

# Heraeus

Heraeus Dental Science

iBOND® Self Etch  
iBOND® Total Etch  
Scientific Compendium



Experts in dialogue.

## Preface

For more than 25 years, Heraeus Kulzer has been developing and marketing bonding systems: from one of the first enamel adhesive systems, through the 4<sup>th</sup>, 5<sup>th</sup> (Etch & Rinse), and finally, 7<sup>th</sup> generation (Self-Etch) adhesives. iBOND Self Etch and iBOND Total Etch are our latest developments based on our comprehensive knowledge in adhesive dentistry.

Both bonding systems were designed to fulfill every demand of the daily dental routine.

iBOND Total Etch represents our newest evolution of our 5<sup>th</sup> generation adhesive systems for those practitioners who prefer an etch and rinse adhesive. Due to the innovative system based on nanofillers, iBOND Total Etch not only attains high bond strengths both on enamel and dentine but also ensures optimal marginal adaptation and is ideal for desensitizing hypersensitive areas.

iBOND Self Etch is Heraeus 7<sup>th</sup> generation adhesive system. Its predecessor iBOND Gluma Inside was the first 1-step All-in-One system released to market in 2003. iBOND Self Etch was created to ease dentist's work as it facilitates the dentist to etch, prime, bond and desensitize in one step. Which is not just only easy but also is highly beneficial when treating demanding patients (e.g. young children).

Hundreds of different formulations were compounded and tested to obtain the chemical formulation of iBOND Total Etch and iBOND Self Etch. Here, the focus was on simplifying application, improving bond strength and storage stability compared to predecessor and other products. These improvements have been and will continue to be tested and verified by external studies and investigations.

An overview of existing study results and studies in progress is provided in this brochure (see map and table on pages 4.)

This compendium highlights iBOND Self Etch's and iBOND Total Etch's stability and impressive bonding properties. We kindly invite you to test iBOND Self Etch and iBOND Total Etch by yourselves.

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## Worldwide studies on iBOND® Self Etch and iBOND® Total Etch

External testing of iBOND® Self Etch and iBOND® Total Etch by various study groups worldwide

## iBOND® Self Etch



● in vivo  
● in vitro

### USA

- Dr. Miller, Reality Research Lab
- Prof. Lee, University of Loma Linda, Loma Linda (CA)
- Dr. Lu, University of Loma Linda, Loma Linda (CA)
- Prof. Thompson, University of Texas, San Antonio (TX)
- Prof. Soderholm, University of Florida, Gainesville (FL)
- Dr. Yapp, The Dental Advisor
- Prof. Kugel & Prof. Perry, Tufts University, Boston (MA)

- Dr. Ibarra, University of Washington, Seattle (WA)
- Dr. Özer, University of Pennsylvania, Philadelphia (PA)

### Asia

- Prof. Uno, University of Tokyo, Japan
- Prof. Kanehira, Tohoku University, Sendai, Japan

### Europe

- Prof. van Meerbeek, University of Leuven, Belgium
- Prof. Frankenberger, University of Erlangen, Germany
- Prof. Finger, University of Cologne, Germany
- Prof. Ernst, University of Mainz, Germany
- Prof. Haller, University of Ulm, Germany
- Prof. Hannig, University of Saarland, Germany
- Dr. Ilie, University of Munich, Germany
- Dr. Rupf, University of Leipzig, Germany
- Dr. Blunck, Charité Berlin, Germany
- Prof. Cerutti, University of Brescia, Italy
- Prof. Breschi, University of Trieste, Italy
- Prof. Degrange, University of Paris, France
- Dr. Foxton, King's College London, Dental Institute, UK



