A Collection of Scientific Results

Adper
Scotchbond 1 XT
Total-Etch-Adhesive
Welcome to Adper Scotchbond 1 XT!

Dear Dental Professional,

Adper™ Scotchbond 1 XT represents the culmination of years of experience in the area of dental adhesives. Originally introduced in 1997 as Single Bond, and in more recent years evolved into Adper Scotchbond 1 XT, this 5th generation product is considered an industry leading dental adhesive.

Adper Scotchbond 1 XT is a total-etch dental bonding agent, which utilizes a nanofiller technology. It offers excellence in bonding performance with very low post-operative sensitivity. This booklet contains scientific data to assist you in forming your own judgement of Adper Scotchbond 1 XT. For your consideration, we have divided the booklet into five sections:
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We trust you will find this information informative.
Filler Particles
1. Filler Particles

Consider

The filler density in cured films of adhesives was explored by transmission electron microscopy (TEM at 3M Laboratories). In these images, the electron dense areas (grey to black shaded areas) represent filler. It is readily observed that the cured film of Adper™ Scotchbond 1 XT Adhesive exhibits the greatest filler density of the two, total etch, single solution adhesives. Of interest is the lack of homogeneity in both filler and density and particle size on Optibond Solo Plus™ adhesive. The bar in each image represents 100 nm.

Adper Scotchbond 1 XT adhesive incorporates 10% by weight of 5 nanometer-diameter spherical silica particles. These silane treated particles are incorporated into the adhesive through a process that prevents agglomeration. As discrete particles, their extremely small size keeps them in colloidal suspension. This means you never have to shake Adper Scotchbond 1 XT adhesive prior to using. In contrast, larger filler particles incorporated into some adhesives are at risk of settling out of solution. Such adhesives require routine shaking before use.
Light scattering is significant when the particle size of the filler is greater than the wavelength of visible light. This can lead to an opaque adhesive. With Adper Scotchbond 1 XT, the nanofiller particles are smaller than the wavelength of visible light. Light is not scattered and the adhesive is translucent. Even with 10% filler by weight, Adper Scotchbond 1 XT is clear. Adhesive systems with larger filler particles will not only scatter light but will also have colour that must be considered in esthetic areas. Thicker adhesive layers of these products may be visible at the margin.

Solution

Adper Scotchbond 1 XT nanofiller particles will not settle out of solution, and therefore never require shaking. This also means that Adper Scotchbond 1 XT, even though filled, is clear.
Nanotechnology
2. Nanotechnology

Consider

Despite being one-millionth the size of a pinhead, the nanometer, and the research being conducted around this tiniest of measurements, is sending huge waves of anticipation and speculation through the scientific and product manufacturing communities. Nanotechnology is spreading to numerous industries as leading companies attempt to perfect their products and services by manipulating materials at the molecular level.

According to the June 24, 2002 issue of “Trend Letter” newsletter, in the next few years, nanotechnology will continue to improve mundane materials such as clothing fabric, automobile paint and plastic parts for vehicles. Further into the future, look for amazing breakthroughs in health care and computing. With nanotechnology, dentistry will never be the same again. (Trend Letter is published by Briefings Publishing Group, a Wicks Business Information LLC.)

Well, the future is now for the dental industry. In 2002, 3M ESPE launched Filtek™ Supreme Universal Restorative – 3M ESPE’s first nanocomposite – and a revolution in dental materials was born. Now, 3M ESPE has integrated nanotechnology into its fifth generation total-etch product – Adper™ Scotchbond 1 XT.

Adper Scotchbond 1 XT was listed in the well-respected Forbes/Wolfe Nanotech Report.

“Forbes/Wolfe Nanotech Report
December 2004
Top 10 Nanotech Products of 2004

Solution

3M ESPE, with Adper Scotchbond 1 XT, continues to be a leader in the development of cutting-edge dental materials. Adper Scotchbond 1 XT uses nanotechnology to offer dentists a superior level of fifth generation bonding.
Solvent Systems

**Aim of the study:** The purpose of this in vitro study was to determine the influence of solvent and rewetting time on microtensile dentin bond strengths of four dentin adhesives.

