Science.
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The role of science in the development of dental adhesives.

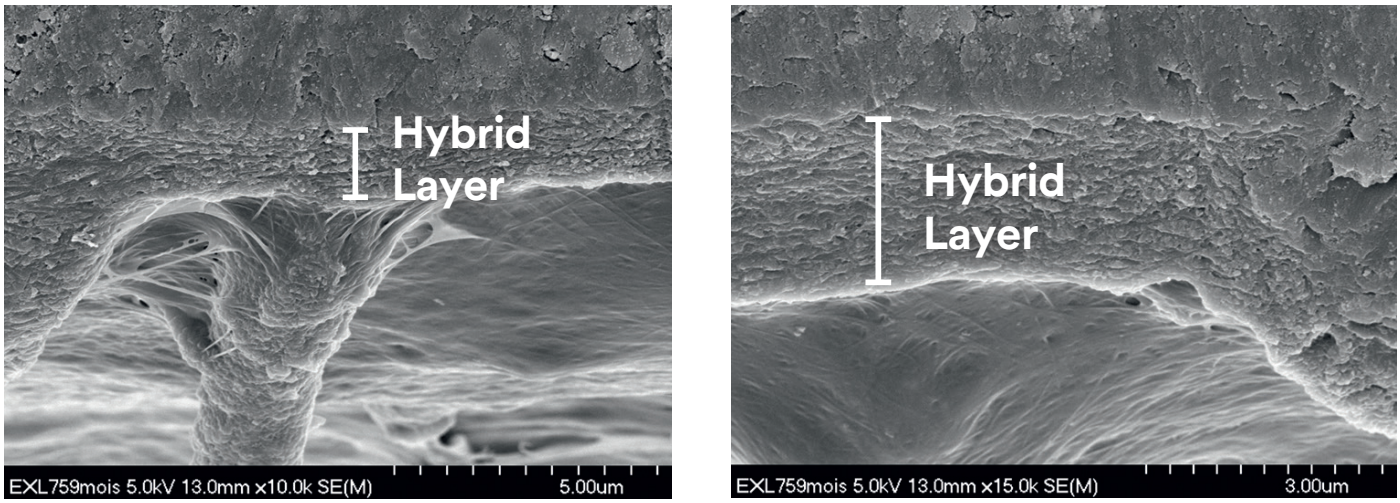
Miryam Schuckar, Germany.

In-vitro testing has offered clinical proof that 3M Scotchbond Universal Adhesive works well in self-etch, selective-etch and total-etch modes, highlighting the importance of science in the development of 3M products. Testing setups that closely imitate the oral environment found the adhesive performed well in the areas of bond durability, bond strength to different substrates, technique sensitivity, moisture tolerance and the marginal integrity of restorations placed with the material. These results, obtained internally at 3M, were confirmed externally by studies conducted at different universities and in the clinical environment, providing practitioners with the scientific proof they need to use 3M products with confidence.