Study Group	University	Country	Study Type	Title	Results
Prof. K.-J. Soderholm	University of Florida, Gainesville	USA	in vivo	Two year clinical evaluation of two self-etching dentin adhesives	available, see page 12
Prof. C.-P. Ernst	University of Mainz	Germany	in vivo	Two years clinical performance of a one-step self etching adhesive	available, see page 13
Prof. J. S. Lee	University of Loma Linda	USA	in vivo	Clinical evaluation of a new dental adhesive in posterior composite restorations	available, see page 14
Prof. A. Cerutti	University of Brescia	Italy	in vivo	Hydrophobic coating on simplified self-etching adhesive: in vivo nano-leakage expression	available and published (IADR 2007, # 0374)
Prof. R. Frankenberger	University of Erlangen	Germany	in vitro	μ-TBS trials on dentin	available, see page 18
Prof. B. Haller	University of Ulm	Germany	in vitro	In vitro evaluation of the marginal quality of class II composite fillings adjacent to dentin when using a new All-in-One adhesive	available, see page 19
Dr. H. Lu	University of Loma Linda	USA	in vitro	SBS comparison of 1-step dentin bonding systems on primary tooth dentin	available, see page 20
Prof. J. Y. Thompson	University of San Antonio	USA	in vitro	In vitro microtensile strength of different bonding system to human enamel and dentin	available, see page 21
Prof. M. Hannig	University of Saarland, Homburg	Germany	in vitro	In vitro investigation on marginal and internal adaption of different bonding agents and composites in class II cavities	available, see page 22
Prof. B. van Meerbeek	University of Leuven	Belgium	in vitro	μ-TBS on enamel and dentin	available, see page 23

Study Group	University	Country	Study Type	Title	Results
Prof. M. Degrange	University of Paris	France	in vitro	In vitro evaluation of the dentin bond strength of the experimental self-etching system iBOND Self Etch	available, see page 25
Dr. M. Miller	Reality Research Lab	USA	in vitro	SBS	available
Prof. W. Finger	University of Cologne	Germany	in vitro	Shear bond strength and marginal integrity to dentin with iBOND Self Etch	available
Dr. S. Rupf	University of Leipzig	Germany	in vitro	Experimental evaluation of the self-etching adhesive iBOND Self Etch and iBOND GLUMA inside in combination with the universal composite Venus for filling class V restorations	available
Prof. S. Uno	University of Tokyo	Japan	in vitro	μ-TBS	available
Prof. R. Yapp	The Dental Advisor	USA	in vitro	μ-TBS on dentin	available
Dr. N. Ilie	University of Munich	Germany	in vitro	Mechanical properties of adhesives	available and published (IADR 2007, # 0927)
Prof. G. Kugel	Tufts University	USA	in vitro	SBS comparison of All-in-One adhesive systems on enamel and dentine	available, see page 26
Dr. K. Tsubota	Nihon University	Japan	in vitro	Influence of adhesive application on enamel bonding of single-step systems	available and published (IADR 2009, # 969)
Prof. M. Kanehira	Tohoku University (Sendai)	Japan	in vitro	Effects of dentin adhesives on cavity adaptation of universal composites	available and published (IADR 2009, # 501)
Dr. U. Blunck	Charité Berlin	Germany	in vitro	Effect of phosphoric-acid-etching on class V dentin margin integrity using All-in-One-adhesives	available and published (IADR 2009, # 1852)
Dr. S. Sharma	Tufts University	USA	in vitro	Strength analysis of rebonded composite restorations	available and published (IADR 2010, # 214)

# iBOND® Self Etch

## Product description

iBOND Self Etch is a light-curing self-etching one component bonding agent for adhesive restorations. Separate conditioning (etching) of the enamel and dentine is not required; however, the use of an additional etching gel on the enamel before application of iBOND Self Etch will not have a negative influence on the bond strength.

iBOND Self Etch was developed for bonding composite resin materials (e.g. composite, compomer and Polyglas®) to the hard tooth structure. iBOND Self Etch etches, primes, bonds, and desensitizes in 1 step.

### Composition

iBOND Self Etch is an acetone/water-based formulation of light-activated methacrylate resins.

