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Assessment of Shear Bond Strength of Orthodontic brackets subjected to pre-rinsing with Oral Rinses

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ABSTRACT

Aim: *To assess the shear bond strength (SBS) of orthodontic brackets when subjected to pre-rinsing with two different Oral Rinses - Chlorhexidine oral rinse and hydrogen peroxide oral rinse.*

Materials and methods: *This in vitro study included 30 extracted human teeth mounted and equally divided into 3 groups based on the oral rinse used. Group 1- Saline , Group 2- Chlorhex-idine oral rinse and Group 3- Hydrogen peroxide oral rinse. The teeth were then bonded and shear bond strength was assessed. The statistical tests were done in SPSS software version 23.0.0.0. Descriptive tests including mean and standard deviation was done. Shapiro-Wilk test was done to assess the normality of distribution. Also, One- way ANOVA along with Tukey's post hoc test was performed.*

Results: *It was reported that group 3 (8.61+1.20 MPa) had higher SBS followed by group 2 (7.55 + 1.35 MPa) and group 1(6.24 + 0.77 MPa) and the difference between them was signifi-cant [p<0.05].*

Conclusion: *Hydrogen peroxide when used for pre-procedural rinsing was found to increase the SBS of orthodontic brackets in laboratory conditions.*

Key words: Oral rinse, Hydrogen peroxide oral rinse, Chlorhexidine oral rinse, Shear bond strength

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INTRODUCTION

A standard measure before any dental procedure, especially pre-operatively is the use of oral rinses. Use of antimicrobial oral rinse before a dental procedure plays an essential role in re-ducing the number of microorganisms in the oral cavity. Orthodontic appliances hamper oral hygiene maintenance and can cause changes in the oral microbiota. The various orthodontic appliances like the bands, brackets, wires could lead to increased accumulation of plaque leading to poor oral hygiene and gingival health. Transient bacteremia following orthodontic proce-dures have been reported in clinical investigations. Degling et al has reported possible chances of bacteremia from minor oral trauma. Orthodontic appliances could provide an envi-ronment suitable for bacterial growth. The rise of bacterial growth can be attributed to oral ulcerations from sharp appliances, altered periodontal structures and increased tooth movement during orthodontic procedures. McLaughlin et al demonstrated an increase in bacteremia after orthodontic banding with a prevalence of around 10%. Similar results have been reported by oth-er studies where they have documented the potential of subgingivally placed orthodontic bands in changing the sub gingival ecosystem in subjects.

The incidence and severity of bacteremia is said to decrease with the use of antiseptic oral rinses before any dental procedure. Chlorhexidine is one of the common oral rinses used in dental procedures. It is used as one of the ingredients in toothpaste as well as a supplement treatment during periodontal diseases. Chlorhexidine oral rinse is commercially available in 0.12% and 0.2% concentrations. It is said to have a short-lived bactericidal effect immediately, followed by longer bacteriostatic effect. Filler et al reported that antibacterial rinse does not weaken the bond strength of the composite. Bishara et al and Damon et al studied about bond strength of orthodontic adhesives on the etched enamel surface after the application of chlorhex-idine varnish. Bishara et al in addition pointed out that SBS is not altered significantly when chlorhexidine varnish is used. The chlorhexidine varnish has to be mixed in advance to the seal-ant, smeared on the etched surface enamel and then light cured.

The application of oxygenating agents like hydrogen peroxide in dentistry is mostly indicated for management of supragingival plaque and for the treatment of acute ulcerative gingivitis with no potential side effects to the tissues. Study by Jhingta et al reported that the addition of 1.5% hydrogen peroxide mouthwash with chlorhexidine

resulted in better anti-plaque activity when compared with chlorhexidine alone and the effect was due to the additive effect of both the chemicals which had different modes of action on the bacteria. Hydrogen peroxide acts by releasing oxygen that immediately kills the obligate anaerobes present in the oral infections.

Following Peng et al's recommendations, several studies have proposed the use of hydrogen peroxide oral rinse as a preprocedural oral rinse to decrease the intra-oral viral load. The recommendation of a pre-procedural oral rinse with hydrogen peroxide was mainly based on the vulnerability of SARS-CoV-2 to oxidation.

Previously our team has a rich experience in working on various research projects across multiple disciplines. Now the growing trend in this area motivated us to pursue this project. The aim of this study is to assess the SBS of orthodontic brackets when subjected to different oral rinses before bonding them.

METHODS

Thirty freshly extracted maxillary premolars were collected for this study. The teeth were stored in saline solution at room temperature right after extraction and were tested within 4 weeks. The teeth that presented with fractures, caries or hypoplastic enamel were excluded. Acrylic resin was used to mount each tooth. The teeth were stored in distilled water, except during bonding and testing procedures. The 30 teeth collected were randomly divided into 3 equal groups.

