COMPARISON OF TWO DIFFERENT ETCH SYSTEMS AS ADHESION RESISTANCE IN DENTAL ADHESIVE SYSTEMS

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Adhesive systems are used in many specialties in dentistry. These systems provide chemical attachment of prosthetic and restorative materials to the tooth surface. The first stage of adhesive systems is the etching process. In the commonly used Total etch systems, acid agent is applied to the tooth first to create roughness on the tooth surface, then the applied bond agent enters this rough surface to ensure retention. The acid agent used is 37% phosphoric acid gel. Normally, phosphoric acid is liquid. It should be applied in gel form in order to be applied in a controlled manner to a certain surface of the tooth and to remain on the desired surface for a long time. Commercially used phosphoric acid gels are produced by a single method and contain the carbomer chemical. Another way to produce gel is silicium dioxide. Acid gels produced with carbomer have a glossy appearance, while acids produced with Silicium have a matte appearance. In this study, we aimed to see the difference in retention of the phosphoric acid gel produced with silicium dioxide compared to the carbomeric acid gel. In this study, we prepared phosphoric acid gel with silicium dioxide and phosphoric acid with carbomer. In our study, 50 extracted caries-free human teeth were used. Orthodontic buttons were attached to the buccal surfaces of the teeth in 2 groups. Phosphoric acid gel prepared with Carbomer was applied for 40 seconds on 25 teeth and phosphoric acid gel prepared with silicium dioxide for 40 seconds on 25 teeth. Afterwards, the teeth were washed with water for 10 seconds and dried, and the orthodontic buttons were adhered with blue light for 40 seconds with Tokuyama bond and flowable composite, and a tensile test was applied to them. There was a statistically significant difference between the tensile force resistance of the buttons attached with two different methods. The teeth in which the gel prepared with silicium dioxide was used showed an average of 6% more resistance to tensile force than the other group. In this study, adhesion strength was measured for the first time by changing the gel base material in acid. We recommend this preparation of acids in adhesive systems, and we believe it can be beneficial for all dentists.

Keywords: dental adhesives, phosphoric acid, tensile test

INTRODUCTION

In dentistry, phosphoric acid is used to etch enamel and, more recently, dentin. It is thought that the acid content is directly correlated with the depth of dentin demineralization (van Meerbeek *et al.*, 1992). The buffering effect of hydroxyapatite and other dentin components limits the interaction of the etching agents with dentin (Sano et al., 1994). The dentin surface is demineralized, the tubules are opened, the smear layer and superior layer of the dentin are removed, and the intertubular dentin's microporosity is increased by the acidic chemicals (Pashley, 1992; Sattabanasuk *et al*., 2007). The tubules are where the acids mostly penetrate. It is believed that the main mechanism of bonding to dentin is the micromechanical entanglement of hydrophilic resins into this demineralized microporous dentin, resulting in the formation of a reticular interwoven hybrid tissue made up of collagen, leftover mineral particles, and resin (Nakabayashi *et al.*, 1982; van Meerbeek *et al.*, 1993). Despite being advertised for years as liquids, the majority of today's etching agents are primarily gels, either thick or thin in consistency (Guba *et al.*, 1994). Gels are thickened by manufacturers to make them easier to handle. The gel forms have the benefit of allowing the practitioner to easily manage how the acid spreads across the surface and visibly detect the acid's presence (Guba *et al.*, 1994).

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Clinically, the demineralizing effect is seen when gas bubbles build up within the gel. Even with rigorous washing, etching gels thickened with silica microparticles leave a particulate deposit on the dentin surface; whereas, polymer-thickened gels leave a clean dentin surface (Kubo et al., 1991). Dentin may generate a layer of denatured collagen and leftover smear layer particles as a result of acid-etching, which prevents the collagen network from being totally exposed (Pashley, 1992). It is unknown if the silica component of some etching chemicals helps to prevent this residual surface layer from forming at all (Hajizadeh *et al*., 2009). Additionally, the effects of additional etching gel ingredients including surfactants, polymers, and other specific modifiers are not fully characterized (Ozcan *et al*., 2015). The aim of this study is which type of thickener in the etchant, similar acidic concentrations of various phosphoric acid etching agents make more tensile strength.