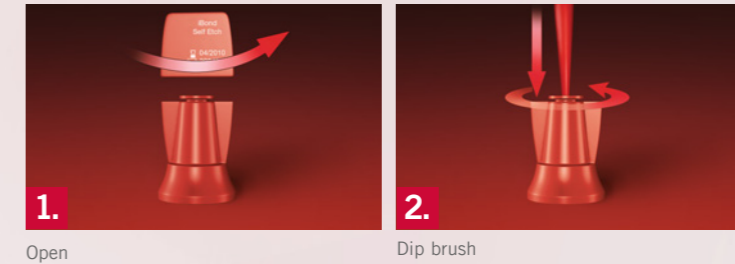
### Indications

Bonding of direct light-cured composite restorations (including Polyglas and compomers). Bonding of indirect restorations in combination with a light-curing luting cement: porcelain, Polyglas, and composite restorations (inlays, onlays, veneers, crowns). Sealing hypersensitive areas of teeth.

# Clinical application

## Application of iBOND® Self Etch

### iBOND Self Etch – Step-by-step application

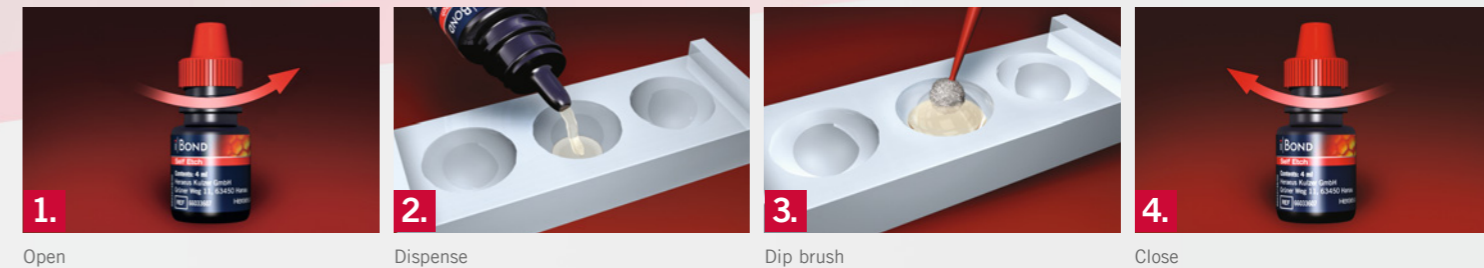


1.

Open

2.

Dip brush



1.

Open

2.

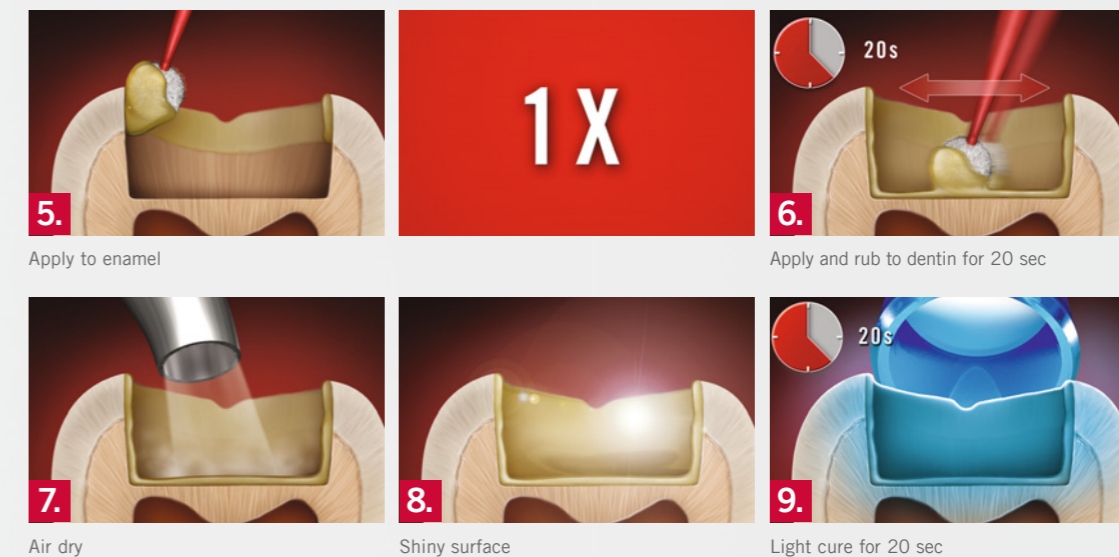
Dispense

3.

