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ABSTRACT

Background: *The use of fixed orthodontics has a risk of increasing plaque retention, especially the gingival margin area. Efforts have been made to minimize the development of plaque against inflammation of the surrounding tissue and cross-infection, one of which is by decontaminating the buccal tube. The decontamination material commonly used is sodium hypochlorite 0.5%, but this antibacterial agent requires further research on the shear strength of the buccal tube attachment. The purpose of this study was to determine the effect of 0.5% sodium hypochlorite on the shear strength of buccal tube attachment after decontamination*

Method: *The research design used was the post test only control group design. The total research sample amounted to 52 samples and was divided into 4 groups: group I Clorhexidine 2% for 1 minute, group II Clorhexidine 2% for 5 minutes, group III 0.5% NaOCl for 1 minute and group IV NaOCl 0, 5% for 5 minutes. Post Decontamination of Buccal Tube and bonding shear strength was carried out using Universal Testing Machine. The Kruskal Wallis test was carried out to see the differences in the four groups in the shear strength of attachment and the Mann Whitney test to find out the differences between groups.*

Result: *The shear strength of the attachment by decontamination using 2% chlorhexidine for 1 minute was higher than the other 3 groups, which was 25.3 J/mm2, the lowest shear strength was for the 0.5% sodium hypochlorite group for 5 minutes, which was 16.5 J/mm2. Kruskal Wallis test results p value 0.000 (p <0.05), a significant difference in the four groups of bonding shear strength. Mann Whitney test (p<0.05) so that there was a significant difference in the buccal tube attachment shear strength between groups*

Conclusion: *There is an effect of shear strength of attachment on the buccal tube post decontamination*

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INTRODUCTION

The role of Sterilization is indispensable in daily clinical practice. Although all the instruments used in Orthodontics, as in dentistry, are sterilized before use, the same is not true for orthodontic archwires, brackets, buccal tube and bands. The orthodontic materials are used "as received" from the manufacturers, often with the assumption that the level of hygiene in the manufacturing process and subsequent transportation is sufficient to allow them for clinical use. In an era, where the orthodontic armamentarium has been upgraded with novel therapeutic systems, it becomes an integral part of the clinical practice to know all relevant aspects of sterilization.[1] Heat sterilization and disinfection are the effective methods to eliminate microorganisms causing contamination. However, literature has reported chemical disinfection to be more effective in reducing contamination when compared to heat sterilization. Glutaraldehyde, hydrogen peroxide, alcohol, and chlorhexidine are the disinfectants commonly used in the chemical sterilization process. Currently, chlorhexidine and sodium hypochlorite is the most favorable disinfectant due to its broad-spectrum bactericidal action against both the gram-positive and gram-negative bacteria.[2] This adverse effect of NaOCl on the resin enamel bond strength has been investigated and previously confirmed.[3] Good shear strength can affect the effectiveness of treatment and patient comfort.[4] Therefore, the purpose of this study was to determine the effect of 0.5% sodium hypochlorite on the shear strength of buccal tube attachment after decontamination.

METHOD

This study uses a true experimental design with a research design using a Post Test Only Control Group Design. This research has received ethical feasibility from the FKG Unissula Health Research Ethics Commission No 366/B.1-KEPK/SA-FKG/IV/2022. Based on the formula introduced by Federer, the study sample consisted of 52 premolars which had been extracted for the benefit of orthodontic treatment, manufacture of prostheses or could not be maintained in the oral cavity, had no caries on the buccal surface of the premolars, had been cleaned using a brush and running water from the remains of blood. Post-extraction premolar tooth sample transport media until the study was carried out using Hanks Balanced Salt Solution.

The crown of the premolar tooth was then cut horizontally from mesial to distal to the extent of 2 mm from the cementoenamel junction in an apical direction using a disc bur. The sample is then embedded in the self-cured acrylic resin mold that has been made. Samples that have been planted, soaked again in saline solution while waiting for further treatment. Prior to the shear strength test, antagonist molds were made. The material used is the same as the previous mold. Before inserting the buccal tube, the tooth surface was cleaned using a brush, etched with 37% phosphoric acid for 10-20 seconds, rinsed thoroughly and dried until frosty. The next stage is bonding, aerated and exposed to light for 3 seconds with a LC wavelength of 1000 nm. Buccal tube cementation with 3M Unitek Transbond XT light cure Orthodontic resin cement

Buccal tube debonding was carried out 30 minutes after bonding. This is based on the estimate that the arch wire was installed 30 minutes after bonding. The bonding shear strength test was carried out at the Integrated Laboratory F MIPA UGM. The sample is inserted into a steel tube and then mounted on the grip of the test equipment (Torsee's Electronic System Universal Testing Machine (2tf "Senstar", SC-2-DE, Tokyo-Japan). The maximum load used is 100 kgf with a tensile speed of 0.5 mm/minute. The machine is connected to a device that can show the strength of how many

brackets are released. The data obtained is in the form of load in kgf which is then converted in Newton units

