Influence of the Grander Technology in the Physical Properties of the Self-Etch Adhesive System

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ABSTRACT

Aim: The objective of this study was to evaluate the influence of the Grander technology in reducing the surface tension and contact angle of self-etch adhesive system.

Materials and methods: Distilled water and Xeno III self-etch adhesive system (Dentsply) were modified by physical contact with the flexible unit Grander system to revitalize water, for 48 hours, resulting in four groups: Group CW-distilled water under normal conditions; Group CA-Xeno III adhesive system under normal conditions; Group GW-distilled water system modified by the Grander system; Group GA-Xeno III adhesive system modified by the Grander system. Surface tension and contact angle of the adhesive system and water in normal and Grander-modified conditions was measured with a goniometer. ANOVA and Tukey test were used to analyze the results (5%).

Results and conclusion: For surface tension, ANOVA showed p < 0.05, what indicated significant differences between the groups. The mean values (D/cm) for the groups were: CW-72.4 a; GW-69.45 b; GA: 31.17 c; CA-29.98 c. The results showed a significant reduction of surface tension for distilled water modified by Grander system. Grander technology did not interfere in the surface tension and contact angle physical properties of the Xeno III self-etch adhesive system.

Clinical significance: Grander technology is a method that revitalizes water by physical spatial restructuring of its molecules. The modify of an adhesive system, also a liquid with an aqueous solvent, to provide a reduction in surface tension and contact angle, increasing its wetness capacity and therefore ensuring a greater diffusibility.

Keywords: Grander technology, Surface tension, Contact angle, Self-etch adhesive systems.


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INTRODUCTION

The use of adhesive systems in Dentistry was initiated when Buonocore (1955) developed the technique of etching enamel. This technique is based on etching enamel surface with phosphoric acid gel, at a concentration between 30 and 40%, which promotes the selective dissolution of hydroxyapatite crystals, producing surface microporosity and increased surface energy of enamel. This etching provides a superficial layer removal of enamel around 10 μm, creating a porous layer of 5 to 10 μm. The mechanism of bonding adhesive to enamel is explained by the increase surface energy of the enamel from 28 to 72 dynes/cm after etching, by the creation of microporosity restraint geometry, which is subsequently filled by the adhesive, forming the tags. The low viscosity of the adhesives allows the flow in these micropores by capillary action, providing a micromechanical union after its cure.

To obtain an adequate bond between the enamel substrate and adhesive system, it is necessary the formation of a small contact angle of the adhesive deposited on the enamel, what shows a good moistening capacity of the surface by the adhesive. The ideal interaction occurs when the surface tension of the adhesive system is slightly lower than the surface energy of the substrate.

Following the modern trend of simplifying the clinical steps and saving operating time, new bonding strategies were developed. Watanabe in 1994 proposed the use of high concentrations of acidic resinous monomers which, in an aqueous solution, are capable of releasing H+ ions and producing etching of the dental structure, at the same time as they penetrate into the substrate. These materials were called self-etching, since they dispensed the separate application of the acid.

Although they presented good performance in dentin, some researchers have suggested that due to their low acidity, their performance in enamel is lower and capable of leading to low bond strength values in this substrate. Morphologic studies of enamel surfaces have demonstrated that the application of some self-etching primers does not result in the same etching when compared with that produced by phosphoric acid, and their use in regions with extensive areas of enamel is very controversial.

Recently, Johan Grander developed the Grander technology, a method that revitalizes water by physical spatial restructuring of its molecules. This restructuring allows a molecular balance with improved transportation properties, probably by reducing its surface tension. Extrapolating the water revitalization process for the ideal conditions desired in terms of adhesiveness, we could modify an adhesive system, also a liquid with an aqueous solvent, to provide a reduction in surface tension and contact angle, increasing its wetness capacity and therefore ensuring a greater diffusibility.
The objective of this study was to evaluate the influence of Grander technology in the surface tension and contact angle of self-etch adhesive system. The null hypothesis tested was that the Grander technology cannot change the surface tension and contact angle physical properties of the adhesive system.