Dip brush

4.

Close



5.

Apply to enamel

1X

6.

Apply and rub to dentin for 20 sec

7.

Air dry

8.

Shiny surface

9.

Light cure for 20 sec

100

In vivo studies

[IMP a]

80

60

40

100  
80  
60  
40  
20  
0



## iBOND® Self Etch – In vivo studies

### Clinical comparison of two self-etch adhesives in class V cavities after 2 years

#### Two year clinical evaluation of two self-etching dentin adhesives

##### Source

M. Ottenga, S. Nimmo, K.-J. Soderholm, University of Florida, Gainesville, USA, J Dent Res 89 (Spec Iss B): 684, 2010

##### Objective

Aim of this clinical evaluation was to investigate the performance of the All-in-One adhesive iBOND Self Etch (Heraeus Kulzer) in class V cavities in comparison to the self-etching product Clearfil SE Bond (Kuraray) after 2 years.

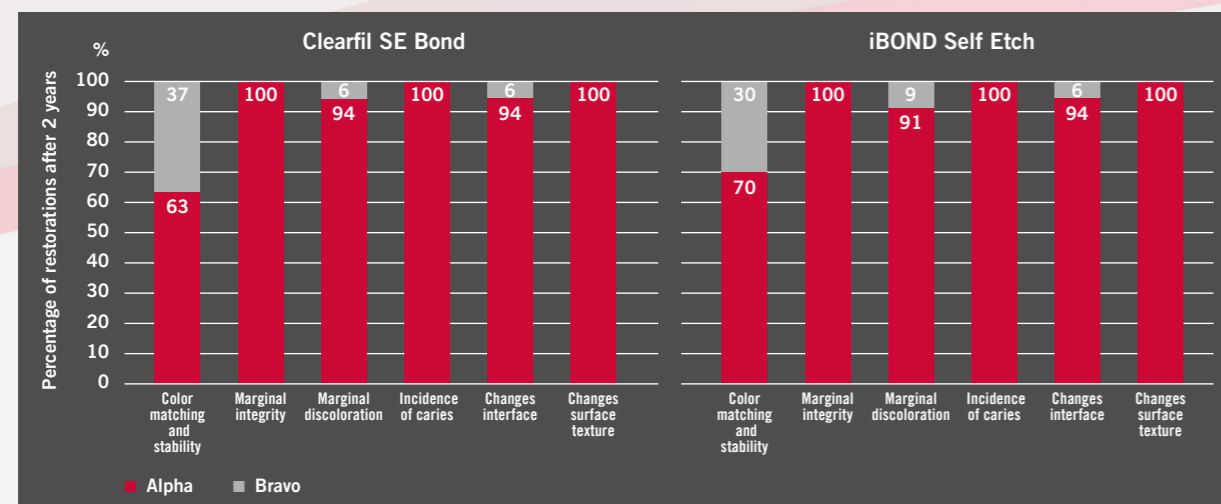
##### Materials and Methods

Originally 84 class V restorations were placed in incisors, canines and premolars of 21 patients using a split mouth design. The restorations were applied using either iBOND Self Etch or Clearfil SE Bond in combination with the composite Venus (Heraeus Kulzer). Every study subject received 2, 4 or 6 restorations. At baseline and all recalls the restorations were judged according to the following criteria: Retention, colour matching and stability, marginal integrity, marginal discoloration, incidence of caries, anatomic form, changes in restoration-tooth interface, changes

in surface texture, postoperative sensitivity and maintenance of periodontal health. Following the baseline evaluation, the patients have been reevaluated after 3 months, 1 year and 2 years. Alpha and Bravo ratings are clinical acceptable.

