acrylic blocks in such a way that they were embedded in acrylic up to the cervical margin with the long axis of the tooth kept parallel to the center axis of acrylic block. [Figure1]

The sample selection was based on the following inclusion and exclusion criteria:

INCLUSION CRITERIA:

1. Teeth with intact anatomy
2. Teeth free of caries/restorations
3. Teeth free of dental wears, fractures, and structural abnormalities.

EXCLUSION CRITERIA:

1. Carious and restored teeth
2. Attrited teeth
3. Teeth with intrinsic stains or white spot lesions
4. Fractured teeth and teeth with dental anomaly
5. Teeth with iatrogenic damage.



Figure 1: Study samples

Buccal surface of all the teeth were acid-etched with 37% orthophosphoric acid for 30 seconds and washed for 20 seconds and air dried. After the appearance of frosty white surface, primer (3M Transbond, California) was applied on etched surface and cured with light cure and orthodontic MBT metal brackets (3M Unitek Gemini) were bonded with composite (3M Transbond XT Unitek) and it was light cured with light-emitting diode light device [Figure 2]

After bonding, all the specimens were equally distributed in 3 groups (Group1, Group2 & Group3) and were immersed in the respective solutions until the debonding procedure. [Figure 3]

Group I(n=10): Artificial saliva

Group II(n=10): Alcohol

Group III(n=10): Gutkha

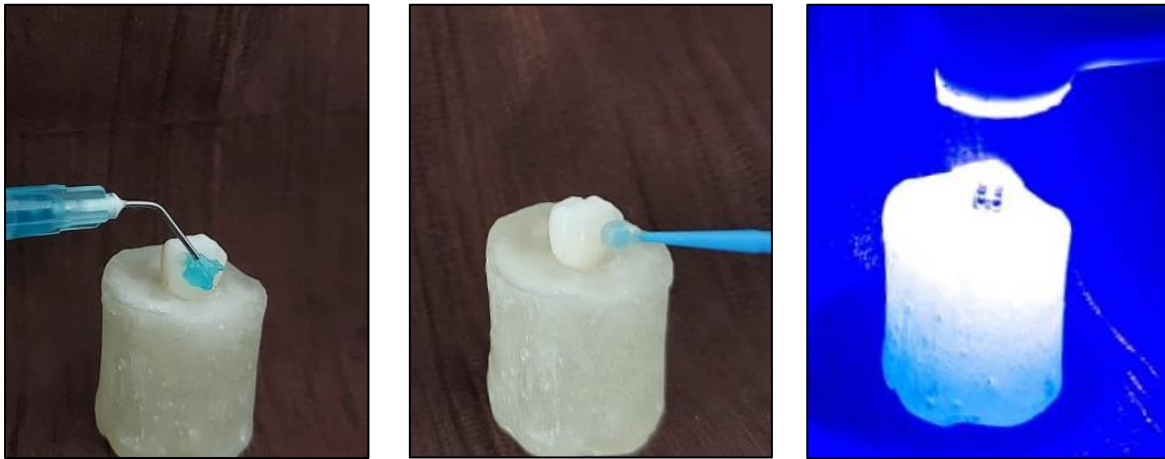


Figure 2: Bonding procedure:
A. Etchant application; B. Primer application; C. Bracket placement and curing



Figure 3: Groups of study
Group 1: Samples dipped in artificial saliva
Group 2: Samples dipped in alcohol solution
Group 3: Samples dipped in ghutka solution

Twenty-four hours after storage in each solution, the debonding procedure was carried out at the Universal Testing Machine (Unitest 10) [Figure 4] and the shear bond strength was calculated using the formula:

$$\frac{\text{Debonding force in Kg}}{\text{Surface area of the bracket base in mm}} \times 9.81 = \text{MPa}$$



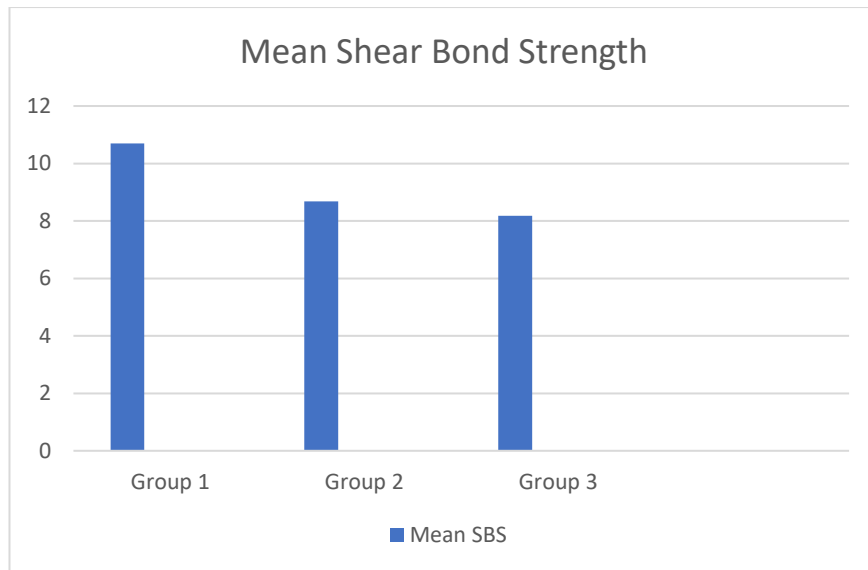
Figure 4: Debonding procedure carried out at the universal testing machine

RESULTS

Table 1 and graph 1 shows the comparison of mean shear bond strength between study groups. It was found that the mean shear bond strength was 10.7 MPa, 8.68 MPa and 7.40 MPa in groups 1, 2 and 3 respectively. Therefore, the results of this study showed that the mean shear bond strength was highest in the control group stored in artificial saliva (Group A), followed by group B which was stored in alcohol solution and the shear bond strength was found to be weakest in group C that was stored in gutka solution. The difference in shear bond strength of the study groups when compared using Analysis of Variance (ANOVA) was found to be statistically significant with p-value 0.001

GROUPS	SBS (Mean)
Group I: Artificial saliva	10.7 MPa
Group II: Alcohol	8.68 MPa
Group III: Gutkha	7.40 Mpa

Table 1: Shear Bond Strength values



Graph 1: Comparison of mean shear bond strength between study groups

DISCUSSION

With increase in the number of adults seeking orthodontic treatment, there comes the patients having detrimental oral habits such as alcohol consumption, tobacco chewing, smoking, etc. In orthodontics, a large number of brackets gets debonded during the course of treatment. This study was undertaken with a purpose to know if such detrimental oral habits have any influence on the shear bond strength of orthodontic brackets. The different conditions that brackets undergo inside the mouth can influence or change bracket bond strength and be detrimental for treatment.

Abu Bakr⁽⁷⁾ studied how different drinks affected dental adhesion and color stability. They tested alcoholic beverages (whiskey), acidic drinks (coca-cola and orange juice), and deionized water. Whiskey had the biggest impact on both adhesion and color, followed by coca-cola and then orange juice. West's⁽⁸⁾ research indicated that a carbonated orange drink with added calcium caused less damage to tooth enamel compared to a regular carbonated orange drink.

While some studies suggest that alcohol-based mouthwashes like Listerine can help reduce plaque and improve oral health for people with braces, their alcohol content may weaken the bond strength of orthodontic appliances and cause a burning sensation.^(9,10)

CONCLUSION

Detrimental oral habits such as alcohol consumption, tobacco chewing, smoking, etc can significantly alter the bond strength as seen from this study. Consumption of these substances should be avoided during the course of orthodontic treatment and to shorten the orthodontic treatment duration.

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