Tensile bond strength of hydroxyethyl methacrylate (HEMA) bonding agent to bovine dentine surface at various humidity

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ABSTRACT
One factor that make bonding agent adhere to dentine surface maximally is the humidity condition around the dentine surface. The best bond strength between bonding agent with dentine surface is depending on the moist surface. It mean that the dentine surface should neither too dry or wet. The objective of this research is to know the tensile bond strength of hydroxyethyl methacrylate (HEMA) bonding agent to bovine dentine surface at various humidity. The bovine dentine was grounded to give flat surface, which was then etched with 37% phosphoric acid for 15 seconds. Dentine was washed with 20 ml water and dried with blot dry technique. The dentine, except the control group, was placed in a desiccator for one hour at difference humidity. Dentin was removed from desiccator, then covered with bonding agent and put into tensile tool plunger. Self-cured acrylic resin was applied on this bonding agent layer, which was placed on opposite-plunger. After 24 hours, tensile bond strength was measured with Autograph instrument. Data was statistically analyzed with One-Way ANOVA at 95% confidence level, continued with LSD test. Results of this study showed that 60%–90% humidity gave produce the lower of tensile bond strength of bonding agent to dentine surface (p ≤ 0.05). In conclusion, the treatment in 60% humidity gave the greatest tensile bond strength.

Key words: humidity, dentine bonding agent, bovine dentine, tensile bond strength


INTRODUCTION
In operative dentistry field, drying is one step of the application of dentine bonding based on hydroxyethyl methacrylate (HEMA) to dentine surface. This step is done based on total etched technique. The purpose of the procedure is to blot up excess water that were used for washing dentine surface after etching process. The purpose of washing is to removed the salt that formed as reaction of acid etched materials and dentine mineral. Some researchers said that the dentine surface should neither too dry nor wet. If the surface is too dry, the dentine collagen will collapse so that the bonding between resin and dentine collagen will be difficult. On the contrary, if the dentine surface is too wet, there are too many water molecules around collagen, so hydrogen bond between water and amino collagen will inhibit bonding agent to bond with collagen. Therefore an optimal condition of dentin surface is needed to obtain a maximal bonding between dentine bonding agent and dentine collagen.

A good moisture characteristic of dentin bonding materials is referring to the low level of viscosity so that can improve surface energy. HEMA is a humectants hydrophilic agent that has ability to wet dentin surface. Generally, the bond efficacy of resin bonding materials to dentin collagen depend on some factors that are: the lowness of monomer viscosity, concentration and type of monomer, acid application as conditioner, humidity and temperature around fibril kolagen. Research concerning the influence of humidity to tensile bond strength of dentin bonding materials at dentin surface was done by in vitro experiment. In this research, they used 33%, 50%, 75%, and 100% humidity. Humidity of oral cavity depends on the usage of rubber dam. If we use rubber dam, the humidity is 50% at 23 °C that influenced by the humidity of the dental practice room. But, if we do not use rubber dam, the humidity is about 80–94%.

In this research, we used humidity that ranging from 60–90% with temperature 25 °C. This 60% humidity is minimum humidity according to the research previously. At 50 % and 65 humidity, the tensile bond strength of bonding materials at dentine is higher than 80% and 90% humidity. The purpose of this research is to know the tensile bond strength between HEMA dentine bonding agent to bovine dentine surface at various humidity.

This research will be explain the mechanism of tensile bond strength of HEMA dentine bonding agent to bovine dentine surface at various humidity, so clinically will be
achieve maximum tensile bond strength of HEMA dentine bonding agent to dentine surface.

MATERIALS AND METHODS

Materials that were used: bovines incisive, acid etch (Ivoclar Vivadent, Schaan/Liechtenstein), HEMA dentine bonding (Voco, Germany).

Appliances that were used: diamond disk, diamond drill, emery number 400 and 1000 (Fuji Star, Japan), desiccator with vacuum faucet, hygrometer and air thermometer (Haar. Synth. Hygro, Germany); compressor/air suction tool (Schuco, USA), Autograph AG-10 TE, (Shimadzu, Japan).

Tooth sample was cleaned carefully by removed dirt at tooth surface using brush, while for hard or soft tissue using sharp scalpel. During cleaning, tooth was always in wet condition. Tooth was cut with diamond disk and planted in hard gypsum cylinder log. The dentin part was facing upward. Preparation was done until dentin surface using fissure diamonds bur. the surface of dentin was attenuated with silicon emery number 400 and continued with number 1000. After that, dentin was covered with adhesive tape which 3 mm diameter and attached precisely in the middle of the dentin surface. The preparation above as according to procedure that was done previously. Next, dentin specimen was coated with 37% phosphoric acid etch with cotton pellets for 15 second, then washed with 20 ml aquades using injection spuit and dried smoothly using cotton pellets. This drying techniques is call blot dry technique.