##### Results

After 2 years 18 patients, who originally received 36 iBOND Self Etch and 36 Clearfil SE Bond restorations, were available for evaluation. At this time 68 (33 iBOND Self Etch and 35 Clearfil SE Bond) of these restorations were in service. One restorations failed for endodontic reason/crowning which was not related to the class V restoration, 3 failed because of fractures. Two of these restorations (1 iBOND Self Etch and 1 Clearfil SE Bond) had failed in the same patient, and in all cases, the restorations had fractured leaving a large piece of the composite still bonded to the dentine. One iBOND Self Etch restoration was lost in a patient presenting highly sclerotic dentine. None of the patients showed postoperative symptoms or periodontal impairments. Both adhesives had a tendency of marginal discrepancies (clinical acceptable) caused by over-contouring the cavo-surface margins. All 68 restorations performed clinically sufficient after 2 years.



The 1-step iBOND Self Etch behaves clinically as good as the 2-step self etch "gold standard"

##### Conclusions

The All-in-One iBOND Self Etch achieves comparable good results as the long-term established and well evaluated 2-step self-etching adhesive Clearfil SE Bond.

The biggest problem of self-conditioning adhesives seem to be over-contouring of the restorations.

## iBOND® Self Etch – In vivo studies

### Two years clinical evaluation of iBOND® Self Etch in class III cavities

#### Two years clinical performance of a one-step self etching adhesive

##### Source

A. Schattenberg, I. Busemann, T. Käter, B. Willershausen and C.-P. Ernst, University of Mainz, Germany, J Dent Res 88 (Spec Iss B): 219, 2009

