A new category of adhesive

DPR takes an in-depth look at the research behind Scotchbond™ Universal Adhesive from 3M ESPE, and why this might be the right adhesive for your practice.

by REENE KNIGHT

A DPR SPECIAL REPORT

Our award-winning editorial team turns our door into the industry into a window on the product development process.

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89% of dentists who have used Scotchbond Universal Adhesive said they were either very satisfied or satisfied with the material.

Source: 3M ESPE

Life just got a little simpler at Dr. Jeff Blank’s practice.

Instead of keeping various bonding agents on hand for total-etch, selective-etch and self-etch cases, he now has one that works for all three. Dr. Blank is one of about 200 dentists who had the opportunity to try Scotchbond Universal Adhesive in their practice. Since June he’s used the adhesive for 23 cases, including Class IV or V in the esthetic zone, to cement veneers, on Class I, II and III restorations, as well as direct restorations in crown preps. He’s impressed with the results, describing it as a “truly universal adhesive.”

“Scotchbond Universal adhesive is possibly the most forgiving adhesive on the market,” he said. “One study suggests that even if a slight amount of saliva gets on a margin, which is very common, bond strength remains high. This is unheard of. Of course, proper isolation is always recommended… but it’s nice to know we have some leeway in the often hostile clinical situations we are presented with.”

That’s what this new adhesive is all about—making it easier for dentists to get the results they’re after, no matter what type of case they’re facing. It launched Oct. 1, after almost 3 years of work from a variety of people and departments at 3M ESPE (3MESPE.com). Not only does it work in both self-etch and total-etch modes, it bonds to all dental surfaces without any extra primer. It also features a broad range of indications for indirect and direct procedures—with virtually no post-op sensitivity, even in total-etch mode, said Beth Eksra, Marketing Manager for Adhesives. With this adhesive dentists only need to know one system and one application technique, and that means a streamlined inventory and no need to keep products on hand that may go bad if they’re not used enough.

“...it takes a lot of complexity out of the dental operatory, as it offers one simple, robust solution for all bonding needs,” said Christoph Thalacker, a research chemist at the 3M ESPE lab in Germany.
"With Scotchbond Universal, worries like ‘Did the assistant pick the right bottle?’ ‘Am I using the right procedure?’ ‘Does this material actually stick to the substrate I want to bond to?’ ‘Is the tooth too moist or dry?’ are a thing of the past."

**How it began**

The idea behind Scotchbond Universal was to build on what the company already offered in Adper™ Single Bond Plus Adhesive and Adper™ Easy Bond Self-etch Adhesive, and broaden the range of possible indications, Thalacker said. The goal was to develop a truly universal adhesive to eliminate the need for all those complicated bottles in the operatory and provide dentists with one easy technique with fewer steps and less chance of error.

“When it comes to adhesives, we tend to build on our successes,” said Jon Fundingsland, Professional Relations Manager. “The chemistry of Scotchbond Universal can be easily traced to Adper Scotchbond Multi Purpose adhesive. With Scotchbond Multi Purpose we Incorporated a component of Vitrebond™ Light Cure Glass Ionomer Liner/Base (a patented modification of polyalkenoic acid, now called the Vitrebond copolymer) into the primer. This offered much more consistent bonding in the presence of high-humidity (like the oral environment). It also had a blend of hydrophilic and hydrophobic monomers. Both the Vitrebond copolymer and our expertise in resin technology were incorporated as we introduced Adper Single Bond Adhesive, Adper Single Bond Plus adhesive, Adper Easy Bond self-etch adhesive, and now Scotchbond Universal. But Scotchbond Universal goes further and incorporates not only components to bond to dentin and enamel, but also components to bond to etched ceramics, zirconia, alumina and alloys.”

**Getting feedback**

A successful background in adhesives isn’t the only element 3M ESPE needed to develop this product. They knew clinician feedback would be key to developing a product both the company and their customers could get excited about. Opinion Leaders helped the team at 3M ESPE define the product early on, Fundingsland said.

“At our annual meeting with Opinion Leaders in 2008, we had a session to discuss adhesives. We had recently introduced Adper Easy Bond self-etch adhesive, and were discussing similarities with Adper Single Bond Plus total-etch adhesive,” he said. “During the discussion it hit me—what if we had one adhesive that was suitable for both self-etch and total-etch techniques? After a very lively discussion, the KOLs at the meeting thought this was a really good idea and rated it as definitely worth pursuing.”