MATERIALS AND METHODS

Modification of Adhesive System and Water by the Grander System

The first step required for the execution of the entire methodology was the modification of the Xeno III self-etch adhesive system (Dentsply De Trey GmbH D, Konstanz, Germany) and of the water by the Grander system:

- **Experimental**: Two sets of the same batch of the adhesive system were used. One set was kept unchanged and the other was placed in physical contact with the Grander system Flexible unit (Grander Technologies, Jochberg, Austria). This system consists of a device named Flexible unit, capable of revitalizing waters by electromagnetic induction of molecular rearrangement through contact with bottles of liquids or by the passage of liquids through the interior of channels placed among cylinders that build the core of the unit. Thus, the bottles of adhesive system were placed in contact with the unit flexible for 48 hours.

- **Control**: Two bottles with 5 ml of distilled water were revitalized by the Grander system for 48 hours, following the same treatments described above.

The commercial name, chemical composition, batch number and manufacturer of the material used are presented in Table 1.

Surface Tension Measurement

For surface tension, four groups were established as follows:

- **Group 1**—Distilled water (control);
- **Group 2**—Grander-modified distilled water (experimental);
- **Group 3**—Xeno III self-etch adhesive system (control);
- **Group 4**—Grander-modified Xeno III self-etch adhesive system (experimental).

Surface tension of each group was measured by automatic goniometer (Ramé-Hart Instrument Co. 0.100-00, Washington DC, USA). Temperature and moisture conditions of the environment were controlled in 23°C and 50% respectively.

Samples were collected from each group on a micro-syringe (Gilmont, Barrington, Illinois, USA). The micro-syringe presents a micrometer Teflon, a glass barrel, a rubber sealing ring and a metallic needle number 22. The barrel was wrapped in aluminum foil in order to prevent adhesive systems polymerization in its interior, due to the room light. The whole set was fixed in the goniometer support to measure the surface tension.

By turning the micrometer screw clockwise by hand, a gradual drop of liquid was obtained, which remained attached to the needle tip due to its surface tension. The device allows adjustment of the number of steps/time. Twenty measures were taken for every drop of each liquid tested, yielding an average of surface tension.

Data were submitted to the two-way ANOVA (liquid and procedure factors) followed by the Tukey test, at a 5% level of significance.

Contact Angle Measurement

For contact angle measurement, two groups were established as follows:

- **Group 1**—Xeno III self-etch adhesive system (control);
- **Group 2**—Grander-modified Xeno III self-etch adhesive system (experimental).

The contact angle was evaluated in two different substrates: Titanium plate and enamel substrate.

- **Contact angle measurement in the titanium plate**: Ten drops of Xeno III adhesive system were dropped individually on a titanium plate. The waiting time of
CONTACT ANGLE MEASUREMENT IN THE ENAMEL SUBSTRATE: Forty extracted bovine incisors were cleaned and stored in distilled and deionized water in a freezer at -18°C until the time of use. Then the roots were sectioned with a steel diamond disk (KG Sorensen, Rio de Janeiro, Brazil) at the cement-enamel junction. The buccal surfaces were worn using abrasive papers (granulations 400 and 600) coupled to a circular polishing machine (PA-10, Panambra, São Paulo, Brazil) under water cooling, to expose an area in enamel measuring a minimum of 4×4 mm. An opening was made on the lingual side using a spherical diamond tip 1012 (KG Sorensen, Rio de Janeiro, RJ, Brazil) to remove the pulp tissue. The openings on the lingual face and root canal were clogged with utility wax (Polidental, Cotia, SP, Brazil). After this the worn buccal faces were turned facing down in a silicone mold, which was then filled with self-polymerizing acrylic resin (Classic, São Paulo, Brazil). The enamel surface was standardized using abrasive papers (granulations 1200 and 4000) for 20s each, coupled to a circular polishing machine. Each specimen received on the enamel surface one drop of Xeno III adhesive system, totaling 20 drops for each group (experimental and control). The contact angle was measured by the same protocols described above. For each drop, 20 measurements were realized and the mean values were calculated.