**Results:** Mean microtensile bond strength in MPa

![Graph showing microtensile bond strength for Scotchbond 1, P&B NT, and Excite in different conditions.]

**Conclusion:** Bond strengths upon rewetting depend on the type of solvent in the bonding system. The ethanol-and water-based total-etch adhesive Scotchbond 1 displayed a statistically higher microtensile bond strength than the acetone- and the ethanol-based total-etch adhesive on dry dentin, and also on dentin rewetted for 5 s or 15 s. This may contribute to a lower technique sensitivity of Scotchbond 1 compared to the other two adhesive systems.
“The analysis of variance of the results followed by orthogonal contrast comparisons revealed a significantly higher loss of mass in the single-bottle adhesives that contain organic vehicles (especially in those in which the vehicle was acetone). A somewhat lower loss of mass was found in a water-based product.”

“The conservation of the adhesive systems in tightly covered containers, and dispensing them immediately before application, are important clinical steps to avoid changes in the relative proportions on their components.”

“However, the acetone-containing bonding agents demonstrated a trend toward decreased bond strengths when the bonding agents were dispensed 10 minutes prior to their application. It is advisable to dispense these bonding agents just prior to application.”

**Solution**

*Adper™ Scotchbond 1 XT* is based on ethanol/water which may not evaporate at the same rate as acetone-based products.
Adper® Scotchbond 1 XT

3. Solvent Systems

Consider

All fifth generation adhesives rely on a solvent to bring the adhesive into the hybrid zone. Typically, systems use water, ethanol or acetone. Acetone is the most volatile solvent, followed by ethanol and water. As solvents evaporate, the % composition of the adhesive changes and this may have an affect on the performance of the bonding agent.

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<tr>
<td>One Step™</td>
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<tr>
<td>Optibond® Solo</td>
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Perdigao, J., Swift E., Lopes, G.,
"Effects of repeated use on bond strengths of one-bottle adhesives"
Quintessence Int. 1999:30:819-823

“Acetone-based adhesives may have a shorter useful life than ethanol- and water-based adhesives.”

“Water-based one-bottle adhesives may result in lower bond strengths than acetone- or alcohol-based one-bottle adhesives. The evaporation of the acetone solvent from acetone-based adhesives over the 3 weeks of simulated use may decrease the reactivity of the adhesive on moist dentin.”
Bond Strength
Consider

A microtensile bond strength experiment was performed at the University of Minnesota comparing Adper™ Scotchbond 1 XT Adhesive to Adper Scotchbond Adhesive and Optibond Solo Plus adhesive. Twenty-four extracted human third molars were prepared for bonding, 12 each for enamel and dentin. Enamel was prepared by roughening with a diamond bur for five seconds while dentin samples were prepared by cutting the crown off with a diamond saw exposing middle dentin. Filtek™ Z250 Restorative was bonded to the substrates using the above named adhesives followed by sectioning into rectangular sticks with cross-sectional areas of 0.7 mm² for dentin and 1.6 mm² for enamel. Each stick was then tested under a tensile load using an Instron testing machine. The figure below depicts the results.

![Graph showing microtensile bond strength](image)

**Enamel and Dentin Microtensile Bond Strength (MPa)**

*Source: Dr. J. Perdiago, University of Minnesota, 2004 (Unpublished Data)*

Solution

While the enamel bond strengths were found to be equivalent for the three adhesives tested, the dentin bond strength for Adper Scotchbond 1 XT adhesive was significantly greater than the other two adhesives.
“Microtensile bond strength of eleven contemporary adhesives to enamel.”

Aim of the study: The purpose of the study was to compare the microtensile bond strength of 11 adhesives to enamel.