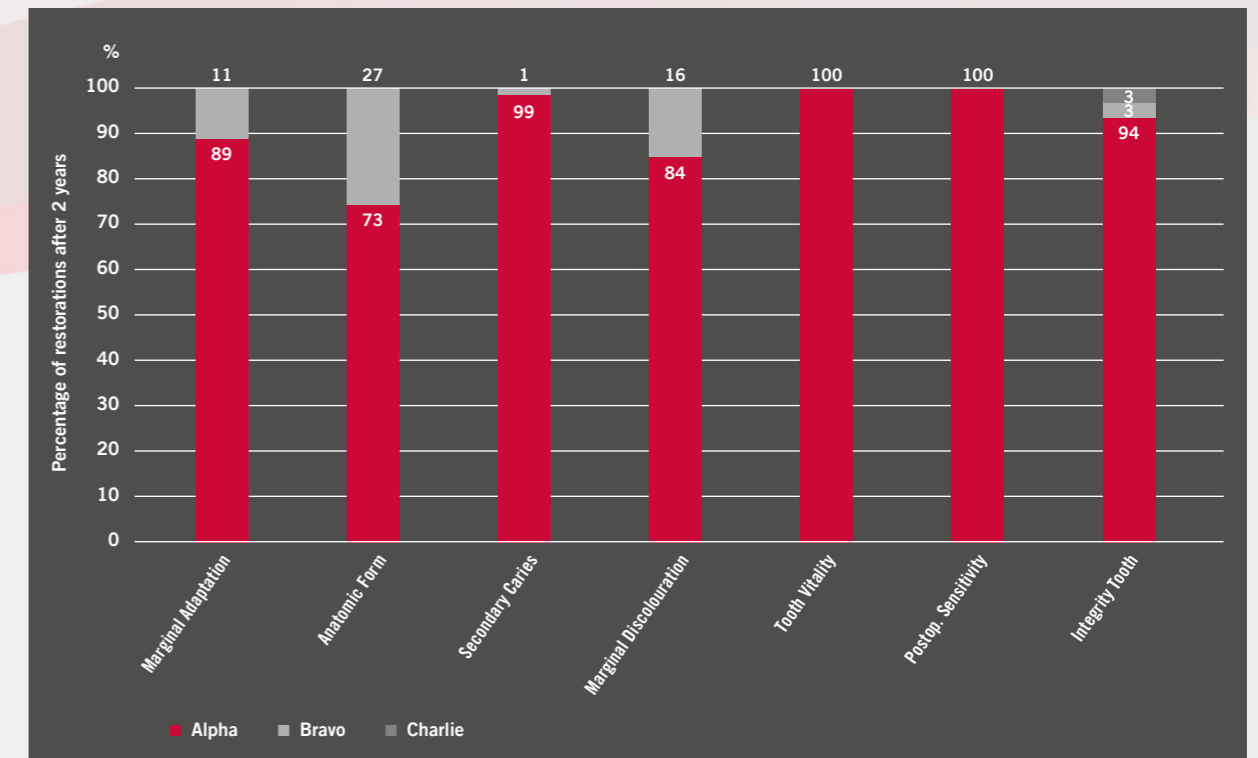
##### Objective

The aim of the study was to evaluate the clinical and aesthetical 2-years performance of the new 1-step self-etching adhesive iBOND Self Etch in combination with the microhybrid composite Venus to restore class III cavities.

##### Materials and Methods

38 patients received 72 class III restorations. All class III cavities were treated according the same protocol and scored referred to the Ryge / CDA-criteria at baseline and after 3, 12 and 24 months. After preparation each cavity was conditioned and bonded in 1 step as per manufacturer's instructions using iBOND Self Etch and Venus (both Heraeus Kulzer). After 24 months, 70 restorations (97%) were available for reevaluation.

##### Results



iBOND Self Etch allows good and aesthetic results in anterior teeth

##### Conclusions

The positive trend for iBOND Self Etch demonstrated in assessments after 3 and 12 months continues also after a time period of 24 months. Except one, all iBOND Self Etch restorations show clinically good and aesthetically acceptable results.

## iBOND® Self Etch – In vivo studies

### 36 months clinical evaluation in posterior teeth

#### Clinical evaluation of a new dental adhesive in posterior composite restorations

##### Source

2-years results were already published: Lee SS, Meharry M, Arambula M, Abdel-Salam N and Li Y: iBOND Self Etch, A 24-Month Clinical Evaluation. J Dent Res 89 (Spec Iss B), 690, 2010. Unpublished 3 years report, Jan 2011. Data on file.

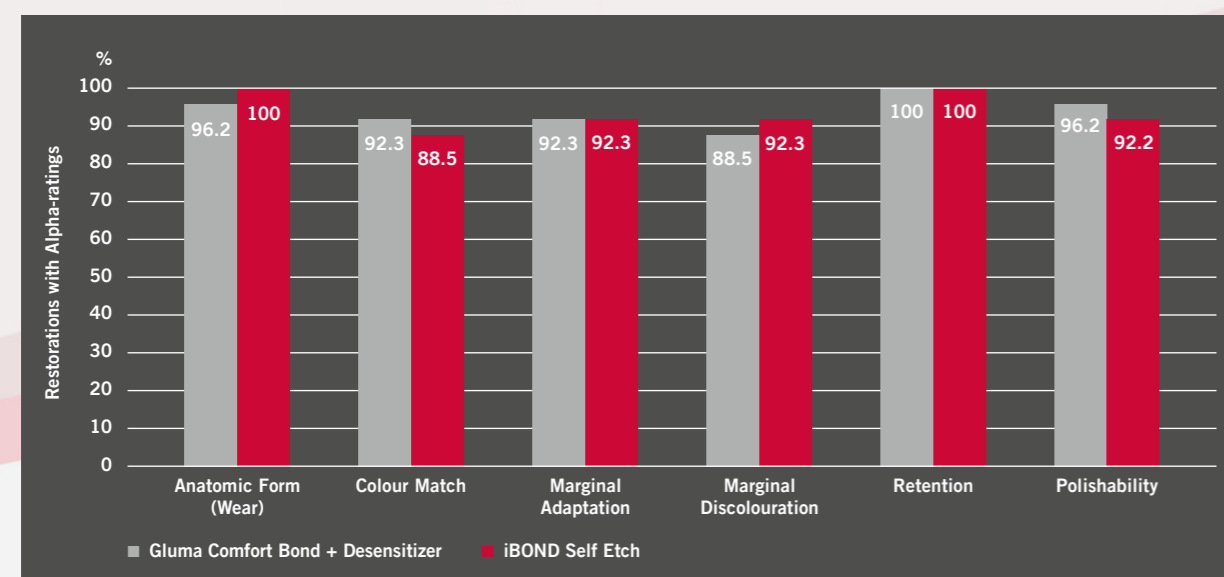
##### Objective

Aim of this clinical trial was to investigate the clinical performance of the All-in-One Adhesive iBOND Self Etch (Heraeus Kulzer) in posterior restorations in comparison to GLUMA Comfort Bond + Desensitizer (Heraeus Kulzer) over a 36-months period.

