

UNI-Q Bond™ Universal In Vitro Evaluation

Matt Cowen, B.S., Margaret Gilmartin, B.S., John M. Powers, Ph.D.

Introduction:

UNI-Q Bond™ (B.J.M. Laboratories Ltd.) is a new universal adhesive with indications for bonding to all materials while having minimal color appearance compared to other adhesives. The change in color after adhesive application can become apparent, especially when used for orthodontic bonding, and when used in combination with very white restoratives making this an important feature for certain indications where adhesive color may be apparent. In this study, we measured the bonding performance, film thickness, and appearance of color of this new adhesive. We also did an assessment of the procedure time of the product compared to a bioactive adhesive on the market.

Conclusions:

UNI-Q Bond universal bonding agent has excellent bond strength and durability after artificial aging to dentin and high initial bond strength to zirconia and enamel. There is little to no perceptible color change when **UNI-Q Bond** is applied and cured to surfaces. The film thickness and ease of application is on par with other leading universal adhesives on the market.

Experimental Design:

MATERIALS:

UNI-Q Bond™ universal bonding agent (B.J.M. Laboratories Ltd.), **3M™ Scotchbond™ Universal Plus** (Solventum), **RE-GEN™ Universal Adhesive** (Vista Apex)

Tests:

Direct Shear Bond Strength: Human adult molars, sterilized in a 1% Chloramine T solution, and stored in deionized water were embedded in acrylic resin discs and ground through 600-grit SiC paper to form bonding substrates of superficial dentin. Zirconia plates were previously cut to be ~12 mm x 12 mm x 2-3 mm thick, processed according to manufacturer instructions, embedded in acrylic resin discs, finished through 600 grit diamond paper, and surfaces treated. The surface treatment was sandblasting with 3 bar (0.3 MPa) pressure and 50 µm particles to **Katana™ Zirconia STML** (Kuraray Noritake Dental, Inc.) Zirconia. Specimen surfaces had a bonding agent placed according to manufacturers' instructions. Composite was then placed on top of the bonding agent utilizing the Ultradent Shear Test mold and jig to produce a 2.38 mm diameter shear test cylinder according to ISO 29022:2013. The cylinder was light-cured for 20 seconds while in the mold with an **3M™ Elipar™ DeepCure-S** (3M) curing light. The specimens were then transferred to a 37°C deionized water bath for 24 hours storage until testing. Additional test groups were subjected to 10,000 thermocycles, which consisted of 25-second immersions in deionized water at 5°C and 55°C for 10,000 cycles. Testing was performed using a universal testing machine at a crosshead speed of 1 mm/min. Means and standard deviations were calculated.

RE-GEN Universal was only tested to dentin and enamel with and without Clean & Boost at 24h for comparison purposes as it is not indicated for ceramic use. Procedures with **RE-GEN Universal** and **UNI-Q Bond** were performed according to the manufacturer's provided instructions and were timed and rounded to the nearest 5 seconds.

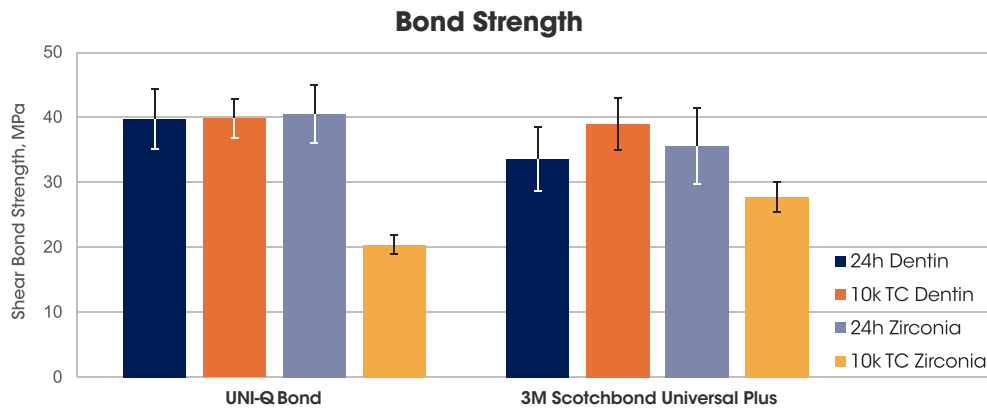
Color Measurements: Adhesives (n=5) are applied to standard white opaque ceramic blocks (Macor, surface roughness Ra = 1.2 µm, L* 97.6, a* -0.4, b* 0.8), and air thinned and cured according to manufacturers' instructions. Color values are presented in the results with means and standard deviations compared to the initial white ceramic values.

