New approaches in bonding to glass-ceramic: Self-etch glass ceramic primer and universal adhesives

The development of many new materials has opened many new treatment opportunities on one hand. On the other, it also made dentistry more complex. These new materials require a massive comprehension for which indications and how the material can be used. This can be very confusing for the dentist and the entire team, because the needed state-of-the-art knowledge exploded also in other dental areas. A good example for this development are the recently upcoming hybrid ceramic materials. Some are composites containing ceramic fillers, whereas other are polymer infiltrated ceramic networks. Both materials are different material classes which need completely different pre-treatments.

So, the simplification of workflows, lesser material components and the incorporation of several functionalities in one product is a strategy to overcome the confusion and to reduce technique sensitivity. Of course, all simplification measurements should never compromise the main properties of a material. So, as a result many universal adhesives were introduced within the last years. Some of them contain “incorporated” silanes and the manufacturers claim, that they do not require an additional silanisation step to bond to silicate ceramics.

The research group at the University of Erlangen in Germany started some in vitro studies to evaluate the effectiveness of the inbuilt silanes. It was already shown, that all tested universal adhesives benefited from an additional silanisation step\textsuperscript{1}.

The following investigation confirmed these results.


GLUMA® Bond Universal

Bond strength to glass ceramics – University of Erlangen, Germany

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Objectives
The purpose of this study was the comparison of the tensile bond strength of silane-containing universal adhesives and self-etch ceramic primer to lithium disilicate ceramics.

Methods
960 lithium disilicate bar-shaped specimens (IPS e.max CAD, Ivoclar Vivadent) were divided into 4 groups. Group 1 was etched with 5% hydrofluoric acid only. Group 2 was additionally silanised (ESPE Sil, 3M ESPE). Group 3 was pretreated using the self-adhesive glass ceramic primer Monobond Etch & Prime (Ivoclar Vivadent) and group 4 had no pre-treatment. Afterwards the 3 universal adhesives (Scotchbond Universal, 3M ESPE; GLUMA Bond Universal, Kulzer and Futurabond U, VOCO) and Heliobond (Ivoclar Vivadent) as control were applied on the differently pre-treated specimens. 2 specimens from the same pre-treatment group were paired and luted perpendicular together using Variolink II (Ivoclar Vivadent). All specimens were then light cured for 40 s (Elipar Trilight, 3M ESPE) followed by a water storage for 24h. Half of the specimens were artificially aged by 5000 thermocycles (5°, 55°C). The tensile bond strength test was then done using the x-rope assisted set up in a universal testing machine (crosshead speed 1mm/min). Pre-test failures were included into statistics with 0 MPa. A 3-way ANOVA was used for the statistical evaluation, followed by pairwise analysis ($\alpha=0.05$).

Results
Most group-adhesive combinations showed higher bond strength directly after 24 h. Group 2 (hydrofluoric acid etching and silanisation) as well as group 3 (self-etching glass ceramic primer) demonstrated statistically significant higher mean bond strengths than the other two groups (hydrofluoric acid etching only and no hydrofluoric acid etching).

The control adhesive showed 25.15, 41.79, 41.32 and 0.23 MPa for the different pre-treatment groups after thermocycling.

Conclusions
Sufficient bond strength to lithium disilicate ceramics requires an additional silanisation step after hydrofluoric acid etching, regardless if the universal adhesive contains silane. Pre-treatment with a self-etching glass ceramic primer seems to be an alternative option.

Comment
1-bottle universal adhesive system with incorporated silanes allow no sufficient long-term bond strength to lithium disilicate ceramics. An additional silanisation step is needed. Simplification of adhesives is useful to reduce technique sensitivity, but it should never compromise bond strength.

Therefore, we have decided during the development of our GLUMA Bond Universal system to have an additional silanisation step with iBOND Ceramic Primer to ensure sufficient long-lasting bond-strength.

Source

The study was abbreviated, summarised and commented and all diagrams and titles have been established by Kulzer. The Kulzer products mentioned in this study are chemically equivalent to the originally tested Kulzer products.