#### Materials and Methods

In the context of this split mouth design study 60 class I and II restorations were performed in combination with Venus (Heraeus Kulzer) in 21 patients. 30 restorations were made with each adhesive system. Every study subject received between 2 and 4 restorations. At baseline and during every follow-up visit (6, 12, 24 and 36 months) the restorations were judged according to modified Ryge: anatomic form, colour match, marginal adaptation, discolouration, surface staining, retention, fracture, secondary caries, polishability and changes in adjacent teeth. Postoperative sensitivity and gingival health were also determined.

#### Results

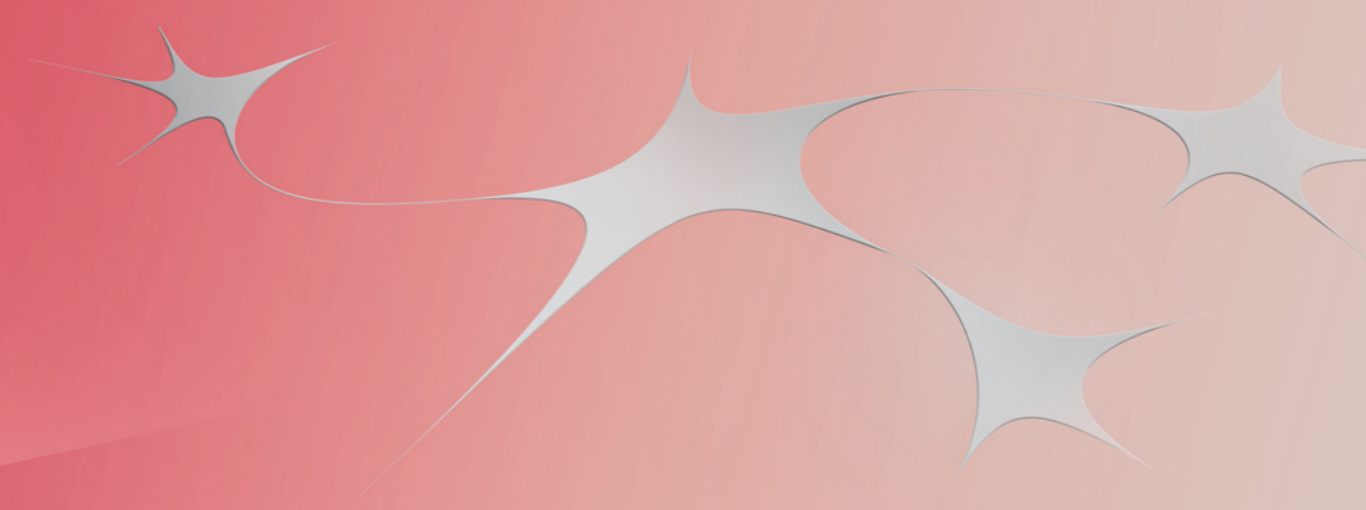


7<sup>th</sup> generation adhesive iBOND Self Etch shows similar clinical performance than an etch & rinse adhesive

After 36 months the recall rate is 86.7%. All restorations are in situ. Fractures, surface stain, changes of adjacent teeth or secondary caries are not detected. Both adhesive systems display only clinically good and acceptable ratings (alpha and bravo) in each category except one slight colour mismatch in iBOND Self Etch (charlie) due to colour change of the tooth. None of the patients shows postoperative sensitivities or gingival inflammations. No statistical significant differences were present.