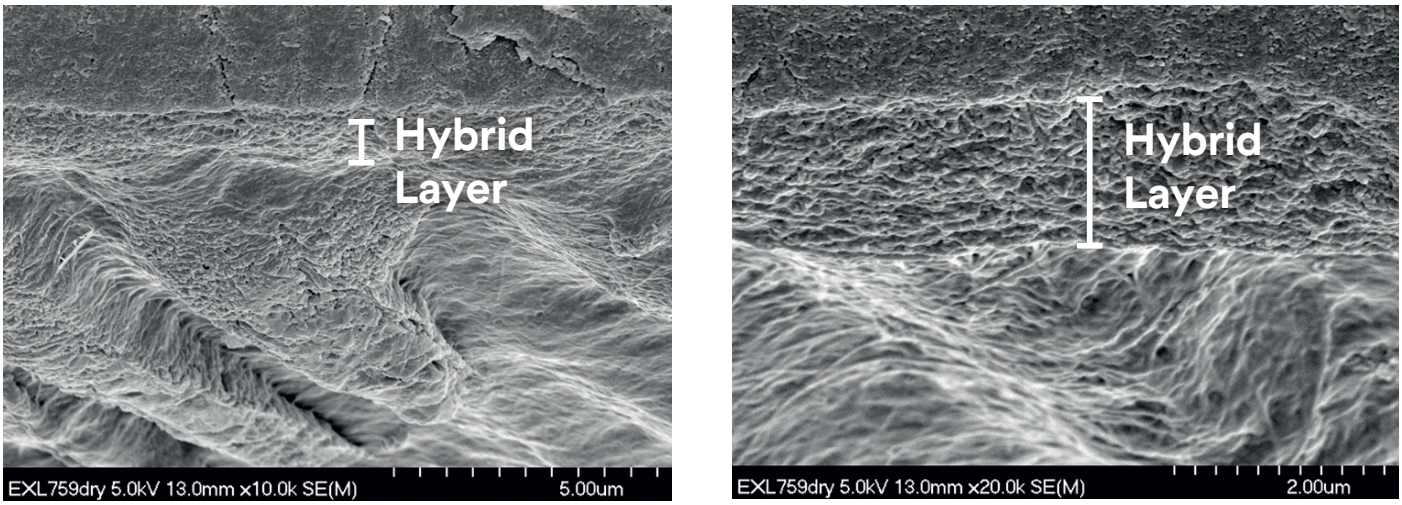
As in-vitro testing is required to assess specific properties of new formulations and to precisely predict a material's clinical behavior, it is essential that the test setups will closely imitate the conditions found in the oral environment. To ensure this, 3M employees make use of modern equipment, and if required, they leverage their knowledge and experience to develop new test methods, which are tailored to their specific needs.

In-vitro performance of a universal adhesive

Properties tested during and after the development of 3M™ Scotchbond Universal Adhesive, for example, included the bond strength to different substrates, bond durability, technique sensitivity and moisture tolerance as well as the marginal integrity of restorations placed with the material. The results obtained allowed the team of developers to predict that the first universal adhesive introduced to the dental market was going to work well in the self-etch, selective etch and total-etch modes. In addition, the outcomes showed that users would benefit from a high moisture tolerance and low technique sensitivity, which might add to low failure rates. The results obtained internally at 3M were confirmed externally in studies conducted at different universities[1-6].



Distinct hybrid layer formed after application of 3M™ Scotchbond™ Universal Adhesive on etched moist dentin.
Source: Dr Jorge Perdigão[2]