Samples were placed into desiccator for 1 hour at 60% humidity for group I; 70% for group II; 80% for group III; 90 % for group IV, and 65% for group of V (control group) with 8 samples each. Immediately, after released from desiccator, primary condensation and bonding were mixed and then applied to dentine surface using disposable brush for 30 second, after that were exposed with light curing unit for 20 second (as according to manufacturer’s guide). Next, the cylinder log was inserted into plunger. The opponent plunger was filled with self cured acrylic as filling materials over dentine bonding and then united with the other plunger and fixed by installing lock dowel. Samples were kept at room temperature (± 28 °C) for 24 hours. After 24 hours, the tensile bond strength of the samples was measured with Autograph (cross head speed = 10 mm/minute, range: 5, capacities of load cell: 5 kN/500 kgf). The result which shown at screen have set of kgf (1 kgf = 9.81 N. 1MPa = N/mm²). Wide of dentine surface sample = Ar² = 7.1 mm². Data was statistically analyzed with One-Way ANOVA at 95% confidence level and was continued with LSD test.

RESULTS

The tensile bond strength, mean, and standard deviation of HEMA dentine bonding agent to bovine dentine surface can be seen in table 1. The differences of all samples in this experiment were analyzed with One-Way ANOVA at 95% confidence level. The result showed that tensile bond strength of HEMA dentine bonding agent to bovine dentine surface at 60%–90% humidity level significantly different (p < 0.05). LSD test was used to determine the difference of each sample (Table 2).

The data distribution of tensile bond strength was normal that analyzed with Kolmogorov-Smirnov test. Sample group at 60–90% humidity have p value more than 0.05, it mean the variable data has normal distribution. Lavene test was used to prove that the tensile bond strength sample was homogenous. From the calculation, it obtained that sample group of tensile bond strength at 60–90% humidity was homogeneous (p > 0.05).

Table 1. Mean and standard deviation of tensile bond strength between dentine bonding agent based on HEMA with bovine dentine surface (MPa)

<table>
<thead>
<tr>
<th>Humidity</th>
<th>n</th>
<th>X</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>60%</td>
<td>8</td>
<td>16.74</td>
<td>1.8</td>
</tr>
<tr>
<td>70%</td>
<td>8</td>
<td>12.74</td>
<td>2.5</td>
</tr>
<tr>
<td>80%</td>
<td>8</td>
<td>11.59</td>
<td>2.4</td>
</tr>
<tr>
<td>90%</td>
<td>8</td>
<td>10.02</td>
<td>2.1</td>
</tr>
<tr>
<td>Control 65%</td>
<td>8</td>
<td>15.50</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Description:

n = Sample amount, X = Mean of tensile bond strength, SD = Standard Deviation

Table 2. LSD of the tensile bond strength between dentine bonding agent based on HEMA with bovine dentine surface

<table>
<thead>
<tr>
<th>Humidity</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>Control (65%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60%</td>
<td>XXX</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>--</td>
</tr>
<tr>
<td>70%</td>
<td>+</td>
<td>XXX</td>
<td>--</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>80%</td>
<td>+</td>
<td>--</td>
<td>XXX</td>
<td>--</td>
<td>+</td>
</tr>
<tr>
<td>90%</td>
<td>+</td>
<td>+</td>
<td>--</td>
<td>XXX</td>
<td>+</td>
</tr>
<tr>
<td>Control (65%)</td>
<td>--</td>
<td>+</td>
<td>+</td>
<td>XXX</td>
<td></td>
</tr>
</tbody>
</table>

Description:

+: significance difference, —: not significance
DISCUSSION

The effect of 60–90% humidity to the tensile bond strength between resin bonding materials and dentin surface showed the significance in each sample group (p < 0.05). To know the significance of each sample group the data was analyzed using LSD test (Table 2). The result showed that sample group at 60% humidity have p value smaller than 0.05 compared to sample group at 70%, 80%, and 90% humidity. It mean the tensile bond strength between resin bonding and dentin at 60%, 70%, 80%, and 90% humidity was significantly different. The tensile bond strength at 60% humidity compared to sample group at 65% humidity was not significantly different (p > 0.05).

Tensile bond strength of resin bonding to dentin was significantly different between at 70% and at 60%, 90% and 65% (control group) humidity (p < 0.05), but at 70% humidity and 80% have no significance (p > 0.05). If we compared, sample group at 80 % humidity and 90% humidity had p value more than 0.05. This matter means there was no significance of the tensile bond strength between sample group at 80% and 90% humidity. The tensile bond strength of sample group between at 80% humidity and to control sample group show the significance. If compared to control group, tensile bond strength of sample group at 90% humidity was significantly different (p < 0.05).

REFERENCES