Film Thickness (n=5): Specimens prepared for the color measurement testing had the film thickness measured with a high accuracy micrometer (Mitutoyo 293-831-30) to 0.001 mm resolution before and after adhesive placement with a glass cover slip to minimize local effects on thickness. This is meant to simulate the effect that adhesive film thickness will have on indirect restoration fit.

SEM Evaluation: Class 2 restorations (n=2) were prepared in molars, and bonding agents, **UNI-Q Bond** and **3M Scotchbond Universal Plus**, were applied according to the manufacturers' instructions with **3M™ Filtek™ Supreme Ultra** (Solventum) composite. The molars were then sectioned into several 1-mm thick slices, dried through successive ethanol immersions, sputter coated with 80:20 gold: palladium and examined using a TESCAN RISE scanning electron microscope to measure the thickness of the bonding layers in at least 15 areas.

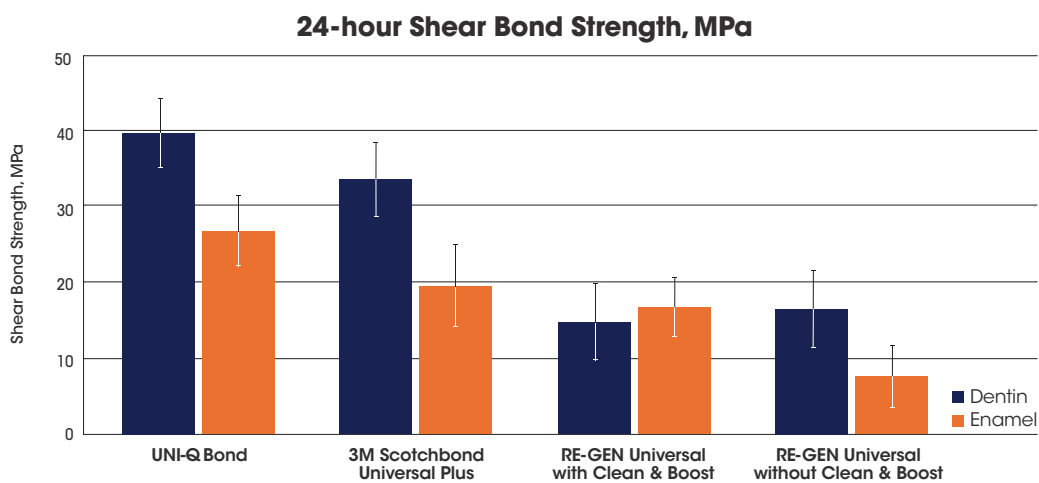


Results:



This test includes thermocycling which artificially ages the bonding interface by accelerating hydrolytic degradation, and exposes the bonding interface to stresses from heating and cooling, expanding and contracting the materials. Measuring the change from the initial bond strength after 24 hours of storage to after thermocycling is one of the ways of evaluating bond durability.

UNI-Q Bond has excellent dentin bond strength and durability to artificial aging in this test. **UNI-Q Bond** has comparable bond strength durability to zirconia to other universal adhesives we have tested after thermocycling but may be less durable than dedicated ceramic primers.



Bond strength to enamel for **UNI-Q Bond** and **3M Scotchbond Universal Plus** were in the self-etching mode. The initial bond strength for **RE-GEN Universal** to dentin is significantly lower than the other adhesives tested, while the enamel bond strength requires application of **Clean & Boost** to achieve sufficient bond strength. **UNI-Q Bond** has good initial bond strength to self-etched enamel, which in this test, rarely goes above 30 MPa in the self-etched mode among other adhesives.

