

Futurabond U – Micro-shear bond strength on human dentine/enamel before and after thermocycling (self-etch and total-etch modes)

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Universal bonding systems offer dentists a variety of different application possibilities compared with the conventional self-etch and total-etch systems. The free selection of the etching technique is a great advantage and the unrestricted compatibility with all dimethacrylate-based composites, ceramics and metals facilitates everyday work in the practice for the dentist. At Tanta University in Egypt, Abdalla et al. tested the effect of thermocycling on the micro-shear bond strength of the universal bonding systems Futurabond U and Scotchbond Universal on enamel and dentine applied in total etch and self-etch modes.^[1]

The primary task of a bonding system is to achieve cementation of the dental hard tissue with a composite which is long-lasting with tight marginal seals. The adhesion between the composite and dental hard tissue created by the bonding system can be investigated with a special testing machine (e.g., Zwick, Instron) and suitable, prepared test specimens. There are a range of parameters which provide information about the strength of the bond. The investigation of the shear bond strength is aimed at describing the stability of the bonding layer when subject to shear force. There are a number of factors which can destroy the bond between the dental hard tissue and composite. If the fracture appears in the bonding layer, it is referred to as an adhesive failure. In contrast, if the fracture appears in the composite or the dental hard tissue, it is referred to as a cohesive failure. Exposing the test specimen to the thermocycling procedure before the shear bond strength is measured simulates the natural ageing of the test specimen. To this end, the test specimens are immersed in warm and cold water alternately for a different number of cycles. Initially high adhesion values and low differences in the adhesion values following the thermocycling are indications of a high quality bonding layer.

Study design

The shear bond strength test was performed on human teeth. The teeth were ground to remove the superficial occlusal enamel. The enamel surface was then polished with silicon carbide paper (600 grain) to create a standardised smear layer. For the dentine test specimens, the occlusal enamel is also separated and the dentine surface prepared in the same way as the enamel preparation.

The test compared two universal bonding systems: Futurabond U (VOCO) and Scotchbond Universal (3M ESPE). The bonding systems were applied on the prepared surfaces in accordance with the manufacturers' instructions (both in self-etch and total-etch modes) and composite cylinders (0.8 mm in diameter and 2 mm in length) applied. 20 of each type of test specimen were produced, of which half were subjected to the thermocycling process to simulate artificial ageing (5,000 cycles, 5 °C / 55 °C). The micro-shear bond strength measurements were then taken with the Instron testing machine.

Results of the study

Futurabond U displayed excellent adhesion values on enamel and dentine both in total-etch mode and in self-etch mode (initially and after thermocycling). Futurabond U achieves a micro-shear bond strength of 39.5 MPa on enamel in total-etch mode initially and an adhesion value of 35.4 MPa after the thermocycling. A similar trend was also observed on dentine: Futurabond U displayed an adhesive strength of 32.8 MPa initially and 29.5 MPa after thermocycling. The ageing simulated by the thermocycling only results in a slight reduction (10.2 % on average) of the adhesion values. The initial adhesion values for Scotchbond Universal are slightly lower (enamel: 36 MPa, dentine: 22.4 MPa) than for Futurabond U. At an average of 31 %, the reduction in the adhesion values following thermocycling is considerably higher (enamel: 25.1 MPa, dentine: 15.3 MPa).

Futurabond U achieved similarly outstanding adhesion values in self-etch mode to those in total-etch mode. On enamel the adhesion value was 36.9 MPa initially and 33.8 MPa following thermocycling. The values on dentine were slightly lower, with an initial adhesion value of 30.7 MPa and a value following thermocycling of 27.9 MPa. The reduction in the adhesion values following simulated ageing was just 8.8 % on average. Scotchbond Universal displayed considerably lower adhesion values even before the thermocycling of 28.1 MPa on enamel and 19.3 MPa on dentine in self-etch mode. Following thermocycling it was obvious that the adhesion value on enamel had only reduced slightly (25.7 MPa), whereas the adhesion value on dentine was considerably lower (12.8 MPa).