Results: Mean microtensile bond strength in MPa

Conclusion: Scotchbond 1 was among the group of adhesives that showed the highest bond strength. Adhesives with simplified total- as well as self-etch approaches produced bond strength to enamel that matched those recorded for a conventional 3-step total-etch adhesive.
Sen D, Gökhan A.
“Shear bond strength of two composite core materials after using all-in-one and single-bottle dentin adhesives.”
J Prosthodont 2005;14(2): 97-103

**Aim of the study:** The purpose of the study was to compare the shear bond strength of two composite core materials after using all-in-one and single-bottle adhesives.

**Results:** Mean shear bond strength in MPa

**Conclusion:** The single-bottle adhesives Scotchbond 1 and One-Step Plus revealed higher bond strengths to both core-build-up materials than the all-in-one bonding systems.

Aim of the study: The objective of the study was to determine the influence of X-ray irradiation on dentin bond strength.

Results: Mean tensile bond strength in MPa

Conclusion: Irradiation itself did not show any significant influence on adhesion of composite to dentin. On non-irradiated dentin, the bond strength of Scotchbond 1 was significantly higher compared to Solobond Plus and Prime&Bond 2.1. On irradiated dentin, the bond strength of Scotchbond 1 was significantly higher compared to Solobond Plus.
Leakage
5. Leakage

Loguercio AD, de Oliveira Bauer JR, Reis A, Grande RH
“In vitro microleakage of packable composites in Class II restorations.”
Quintessence Int. 2004;35(1):29-34

Aim of the study: The purpose of the study was to evaluate the microleakage in Class II composite restorations at enamel and dentin margins.

Results: Leakage scores in cementum: 0 = no dye penetration; 1 = dye penetration up to one half of the gingival floor; 2 = penetration up to more than one half of the gingival floor; 3 = dye penetration up to the axial wall.

Conclusion: All adhesive/composite combinations are able to prevent dye penetration in enamel margins. However, Scotchbond 1 / P60 is preferable to reduce the microleakage in the cementum margin.
Marginal Adaption
Rahiotis C, Tzoutzas J, Kakaboura A
“In vitro marginal adaptation of high viscosity resin composite restorations bonded to dentin cavities.”

Aim of the study: The aim of the study was to evaluate the marginal adaptation of composite restorations bonded to dentin in a cylindrical cavity model.

Results: Percentage length of debonded margins relative to the cavity periphery.
Same letters indicate no statistically significant difference.

Conclusion: Scotchbond 1 / Z250, together with 2 other adhesive/composite combinations, presented the best marginal adaptation.
AW TC, Lepe X, Johnson GH, Mancl LA
“A three-year clinical evaluation of two-bottle versus one-bottle dentin adhesives.”
JADA 2005;136(3):311-322

**Aim of the study:** The aim of the study was to evaluate the clinical performance of Scotchbond 1, Scotchbond Multipurpose and One Coat Bond over a period of 3 years in noncarious cervical lesions.

**Results:** Marginal integrity and marginal discoloration after 3 years in % of the total margin.

**Conclusion:** Scotchbond revealed the highest marginal integrity and the lowest marginal discoloration after three years. However, there was no statistically significant difference between the groups, thus all three adhesives performed with clinically acceptable results.
Adper™ Scotchbond 1 XT

7. Delivery System

Consider

Individual unit doses allow for a superior level of infection control, as cross contamination issues are minimized. Plus, unit doses ensure compositional integrity as each unit dose is to be used once and discarded, eliminating the possibility of evaporation that exists in bottle systems.

Solution

Adper™ Scotchbond 1 XT Adhesive is now offered in a convenient and hygienic unit dose delivery system. Simply pressing the single-chambered foil package advances adhesive to the self-contained applicator.

Indications for Use

Adper Scotchbond 1 XT Adhesive, both unit dose and vial delivery, is indicated for use in the following types of restorations.

- Direct light-cured composite/compomer restorations
- Root surface desensitization
- Porcelain/composite repair
- Porcelain veneers (when used with RelyX™ Veneer Cement)
- Crown and bridge, inlay/onlay, bonding amalgam
  (when used with RelyX™ ARC Adhesive Resin Cement)
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