Procedure Time Comparison Under Ideal Conditions							
UNI-Q Bond	Step	Step 1	Step 2	Step 3	Step 4	Step 5	Total Time
		Time, s	30	10	25		
	Description	Dispense and apply to preparation, leave undisturbed for 20 seconds	Air Drying	Light Cure for 20 seconds			
RE-GEN Universal	Step	Step 1	Step 2	Step 3	Step 4	Step 5	Total Time
	Time, s	40	30	40	20	15	145
	Description	Attach syringe tip and apply Clean & Boost followed by 10 seconds of agitation, and thorough rinsing	Dispense a drop of RE-GEN, apply first coat and allow to dwell for 20 seconds	Apply two additional coats of RE-GEN	Air Drying-Takes Additional time due to large amount of adhesive	Light Cure for 10 seconds	

This shows the breakdown of the procedure times comparing **UNI-Q Bond** which has relatively straightforward procedures compared to **RE-GEN Universal**. The procedure times were timed in a laboratory environment and rounded to the nearest 5 seconds, but keep in mind that clinical environments may increase procedure times. Another notable difference between the **UNI-Q Bond** applications listed in the IFU is that it doesn't require constant agitation or rubbing of the adhesive into tooth structure that is often indicated by other adhesives. **RE-GEN Universal** claims to have other benefits to restorative procedures related to bioactivity not evaluated in this study, and it's important to note that initial bond strength is not the only indicator for clinical success.

Color:

Product	Standard White Background					With Adhesive Applied				
	L*	a*	b*	C*	h°	L*	a*	b*	C*	h°
UNI-Q Bond	97.6 (0.1)	-0.4 (0)	0.9 (0.1)	1.0 (0)	112.7 (1.3)	97.1 (0.1)	-0.6 (0.1)	1.4 (0.3)	1.5 (0.3)	111.4 (0.8)
3M Scotchbond Universal Plus	97.6 (0)	-0.4 (0)	0.8 (0)	0.9 (0)	114.5 (0.8)	96.7 (0.1)	-1.1 (0.1)	-3.8 (0.4)	3.9 (0.4)	106.5 (0.7)

Product	ΔL^*	Δa^*	Δb^*	ΔC^*	Δh^*	ΔE^*_{00}
UNI-Q Bond	-0.5 (0.1)	-0.2 (0.1)	0.5 (0.3)	0.6 (0.3)	-1.3 (1.3)	0.7 (0.3)
3M Scotchbond Universal Plus	-0.9 (0.1)	-0.7 (0.1)	3.0 (0.4)	3.0 (0.4)	-8.1 (1.3)	2.9 (0.3)

3M Scotchbond Universal Plus on a white background has a ΔE^*_{00} value of 2.9, with most of the change in the b^* value (more yellow) which is a visible difference. **UNI-Q Bond** has a ΔE^*_{00} of 0.7, which is not considered a visible difference ($\Delta E^*_{00} < 0.8$ perceptibility threshold). **UNI-Q Bond** shows the ability to be applied and cured to the surface without any significant color change and this can be beneficial in many clinical situations such as orthodontic treatments, pit and fissure sealants and esthetic restorations. This test showed the color change on a white background, and it should be expected that any color change on a tooth-colored background will be even less noticeable.