MATERIAL & METHODS

In this study, we prepared %35 phosphoric acid gel (pink color) with silicium dioxide (aerosil 200 - Evonik Industries GER) and %35 phosphoric acid (blue color) with polymer (carbopol – Lubrizol USA). In our study, 50 extracted caries-free human teeth were used. 25 of them grouped for silicium dioxide acid gel, and other 25 of them grouped for polymer acid gel. First the tooth was cleaned with brush handled by angle drive motor. Then acid applied to their mesial enamel side. Acid was kept on tooth about 40 seconds then pressure rinse with air-water mixture. Then dried with air pressure. Bond agent (Tokuyama-Japan) applied with bond brush to surfaces and given 450nm blue light directly for 10 seconds. After that, orthodontic buttons attached with flowable composite (Tokuyama-Japan) and given 450nm blue light from occlusal side for 40 seconds. After that, 0.5mm stainless steel wires binded to buttons and a tensile test (Instron-USA) was applied to them.

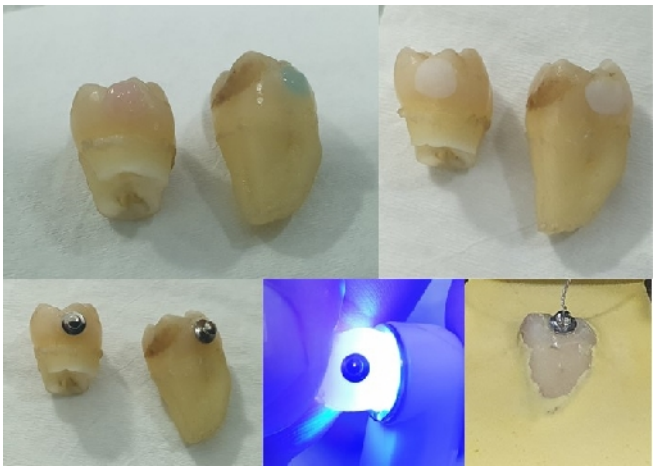

Figure 1. Process flowchart of bonding buttons

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Table 1. Breaking Force Table

Groups	Min BF	Max BF	Average BF
Silicium group	615	960	790
Polymer group	545	850	695

Intermediate Values Used In Calculations:
T = 371.2311
Df = 48
Standard Error Of Difference = 0.283

CONCLUSIONS

In Perdigao *et al.* study, X-ray elemental analysis of both 10% phosphoric acid etching agents confirmed that silicon was present in silica-based gel but not in polymer-based gel. Photomicrographs of dentinal surfaces treated with silica-based showed that a particulate residue was left after rinsing, although the tubule orifices were open. X-ray microanalysis indicated that the residue contained silicon atoms. Cross-sectional views showed funnel-shaped tubules with dissolved peritubular dentin. Particulate debris was also evident in the tubule orifices in the cross-sectional view. When etched with polymer-based, dentinal tubules were opened, but the surface appeared clean and uncontaminated and no silicon was detected with x-ray microanalysis. They also found that there were no significant differences in the bond strengths of specimens etched with the polymer-thickened and silica-thickened gels for either enamel or dentin.(Perdigao *et al.*, 1994)

The shallow depth of intertubular dentin demineralization and the presence of a cuff of superficial peritubular dentin in all the specimens etched with silica-thickened gels may have been caused by a less aggressive effect of the respective etchant. Consequently, this may favor the establishment of high dentin bond strengths, since more calcium might be available (Yamaguchi *et al.*, 1989).

In our study, there was a statistically significant difference ($p \leq 0.05$) between the tensile force resistance of the buttons attached with two different methods. The teeth in which the acid gel prepared with silicium dioxide was used showed an average of 6% more resistance to tensile force than the other group. In this study, tensile test was measured for the first time by changing the gel base material in acid. We recommend this preparation of acids in adhesive systems, and we believe it can be beneficial for all dentists.

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