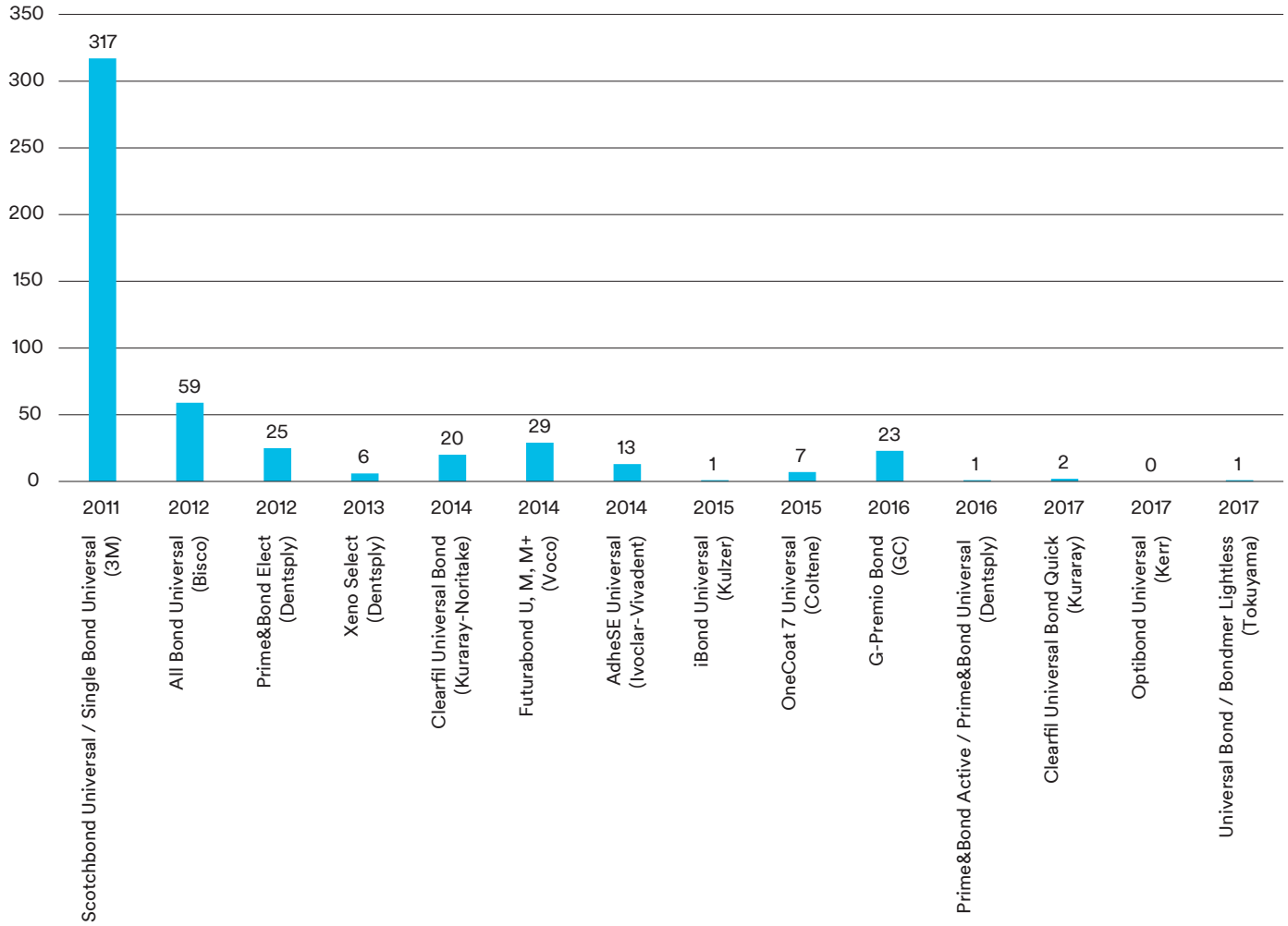
Distinct hybrid layer formed after application of 3M™ Scotchbond™ Universal Adhesive on etched dry dentine.
Source: Dr Jorge Perdigão[2]

Clinical evidence

Meanwhile, clinical proof for an excellent performance of Scotchbond Universal Adhesive is available as well. The material is backed by a wealth of scientific studies. The results available today shed light on the product's clinical performance over a time span of up to five years. Most of them focus on the performance of the universal adhesive applied in different etching modes.

Research on Universal Adhesives: Peer Reviewed Publications

Peer – reviewed publications in Scopus Database (Sep 25, 2018)



One example is a practice-based clinical evaluation with composite restorations placed with Scotchbond Universal Adhesive either in the total-etch or in the self-etch mode[7]. The three-year results published by the UK-based PREP Panel in 2017 reveal that the bonding agent performs well regardless of the adhesive technique used. Similarly good results are obtained in primary teeth, where there are some hints suggesting that the self-etch strategy might be preferable[8].

While in these studies, the restorations were subjected to occlusal loading, three other studies focused on the universal adhesive's behavior when used to restore non-carious cervical lesions[9-11]. In the cervical area of the tooth, conditions are particularly challenging in that a retentive preparation design is missing and the material's adhesive properties are put to a severe test.

Loguercio et al. published positive results after three years, and confirmed that the material performs reliably independent of the selected etching technique and independent of the moisture level of the dentin when using the etch-and-rinse technique[9]. Schneider et al. examined the restorations clinically and by use of optical coherence tomography after two years[10]. The results are promising, with Scotchbond Universal Adhesive showing fewer total failures than a proven etch-and-rinse adhesive. Finally, Robles et al. presented five-year results of their clinical study on the performance of Scotchbond Universal Adhesive[11]. They concluded that, used in the self-etch or in the total-etch mode, the universal adhesive performs as well as or even better than a proven two-bottle total-etch system.