In summary, it can be determined that a higher initial adhesion value and minimal reduction in the adhesion values following thermocycling are an indication of a high-quality bonding system, which ensures long-term fillings with tight marginal seals. This investigation is an impressive example of how Futurabond U amazes with its high adhesion values: both initially and following the thermocycling process, applied on enamel and dentine and irrespective of whether it was applied in the total-etch or self-etch mode.

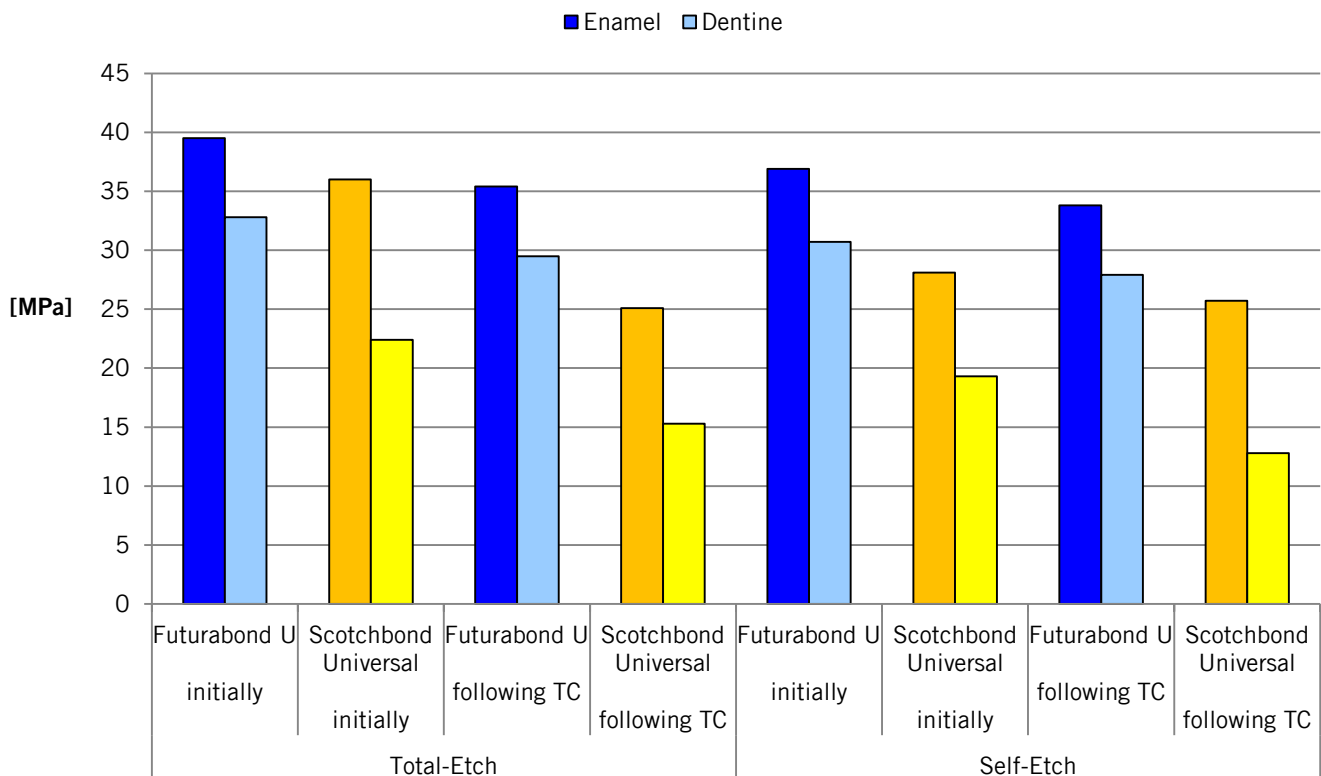


Fig. 1: Micro-shear bond strength on enamel and dentine, in total-etch and self-etch mode, before and after thermocycling

Conclusion: The longevity of fillings is largely dependent on the marginal integrity of the bonding system used. Futurabond U displays excellent micro-shear bond strength values on enamel and dentine both initially and following the thermocycling process, irrespective of whether the universal bonding system is applied in the total-etch or self-etch mode.

[1] Abdalla A., Bond Strength of Self-Etch Adhesives to Enamel and Dentin, report to VOCO, Tanta University, Egypt, 2013