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IN VITRO EVALUATION OF THE SURFACE APPEARANCE AND MICROHARDNESS OF DENTAL ENAMEL TREATED BY ULTRASOUND WITH PROPHYLACTIC PASTE OF HYDROXYAPATITE AND SODIUM FLUORIDE

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ABSTRACT

INTRODUCTION: Closed scaling and root planning is a mechanical therapy that remains the gold standard of periodontal treatment, which is often combined with the removal and cleaning of hard and soft surfaces by ultrasonic means. It is important to determine its advantages and disadvantages, to enhance the results and avoid secondary damage to the patient. **OBJECTIVE:** The purpose of this study is to demonstrate the remineralizing capacity of the prophylactic paste added with hydroxyapatite particles and sodium fluoride, being applied on dental enamel previously treated with an ultrasonic cleaning method. **MATERIALS AND METHODS**: An ultrasonic cleaning method was applied to 40 of 50 specimens, of which 20 were randomly selected for the subsequent application of a prophylactic paste added with hydroxyapatite particles and sodium fluoride. The 50 specimens were subjected to microhardness tests in the durometer name of the durometer under the Vickersstandards and observed in the microscope name of the microscope by a qualified operator for the subsequent obtaining of statistical data. **RESULTS:** When evaluating the mechanical property of microhardness with the vickers measurement of dental enamel, it was identified that the Negative Control group presented, with sufficient statistical evidence, the greatest resistance to indentation with a value of 577 ± 21 vickers ($p<0.001$). Following the Ultrasound + Prophylactic Paste group reported an average of 516 ± 15 vickers, and in terms of its contrast with the Ultrasound group, which presented the greatest loss of microhardness with an average of 483 ± 19, a statistically significant difference was identified ($p <0.001$). On the other hand, the microphotographs revealed a fissured surface

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with enamel detachment in specific areas in group A (ultrasound without prophylactic paste), and for Group B it is possible to see a rough surface, completely invaded by hydroxyapatite crystals, which in theory it would favor the remineralization of the enamel. **CONCLUSIONS:** The use of a prophylactic paste added with hydroxyapatite particles and sodium fluoride showed a notable benefit in enamel that has suffered from previous mechanical damage, opening new lines of research.

Keywords: enamel, hydroxyapatite, sodium fluoride.

1. INTRODUCTION

Currently there are two oral pathologies with the highest incidence and prevalence worldwide; The first is cavities, followed by periodontal disease, according to the World Health Organization. Periodontal disease is infectious with very particular clinical characteristics such as inflammation, bleeding, loss of attachment, periodontal pockets and in severe cases loss of the tooth. Treatment modalities include mechanical therapy, such as scaling and root planning, periodontal surgery, local administration of antimicrobials and systemic antibiotics [(1)].Closed scaling and root planning is a mechanical therapy that remains the gold standard for the treatment of this pathology, which is often combined with the removal and cleaning of hard and soft surfaces by ultrasonic means. This requires an exhaustive analysis of the benefits and disadvantages offered by the use of dental ultrasound, speaking in terms of protection of the tooth structure and effective removal of bacterial deposits [(2)]. Remineralization is defined as the net gain of calcified material in the tooth structure, which replaces that which had previously been lost through demineralization. This occurs through a physical-chemical process that includes the supersaturation of ions in the solution with respect to the enamel, the formation of nuclei and the growth of crystals. When the solution is supersaturated with ions, they begin to form bonds and dehydrate, forming solid nuclei. The nuclei group together to precipitate in the form of crystals in those spaces of the enamel that, as a product of demineralization, have a greater contact area[(3)]. Finally, the newly precipitated crystals will grow isotropically (in different directions and at different speeds), by deposition of ions on their different faces. In tooth enamel, under natural conditions of presence of saliva and biofilm, the chemical processes of ion mobilization are permanent. For example, due to the intense metabolism of biofilm bacteria, organic acids are produced, such as lactic, acetic, propionic, butyric and succinic acids, capable of releasing hydrogen ions (H+) to the biofilm medium and saliva, which decreases the pH value with increasing H+ concentration. This excess H+ binds to PO4 -3 ions to form primary and secondary phosphates up to phosphoric acid. For their part, OH^- also capture H+ to form water[(4)].

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2. MATERIALS AND METHODS

In the present study, 10 teeth were included in the control group, 20 in experimental group A and 20 in experimental group B, all indicated for extraction for orthodontic reasons that contain calculus deposits on the root surface and enamel. All teeth were preserved in glass bottles with sterile distilled solution in order to keep the samples hydrated. The teeth were washed with distilled water and placed in a Nic Tone self-polymerizing acrylic resin base, leaving the buccal surface free. In the control group, 10 randomly chosen pieces were included, to which NO cleaning method was applied. 20 samples were taken randomly from the remaining 40 for the application of the ultrasonic cleaning method. The equipment used Cavitron ultrasonic brand Biosonic model US100R The pieces were handled with latex gloves and healing forceps, then dried with sterile gauze.

