Evaluation of Solvent Evaporation Procedure of a New All-in-One Adhesive

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Introduction:

The group of all-in-one self-etching adhesives are in today´s focus of interest in dental material science and gaining increasingly acceptance by the practitioners. All manufacturers claim ease of use and high bonding efficiencies of their products. Usually, the bonding efficiency is given as shear bond strength (SBS) or micro tensile bond strength after 24 h water storage or after thermocycling for several days.

Objectives:

The objective of this study was to evaluate the influence different solvent evaporation procedures on shear bond strength (SBS) to human dentin when using a new experimental All-in-One adhesive (Heraeus Kulzer).

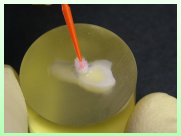
Materials:

The experimental All-in-One Adhesive (Heraeus Kulzer) was a solution of dimethacrylates, acidic monomers (4-META, phosphoric ester monomer), surface modified filler particles (SiO_2) and photoinitiators in a mixture of acetone and water. Light activation of adhesive and composite (Venus, Shade A2, Heraeus Kulzer) was done using a LED light curing unit (Translux Power Blue, Heraeus Kulzer).
SBS was determined using a Zwick Z010 Universal Testing Maschine (photograph 7).

Methods:

96 human molars were randomly divided into 12 groups (n=8). Flat dentin surfaces were prepared on SiC paper, grit 80 through 500. The adhesive was applied in one coat, let dwell for 20s under agitation. During solvent evaporation the distance between tooth and air syringe, the evaporation time and the angle between tooth and air stream were varied (see sceme).

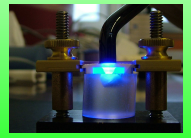
After light curing of the adhesive (20s) the composite was bulk filled in cylindrical plastic molds 2.38 mm in diameter (Ultradent equipment) and cured for 20s (photographs 3, 4). Both, adhesive and composite were cured using a LED LCU. SBS was determined after 24h water-storage of specimens at 37°C with a crosshead speed of 1mm/min (photographs 5, 6). Statistical analysis was done by ANOVA and Duncan ($p<0.05$).



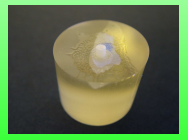
Photograph 1:
Application of adhesive

Photograph 2:
Light activation of adhesive

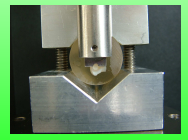
Photograph 3:
Bulk filling of composite



Photograph 4:
20s light activation of composite



Photograph 5:
Final specimen



Photograph 6:
Shear loading after 24h water storage at 37°C

Photograph 7:
Universal testing maschine (Zwick Z010)

Results:

SBS [MPa]: 36.2^{e} (A), 33.8^{d,e} (B), 32.0^{d} (C), 34.6^{d,e} (D), 31.9^{d} (E), 33.5^{d,e} (F), 24.8^{a,b,c} (G), 27.5^{c} (H), 21.6^{a} (I), 26.0^{b,c} (J), 23.1^{a,b} (K), and 23.8^{a,b,c} (L). Same letters denote groups that are not significantly different.

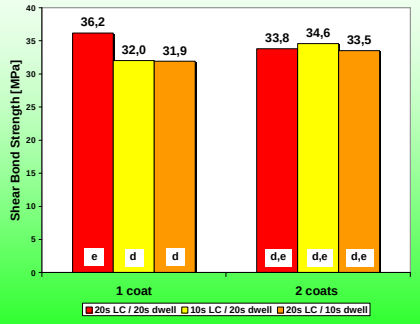


Figure 1: SBS on dentin

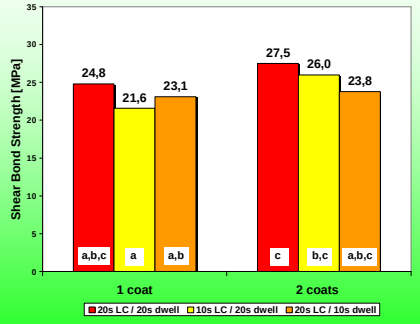


Figure 2: SBS on enamel

Conclusions:

According to this study SBS to dentin was significantly higher when compared to enamel. Unlike the results concerning the substrate the SBS was not strongly influenced by the number of coats, curing time and dwell time. However, a tendency to lower values was observed when using shorter dwell times and shorter curing times.
Additional investigations concerning bond strength under various conditions, marginal adaptation, long term performance and clinical studies are necessary to proof that this new experimental adhesive will work reliable when applied within of 1 coat, 20s dwell time and 20s light activation.