These clinical study results confirm that Scotchbond Universal Adhesive is a reliable product that works very well in the context of direct restorative treatment. Similarly good results are obtained in indirect procedures when the universal adhesive is combined with 3M™ RelyX™ Ultimate Adhesive Resin Cement[12,13].

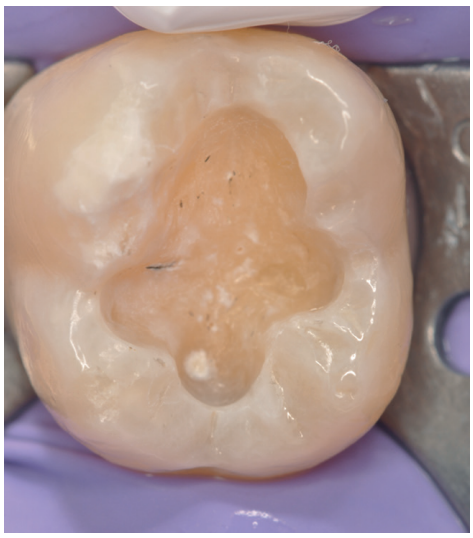


Figure 1: Clinical example for direct composite placement with 3M™ Scotchbond™ Universal Adhesive: Isolated and prepared tooth.

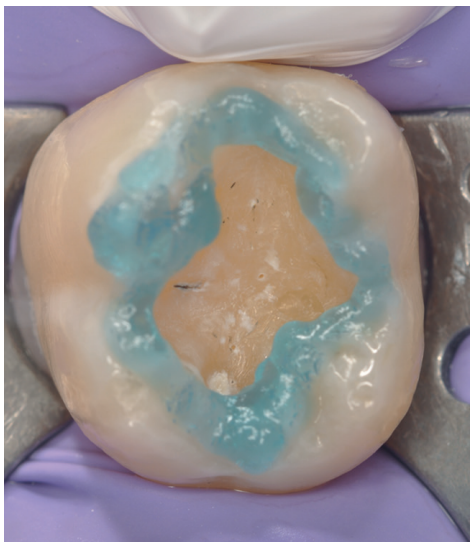


Figure 2: Selective etching: the etchant is applied to the enamel for 15 seconds.

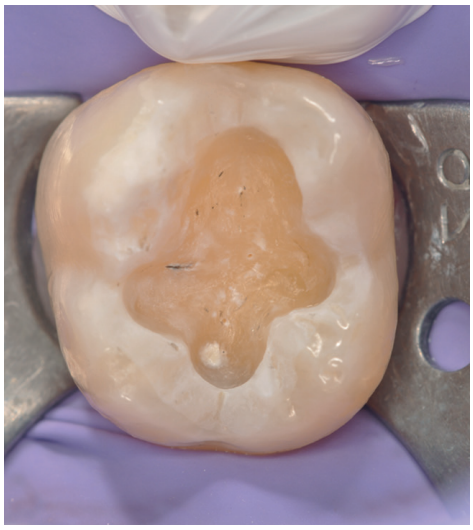


Figure 3: Situation after rinsing of the etchant and light drying of the cavity.

Figure 4: Application of 3M™ Scotchbond™ Universal Adhesive to the surface. The adhesive should be rubbed in for 20 seconds, air-dried for five seconds and light-cured for 10 seconds.

Figure 5: Final restoration after contouring and finishing.

Photos courtesy of Dr Mario deGoes

Conclusion

Science plays an important role at 3M not only during development of dental products, but throughout the life cycle of these materials. Scientific testing carried out in the laboratories and in the clinical environment is taken seriously to provide the proof clinicians need to use a product with confidence. For Scotchbond Universal Adhesive, the desired clinical evidence is now available and supports its users in their striving for simplified procedures in adhesive dentistry.

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