RESULTS

The results showed that the average shear strength of buccal tube attachment in the 4 treatment groups with 0.5% sodium hypochlorite and 2% chlorhexidine decontamination can be seen in table 1

Table 1. Average bond shear strength measurements

Group	Mean	standard deviation
Chlorhexidine 2% 1 minute	25,3	3,3
Chlorhexidine 2% 5 minute	21,1	2,3
Sodium hypochlorite 0.5% 1 minute	17,5	2,8
Sodium hypochlorite 0.5% 5 minute	16,5	2,4

Table 1, it can be seen that the average shear strength of the attachment by decontamination using 2% chlorhexidine for 1 minute was higher than the other 3 groups, which was 25.3 J/mm2, the lowest shear strength was from the 0.5% sodium hypochlorite group for 5 minutes, which was equal to 16.5 J/mm2.

The results of the Shapiro-Wilk test showed p <0.05, the data was not normally distributed. The results of the Levene Statistical test with a p value of 0.000 (p 0.05), the buccal tube attachment shear strength data was homogeneous. The results of the Kruskal Wallis test p value 0.000 (p <0.05), there is a significant difference in the four groups of bonding shear strength. The Mann Whitney test p<0.05, there was a significant difference between groups, while the 1 minute sodium hypochlorite to 5 minute sodium hypochlorite group got results (p>0.05), there was no significant difference in shear strength of buccal tube attachment between groups.

DISCUSSION

The shear strength of the attachment of the buccal tube with decontamination using chlorhexidine for 1 minute was higher than the other 3 groups, which was 25.3 J/mm2. This happens because the chlorhexidine preparation used as a liquid decontamination agent. Chlorhexidine in liquid form has low penetration and absorption ability on tooth enamel so it does not interfere with the enamel bonding process.[5] Due to its low penetration and absorption ability on enamel also makes chlorhexidine material not interfere with the polymerization process between the bonding and the surface.[6] Chlorhexidine has a low ability to reduce the shear strength of the attachment also affected by the fact that the chlorhexidine molecule is smaller than hydroxyapatite crystals and fluoride ions so it has no impact on enamel surface changes.This is in line with research which states that liquid chlorhexidine does not have a significant effect on the shear strength of bracket attachment when compared to gel and varnish preparations. The effect of chlorhexidine on the shear strength of the attachment was also affected by the immersion time in this study because the chlorhexidine immersion time of 5 minutes was lower. This happens because chlorhexidine is tolerated and absorbed well by the enamel, so that in prolonged immersion, chlorhexidine can be absorbed more into the enamel and can interfere with bonding. Weak bond has an impact on decreasing the shear bond of the attachment. Chlorhexidine has the main function as an antibacterial. The enamel surface treated with chlorhexidine will increase antibacterial protection and have the side effect of decreasing

the shear strength of orthodontic bracket attachment.[5]

The minimum bond strength value for successful bonding in orthodontic treatment clinically ranges from 6 – 8 MPa. The buccal tube which was decontaminated with sodium hypochlorite had a good shear strength although it was lower, namely around 17-18 J/mm2 compared to that which was soaked in chlorhexidine. This happens because sodium hypochlorite has the disadvantage that it can reduce the adhesion ability of dental materials. In previous studies it was proven that the attachment of dental crowns with adhesive materials decreased when using sodium hypochlorite. This happens because sodium hypochlorite creates a reaction with molecular oxygen in dental materials which functions as a strong inhibitor, causing damage to the polymerization of dental materials. Defective polymerization of dental materials will cause changes in the shear strength of the attachment. Sodium hypochlorite reduces the shear strength of the bond by penetrating into the space created by sodium hypochlorite on the enamel so that the single bond weakens the enamel. The intertobular space created by sodium hypochlorite cannot be filled with large single bonded molecules, which in itself can reduce the bond strength when used. This is also in line with other studies which found that the use of sodium hypochlorite can reduce the shear strength of the adhesive.[6]

The results of this study are also in line with the research conducted by Sundari, et al, (2017) and found that the shear strength of the attachment does not exceed 30 J/mm2 because it can cause fractures to the enamel. The results in this study obtained the highest bond shear strength with an average of 25.3 J/mm

CONCLUSION

There was a difference in the shear strength of the attachment of the buccal tube soaked in chlorhexidine for 1 minute and 5 minutes and sodium hypochlorite for 1 minute and 5 minutes. The highest shear strength of attachment was on the buccal tube soaked in chlorhexidine for 1 minute then 5 minutes with chlorhexidine.

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All authors have made substantive contribution to this study and/or manuscript, and all have reviewed the final paper prior to its submission.

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