Beyond that first KOL meeting, Kim Wiggins, technical service rep, worked with the marketing department to develop an early concept test. With that test, they identified which adhesive attributes clinicians thought were most important in this type of product and what the current materials on the market were lacking. And the input they received wasn’t just limited to the U.S.—this was a global process that included feedback from clinicians, KOLs and consultant panels based in Europe, Brazil and Japan as well.

As part of their feedback, dentists were asked to weigh each attribute so researchers at 3M knew exactly what they should focus on, said Dan Krueger, Scientific Affairs Manager. Researchers talked with dentists about the direction they were thinking of taking the product to see if they were on the right track, and then combined those two elements together to start developing Scotchbond Universal.

**THE PATIENT BENEFITS**

Scotchbond Universal doesn’t just benefit the dental practice, it also benefits the patient, said Beth Eskra, Marketing Manager for Adhesives. While alleviating post-op sensitivity is a huge benefit for patients, that’s not all Scotchbond Universal offers.

“The adhesive features a good marginal seal and good marginal integrity,” Eskra said. “Patients have an esthetic restoration that won’t get that ring around the restoration, which some doctors have experienced in the past. You can get that selective-etch around enamel margins to make sure you will have a great seal and avoid problems that have plagued other self-etch systems.”
“In the beginning we had a good idea of where we wanted to go with the material, and that comes from interaction with other 3M divisions,” he said. “The next step was to find out from the clinicians what other features we needed to make this better and meet their needs. By defining that early on we were able to hone in and finalize the formulation of the material, bring the opinion leaders together again and say ‘here’s the format of the product’ to validate whether that would be something accepted in the marketplace. From there we could look into a final formulation and begin the external evaluations. We have to meet internal regulatory and biocompatibility requirements so we know the material is safe to use. Once all regulations are met we can finally work in the mouth. So each step builds on the other one.”

When they brought the clinicians together for the second time, they had a chance to use prototypes of the material in a simulated operatory, Thalacker said, and then give 3M feedback about handling, possible indications and the general validity of the concept. This feedback gave the team the chance to make any necessary changes before working on the final formula.

**What dentists wanted**

Most dentists are split when it comes to adhesives, with some preferring total-etch and others more comfortable with self-etch, Krueger said. The clinicians 3M talked with at the beginning of product development wanted something they could use for both, something to help speed up the process and reduce post-op sensitivity for the patient. They wanted something less technique sensitive that would provide strong bonds and that featured dual cure capability. Basically, an adhesive that would simplify the dentistry, yet still provide high end results for their patients.

“The adhesive provides for a very forgiving technique for the clinician to get consistent bonding in either total- or self-etch modes,” Krueger said. “Scotchbond Universal removes the variability they currently have in materials they’re working with. This is going to simplify the procedure, give dentists one material they can use for a much wider range of indications with one technique, while reducing a lot of sensitivity potential and technique sensitivity. We wanted to provide consistent performance so patients receive the best possible restoration.”

Dentists also wanted to simplify bonding to materials like zirconia and ceramics for crown and bridge work, Krueger said. Bonding to these surfaces usually requires different primers, but that is not the case with Scotchbond Universal. The adhesive features a new monomer and silane that allows a chemical bond to these surfaces without a primer. This further simplifies the dentists’ job, and allows them to get rid of even more materials they’ve always had to have on hand before.

**The advantage**

With every product that’s developed at 3M ESPE, the team behind it is not limited to the resources in their dental division. They have access to all of 3M’s diverse technology platforms for all different kinds of applications, Thalacker said, and that played a large role in developing Scotchbond Universal.

“Unlike other dental companies, we at 3M ESPE, have the possibility to tap into these technologies to provide new solutions for our customers,” he said. “This does not only include access to materials like new fillers or monomers, but also to analytical facilities. For example, we were able to collaborate with the Corporate Research Analytical Lab in St. Paul to investigate hybrid layer...
formulation using state-of-the-art electron microscopy equipment. That way we gained valuable insight into how to optimize the formulation for high moisture tolerance, high bond strength even to dry, etched dentin and ultimately virtually no post-operative sensitivities.”

3M has more than 45 technology platforms, and there’s a culture of innovation within the company that encourages scientists to share technology across those platforms, 3M ESPE VP Mark Gates said. For example, when Gates worked in 3M’s automotive division, they bought Bondo, a company that sells a polyester based filler designed to fill dents in cars. They wanted to re-invent the category and find a way to automate the filling process for quality assurance so when it’s applied to a car, it’s consistently mixed and hardens at the proper rate.