Fig. 1: Study specimens.

They were held firmly with the fingers horizontally and with the tip of the ultrasonic instrument the stone deposits were removed with the same pattern of movements in all the pieces, starting from the most apical deposits towards the coronal ones, placing the tip at an angle. of 45° using water pressure at 0.03 MPa at level 5 of the 7 offered by the device. 20 movements were made from apical to coronal on each side of the tooth with duration of 5 seconds each, until the greatest amount of calculus possible was eliminated. When finished, the pieces were returned to the container with new distilled water and preserved until later observed under the Leica hz4hd stereoscopic microscope at 8x. The same ultrasonic cleaning method was applied to the remaining 20 pieces and was carried out by the same operator, following the same previous instructions, reproducing the applied force as much as possible and respecting the operating

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instructions. Followed by ultrasonic prophylaxis, polishing was carried out with Lunos® Two in One prophylactic paste.

Fig. 2: Lunos® Two in One Prophy Paste.

Using a rubber prophylactic cup, it was applied to the specimen to begin polishing at low speed. Following the product instructions, the cup was kept in a position parallel to the piece and repetitive movements were made from cervical to incisal along the length for 10 minutes. seconds, trying to keep the tooth always covered with paste to avoid overheating They were rinsed and placed back in the container bottles with new distilled solution and kept there until observed with the Stereoscopic Microscope (Jeol-Jsm – 7600 F).

3. RESULTS

The results obtained in the present study demonstrate the remineralizing capacity achieved after the application of a prophylactic paste added with hydroxyapatite and sodium fluoride, so the null hypothesis has been rejected. The statistical analysis revealed an increase in the microhardness of the enamel in the pieces treated with ultrasound + Lunos® Two in One Polishing Paste compared to the pieces that were only treated with the ultrasonic method.

When evaluating the mechanical property of microhardness by vickers measurement of the dental enamel, it was identified that the Negative Control group presented with sufficient statistical evidence the highest resistance to indentation with a value of 577 ± 21 vickers($p<0.001$). The Ultrasound + Prophylactic Paste group reported an average of 516 ± 15 vickers, and in contrast to the Ultrasound group, which presented the greatest loss of

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microhardness with an average of 483 ± 19, a statistically significant difference was identified (*p<0.001*).

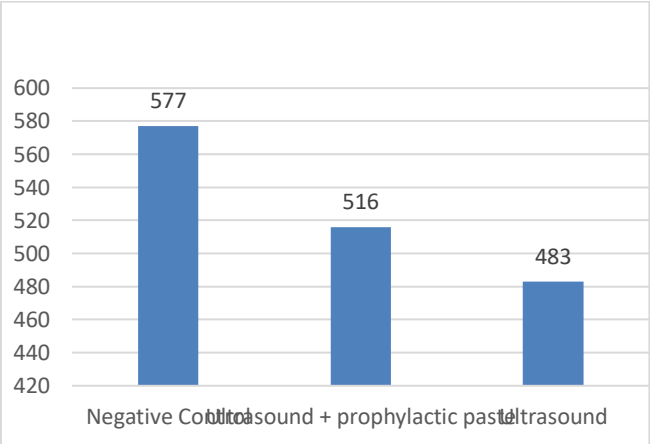

Fig. 3: Evaluation of the mechanical property of microhardness by vickers measurement of the dental enamel.

Surface appearance

The microphotograph corresponding to the Control Group obtained from the SEM at 2000x showed an irregular surface with areas invaded by dental calculus.

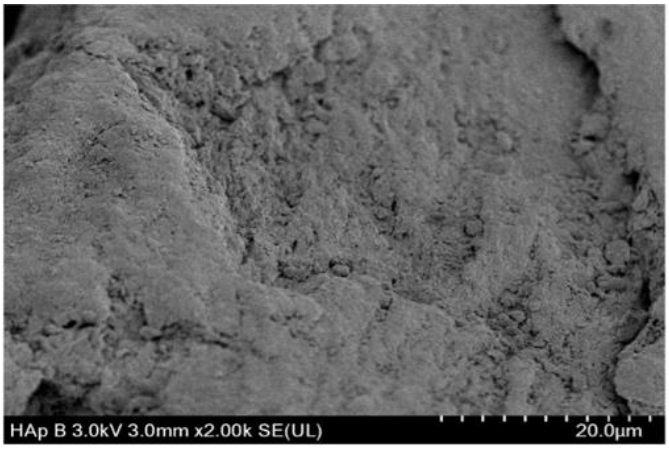

Fig. 4: Control Group.