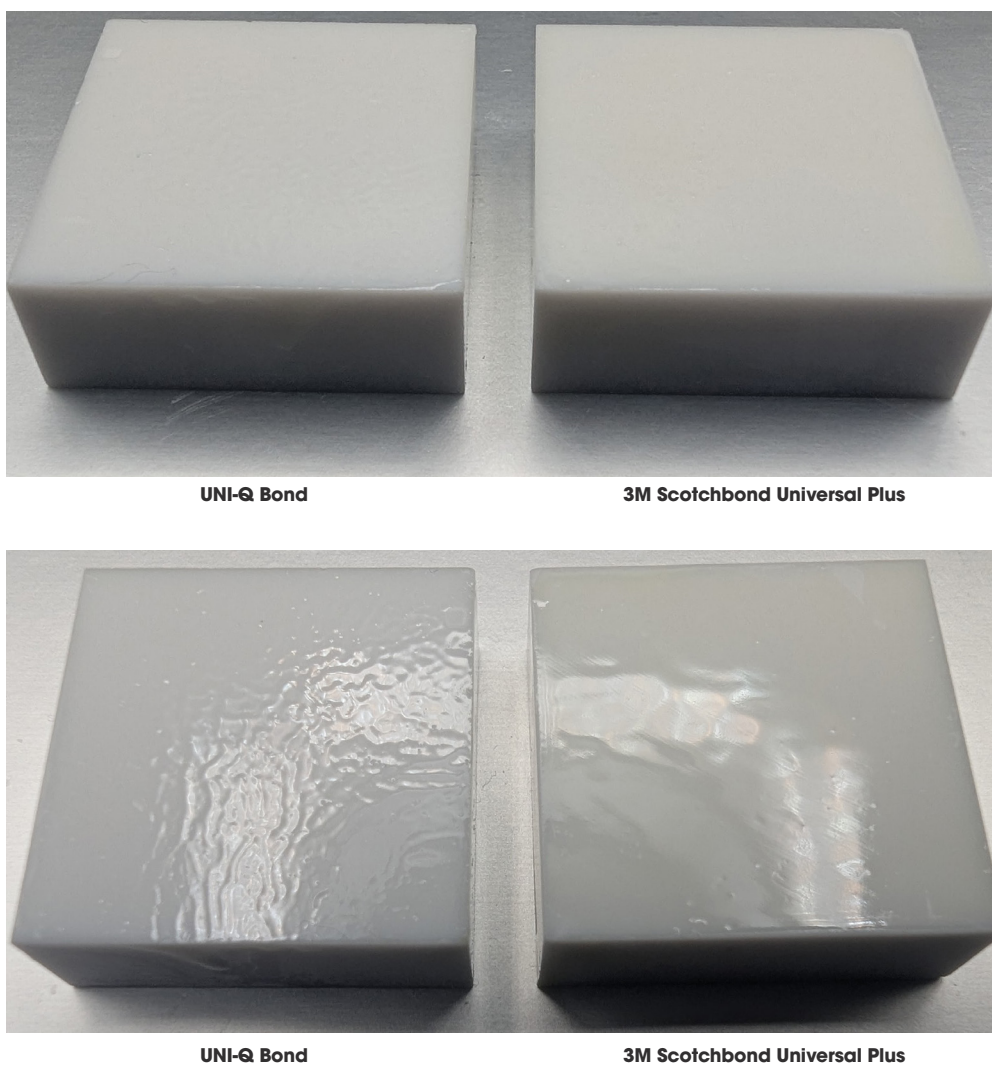


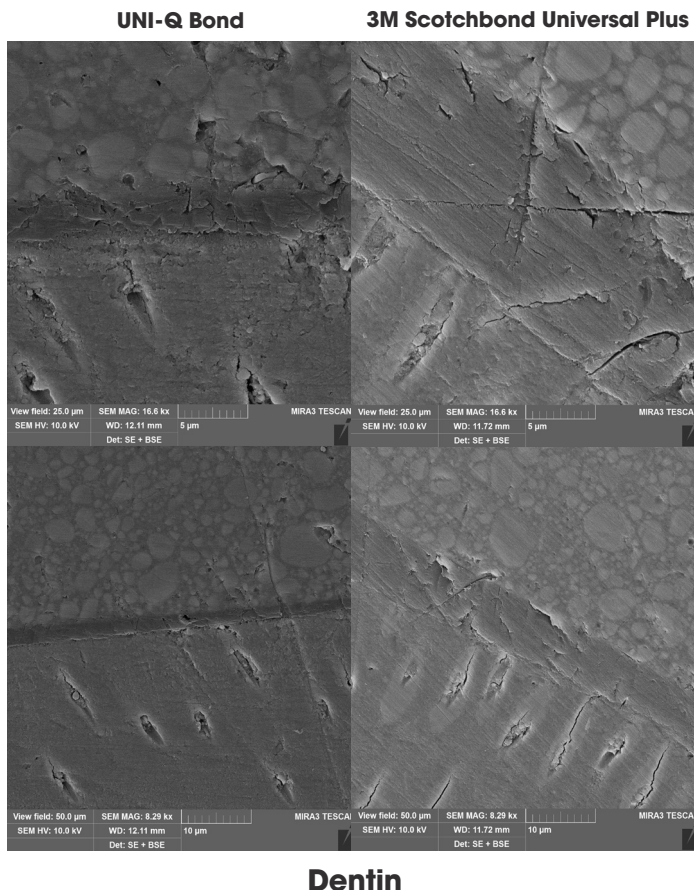
Fig. 1: White Ceramic blocks with adhesive applied. The top image shows the apparent color change without gloss, while the bottom image shows the difference with gloss and surface texture.