“We looked at platforms in the company for a dynamic mixing system that would allow us to mix this material. We talked to the folks in dental and they told us about the mixing nozzle they use for impression material. That nozzle is what was used to automate the mixing process in the body filling category,” Gates said. “We do that all the time. And technology sharing back and forth between health care and industrial gives us a culture of collaborative innovation that happens across industries and regions. We do this worldwide. It’s a topic. 3M can talk about for a long time. It’s part of our DNA. It’s what we do.”

Not only did Scotchbond Universal benefit from this type of innovation, it also benefits from the brand it’s tied to. Scotchbond is tied to one of the core brands at 3M, Gates said, which is used in several markets served by 3M. About 40 percent of all 3M products include adhesive technology, and that includes double sided tapes for industrial bonding and different surfaces like metals and composites. 3M ESPE can leverage that brand strength of being an adhesive company into the dental space.

The research
Before clinicians tested the prototypes in simulated labs, the studies with experts from academia were initiated to prove in vitro performance, Thalacker said. Between 15 and 20 researchers from all over the world have evaluated the material, and the feedback the team at 3M received has validated what they’ve been saying about the material.

When these studies unanimously provided favorable results, the final formulation was thoroughly tested in vivo by almost 200 dentists in the U.S. and five European countries, Thalacker said. These dentists completed about 19,000 applications and offered feedback on their experiences with the material.

“This testing began in January and the team at 3M has received plenty of feedback from these clinicians, with Dr. Blank among them. Dentists have used it in both total-etch and self-etch modes in a variety of indications. Most have been extremely happy with the product,” Thalacker said.

“The concept of only needing a single, truly universal bonding agent that can be used with total-etch, self-etch, selective-etch and indirect restoration cementation is a huge benefit to my practice,” Dr. Blank said. “Currently, I use 3-5 different adhesive systems on any given day. Inventory control alone will be huge in terms of cost savings.”

Dentists use the product for one or two months and then answer a questionnaire about how it performed. 3M uses this information to validate their research. It also gives them one last chance to make any necessary changes before launch. If there are any key areas the product isn’t meeting, the team will review what they need to do next, but that wasn’t necessary with Scotchbond Universal, Wiggins said.

“They’re surprised it can do everything that it can do,” she said of the clinicians’ feedback. “One of the comments I heard recently is they love the idea that the adhesive has silane in it so they don’t have to use a separate silane treatment, and that means they can eliminate that extra silane bottle. It’s just more of a wow factor.”

They are also happy with the handling, the versatility, the results they achieved and the fact that patients didn’t encounter post-op sensitivities, Thalacker said. “They liked the new vial that can be opened with one hand and the fact that the improved tip remains clean throughout use. An equal number of total-etch and self-etch applications were done, showing the concept of the combined total-etch/self-etch adhesive was well accepted.

“All this is valuable information that confirms what we aimed for when the project was started,” Thalacker said. “It helps us to better understand the use of Scotchbond Universal in the operatory, and better communicate with the dentists.”

Dentists also gave suggestions for further applications, accessories and wording for the instructions, and all that feedback is taken very seriously, Thalacker said. Even if they can’t implement such suggestions in Scotchbond Universal, they help the team understand the dentists’ needs and may lead to a future product.

Where they go from here
Once the product is launched, that isn’t the end of the feedback or communication with customers, Wiggins said. Team members continue to listen to customers, whether that be at trade shows or when they call into the customer care center. They’re always looking for opportunities for future development, and keeping the lines of communication open with dentists who are using the product is one of the best ways to do that.

“After the launch, following up on clinicians’ feedback is even more important than before, because then we get the input from a global, very diverse audience. The biggest mistake a product developer can make is to ignore customer feedback,” Thalacker said. “Customer feedback is often the basis for new applications or indications for existing products, or even new product developments. There is for sure a trend toward easy to use products with a broad range of indications, without sacrificing performance.”

Studies will continue, Krueger said, with formal clinical studies just beginning. They track and monitor the product at 6 months, 12 months, two years and three years. They’ll eventually have four more studies to add to the internal and external data they collected pre-launch that is already part of a technical product profile.

For now, the team that worked so hard to get this product where it is today is excited for its launch. They know it will change the way clinicians practice, simplifying procedures and streamlining their inventories. It sets the company apart as a leader in adhesive technology, and it alleviates a problem patients often face—post-op sensitivity.

“We truly feel Scotchbond Universal is the most unique adhesive product on the market. It’s going to really simplify things and give the doctor so much more flexibility,” Krueger said.

“People will ask what class does this fit in, what generation? We’re not going to categorize it. We’re not going to say it’s the 8th generation. We’re calling this a new class of material. It’s a combination of the best self-etch and the best total-etch material, so it really is something unique to the marketplace.”

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