In the micrograph corresponding to the Ultrasound Group obtained from the SEM at 2500x shows a smooth surface free of calculus with microporosities representing the entrance to the prismatic structures and a well delimited detachment of enamel.

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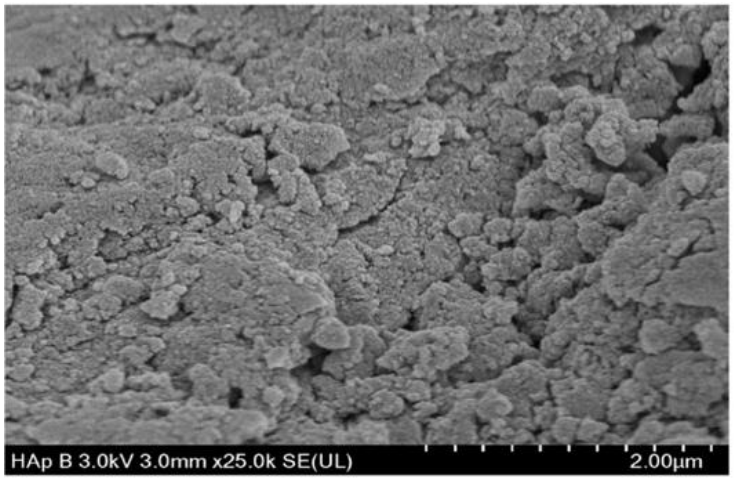

Fig. 5: Ultrasound Group.

The micrograph corresponding to the ultrasound + polishing paste group obtained from the SEM at 2000x shows a homogeneous surface free of calculus and with prismatic structures sealed by hydroxyapatite crystals.

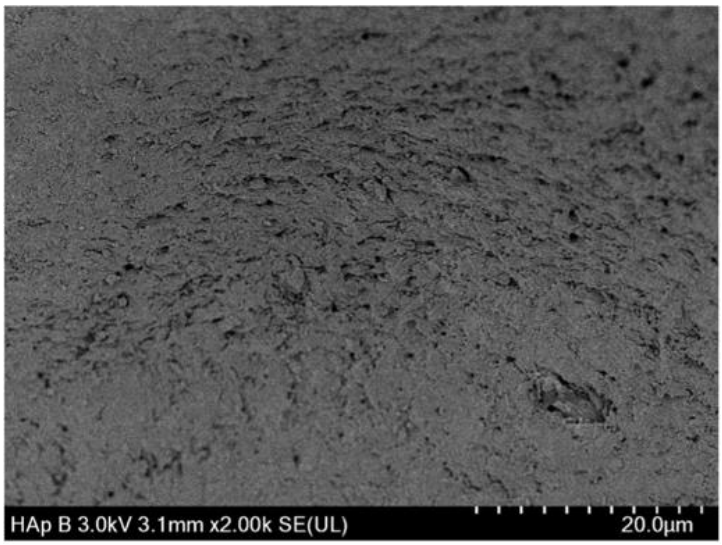

Fig. 6: Ultrasound + Prophylactic Paste Group.

4. DISCUSSION

The results obtained in the present study demonstrate the remineralizing capacity achieved after the application of a prophylactic paste added with hydroxyapatite and sodium fluoride and therefore the null hypothesis has been rejected.

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The statistical analysis revealed an increase in the microhardness of the enamel in the pieces treated with ultrasound + Lunos® Two in One Polishing Paste in comparison with the pieces that were only treated with the ultrasonic method.

Daas et al[(5)] compared in his study the effects of nanohydroxyapatite and fluoride on artificially demineralized dental enamel, analyzing the surface microhardness and the degree of remineralization, achieving statistically similar data with the present study and concluding that they represent an excellent treatment for demineralization lesions in the enamel.

On the other hand,Vyavhare et al[(6)] evaluated the remineralizing properties of hydroxyapatite (10%) and amorphous calcium phosphate (10%) alone on an initial carious lesion and compared the results with those obtained from the application of a fluoride varnish applied in the same way and although the first 2 groups obtained good results, they could not be considered as an effective alternative to fluoride, but rather as probable complements to remineralizing therapy[(7-10)].

5. CONCLUSION

With the limitations of the present in vitro study and the results obtained, the following conclusions were reached:

1. The dental enamel presented a morphological change in the surface appearance and a loss of Vickers microhardness after the application of the ultrasonic cleaning method.

2. The use of a polishing paste with the prophylactic paste Lunos® Two in One applied after the use of ultrasound on the enamel, showed an increase in the microhardness of the enamel in contrast to a tooth with no application.

3. The present study demonstrates with scientific evidence the enamel remineralization process achieved after the application of Lunos® Two in One prophylactic paste on the tooth previously treated with the ultrasonic cleaning method.

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