The three groups were ; group A - Chlorhexidine oral rinse, Group B - 1.5% Hydrogen peroxide oral rinse and Group C - Saline. The mounted teeth were subjected to these oral rinses prior to bonding, then bonding was done with standard protocols.The teeth were cleaned and polished with non-fluoridated pumice powder for 10 seconds in a rubber prophylactic cup. Then it was rinsed for 10 seconds with water.The 35% phosphoric acid was used to etch the enamel surface for 30 seconds and then washed and dried for 20 seconds. The etched surface was then applied with bonding agent following which the brackets were bonded using composite. Excess resin was removed with an explorer. To ensure complete curing of the composite, light-curing was done for 3 seconds around the bracket in all directions.

Instron universal testing machine was used to test the samples in the White Lab at Saveetha Dental and hospitals, Chennai. The brackets were tested for SBS failure by using a blade placed at the bracket-base enamel interface at the occlusal side with a speed of 6 mm/min and a 50-kg load cell. The force producing failure was reported in Newtons. This was converted into Mega-pascals by dividing the measured force values by the mean surface area of the brackets.

Statistics were done using SPSS software version 23.0.0. Descriptive statistics included mean and standard deviation (SD) for each group in megapascals(MPa). Shapiro-Wilk test was done to assess the normal distribution of the samples. A one-way analysis of variance (ANOVA) and Tukey's post hoc tests were carried out to analyze the mean shear bond strength.

RESULTS

The mean and standard deviation of each group are shown in Table 1. It is observed that pre-rinsing Hydrogen Peroxide (8.61+1.20 MPa) has higher shear bond strength followed by pre-rinsing with chlorhexidine (7.55 + 1.35 MPa) and saline solution (6.24 + 0.77 MPa). On One-way ANOVA test, the means between the groups were found to be statistically significant [$p<0.05$] as shown in Table 2.

Shapiro-Wilk test was performed to check the normality distribution of the given samples. The values reported were greater than 0.05 indicating that the data is normally distributed.

Table 1: Descriptive statistics of the Shear Bond Strength after use of oral rinses.

Oral rinse	Mean	Std. dv
Saline	6.11	0.76
CHX rinse	7.55	1.35
HP rinse	8.75	0.84

Table 2: P-Values from Statistical Analysis of Shear Bond strength between the groups (Analysis of Variance [ANOVA] with Tukey's Post Hoc Test).

Tukey's Multiple Comparison Test	SBS
Saline vs CHX rinse	**
Saline vs HP rinse	***
CHX vs HP rinse	*

Discussion

The present study has reported that pre-rinsing with oral rinses doesn't have any adverse effect on shear bond strength of orthodontic brackets. It has been reported that pre-rinsing with 1.5% hydrogen peroxide and 0.2% chlorhexidine oral rinses has shown increased shear bond strength compared to pre-rinsing with saline solution.

Study by Demir et al (5) suggested a significant increase in shear bond strength when enamel is treated with both 7.5% povidone-iodine and 0.2% chlorhexidine prior to etching. However, application of these oral rinses on etched enamel doesn't significantly affect the bond strength. Similar results were obtained by Filler et al and Catalbas et al however the results were not statistically significant. No studies have reported on the effect of pre-rinsing with 1.5% Hydrogen Peroxide oral rinse on SBS of orthodontic brackets. In the present study SBS is increased in teeth exposed to Hydrogen Peroxide prior to bonding.

The mean bond strengths for the various groups in this study ranged from 5.7 to 9.7 MPa. A critical factor is whether the mean shear bond strengths are within the clinically acceptable range. Some authors observed that clinically acceptable SBS ranges from 13.0 to 21.0 MPa, whereas others reported a range from 6.0 to 8.0 MPa. The mean SBS of all composites tested in this study were within the 6.0 to 8.0 MPa range reported by Reynolds and Von Frauhofer. This is found to be adequate for routine orthodontic clinical use. The mean SBS values in the present study were well within the clinically acceptable range of shear bond strengths.Our institution is passionate about high quality evidence based research and has excelled in various fields.

The limitation of the study is the design of the study. Results from in vitro conditions obtained in controlled environments cannot be completely applied in clinical studies as the oral cavity is subjected to a lot of other individual variations.

CONCLUSION

Within the limitations of the study it was observed that the use of oral rinses did not have any adverse effect on the SBS of orthodontic brackets. The SBS was higher when pre-treatment rins-ing was done using 1.5% Hydrogen peroxide followed by 0.2% Chlorhexidine mouth rinses. However, further studies are required with larger sample size.

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