Film Thickness and SEM imaging:

Film Thickness on Ceramic Plates	
Adhesive	Film Thickness, μm
UNI-Q Bond	12 (1)
3M Scotchbond Universal Plus	11 (1)

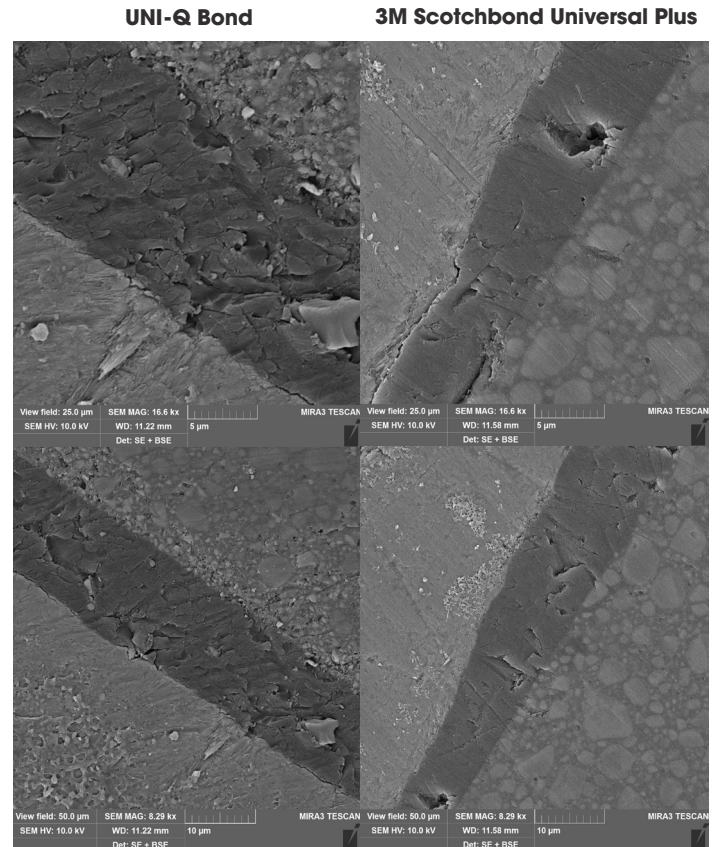
Both adhesives have minimal film thickness that should not interfere with the fit of indirect restorations. The likely difference between the two measurement methods seen is that the plate measurement method is limited by measuring peak to peak thicknesses, or whatever is the highest points on the surfaces, while the SEM measurements are on single point thicknesses.

SEM Imaging Film Thickness, μm - Means (Std Dev) [Range]		
Adhesive	Dentin	Enamel
UNI-Q Bond	4.1 (1.9) [1.6-8.1]	4.5 (2.0) [1.5-9.5]
3M Scotchbond Universal Plus	3.3 (1.7) [1.6-6.9]	4.1 (2.0) [1.4-8.9]



Dentin

Fig. 2: SEM images of adhesives applied to dentin, with **UNI-Q Bond** on the left, and **3M Scotchbond Universal Plus** on the right.



Enamel

Fig. 3: SEM images of adhesives applied to enamel, with **UNI-Q Bond** on the left, and **3M Scotchbond Universal Plus** on the right.

Overall, SEM imaging revealed no significant visible difference between the two adhesives with similar film thickness, and tubule penetration. This also rules out film thickness playing any significant factor in having an impact on the color measurements as both adhesives have nearly identical film thicknesses when air dried.