For contact angle, data were submitted to the two-way ANOVA (substrate and procedure factors) followed by the Tukey test, at a 5% level of significance.
conditions in terms of adhesiveness, the modification of an adhesive system increasing its wetness capacity ensuring a greater diffusibility and, perhaps, its molecular stability is desire for dentistry.20

Gonçalves20 (2005) showed that the Grander technology affect the physical properties of Single Bond and Clearfil SE Bond adhesive systems, reducing surface tension and contact angle of these adhesive systems. Additionally, Gonçalves18 observed that both adhesive systems generated greater thickness hybrid layer and the Single Bond self-etch adhesive system created a greater thickness of the hybridization compared to Clearfil SE Bond self-etch adhesive system, regardless of the substrate and the procedure (control or Grander-modified).

This study showed that distilled water Grander-modified reduced significantly the surface tension when compared to distilled water control (procedure factor). These results are agreement with Gonçalves20 (2005), who noted a significant reduction in surface tension of water after revitalization process by Grander system. Corroborating our study, Faissner21 (2000) evaluated all properties of water after revitalization process (ionic balance, density, conductivity, pH, surface tension, test with boiling alcohol and diagram) and he observed that surface tension showed the most significant change, around 10%.

Also, this study observed that the Xeno III adhesive system showed lower surface tension compared to distilled water (liquid factor). However, the interaction between liquid and procedure factors showed absence of significance. The Xeno III adhesive system do not reduced significantly the surface tension after revitalization process by Grander system, probably because the percentage of water present in it is lower, or alternatively, this adhesive system present greater molecular complexity, differently to the results founded by Gonçalves20 (2005), who observed surface tension reduced significantly after revitalization process by Grander system of the Single Bond and Clearfil SE Bond adhesive systems. The reduced surface tension demonstrates a greater ability of the liquid to wet the substrate and, thereby, improve the adhesiveness and diffusibility.22

The Xeno III adhesive system contains water and ethanol as solvents in it composition. Theoretically, it should cause changes after revitalization process by Grander system. However, this did not occur, probably because water and ethanol in it formulation present small concentrations. Also, this adhesive system contains high viscosity due the presence of silica and urethane dimethacrylate. Our study do not observe visual change in viscosity of this adhesive system after revitalization process, contrasting with the findings by Gonçalves20 (2005), who found greater fluidity of the Single Bond and Clearfil SE Bond adhesive systems after revitalization process by Grander system.

With regard to contact angle, our results demonstrate absence of significant difference between procedure (control and Grander-modified) and substrate factors (enamel substrate and titanium plate). According to Won-suck et al23 (2002), the contact angle vary due surface topography, surface tension, surface energy of solid substrate and the level of interaction between the liquid and solid. Therefore, the smaller the contact angle, the greater the surface wettability. Thus, the contact angle values vary according to surface tension of liquid. The absence of significant reduction in surface tension generates absence of significant variation in the contact angle. This result is probably due to the physical and chemical characteristics of the Xeno III adhesive system.

The dental literature is scarce in studies about surface tension and contact angle of current adhesive systems. However, this study showed that distilled water was modified by Grander system after revitalization process, wherever, Xeno III adhesive system did not show the same results. Probably because it presents higher viscosity and more time in contact with the Grander unit for revitalization process is necessary. The Grander technology is a new technology, therefore, others studies are necessary to demonstrate the possible revitalization process by the Grande system in the adhesive systems.

**CONCLUSION**

Based on the methodology employed, it can be concluded that:

- Distilled water reduced the surface tension significantly revitalization process by Grander system compared to distilled water control;
- Grander technology do not interfere the surface tension and contact angle physical properties of the Xeno III self-etch adhesive system.

**REFERENCES**

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