#### Conclusion

Both adhesive systems show an excellent clinical performance after 2 years in class I and II restorations. The All-in-One Adhesive iBOND Self Etch illustrates comparable results to the 2-step Etch & Rinse System GLUMA Comfort Bond + Desensitizer which is long-term established in the market. iBOND Self Etch convinces in clinical conditions.



100

In vitro studies

[CMPa]

80

60

40

100  
80  
60  
40  
20  
0



## iBOND® Self Etch – In vitro studies

### Microtensile bond strength to dentine

#### µ-TBS trials on dentin

##### Source

Roland Frankenberger, Sergej A. Nikolaenko, University of Erlangen, Germany. Data on file.

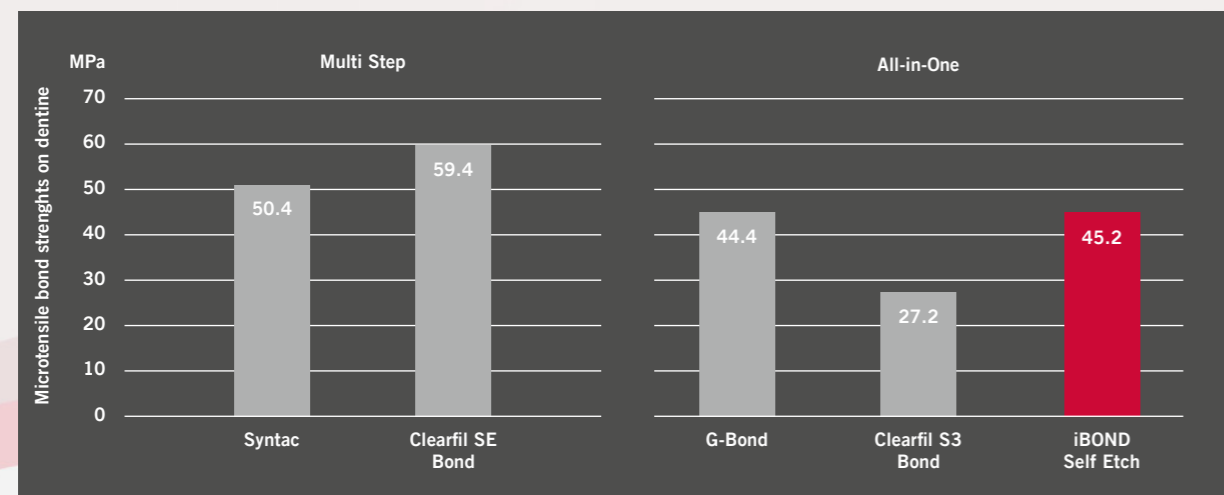
##### Objective

The objective of this in vitro study was to measure the microtensile bonding strength of five different adhesives.

#### Materials and Method:

The bonding strength of the composite Filtek Z250 (3M ESPE) when bonded to dentine using different adhesives was measured. The following adhesives were used: iBOND Self Etch (Heraeus Kulzer), G-Bond (GC), Clearfil SE Bond (Kuraray), Clearfil S3 Bond (Kuraray), and Syntac (Ivoclar Vivadent). Adhesive and composite were applied to a class I cavity, and then adhesion to the cavity floor was determined. The tests were carried out after storage in water for 24 hours at 37°C using a microtensile machine at a displacement speed of 1 mm/min. The mean bond strengths were analysed using the Kolmo Gorov-Smirnov test and the Wilcoxon test ( $p=0.05$ ). Samples that fractured before the test were included in the measurement using 0 MPa.

#### Results



#### iBOND Self Etch convinces with its bonding abilities

The mean microtensile bond strengths in MPa with standard deviation on dentine were: iBOND Self Etch,  $45.2 \pm 8.2$ ; G-Bond,  $44.4 \pm 7.4$ ; Clearfil SE Bond,  $59.4 \pm 6.3$ ; Clearfil S3 Bond,  $27.2 \pm 2.9$ ; Syntac,  $50.4 \pm 8.4$ . The differences between iBOND Self Etch and Syntac, as well as between iBOND Self Etch and G-Bond, were not significant.

#### Conclusion

In this study, iBOND Self Etch shows equivalent or substantially better bond strength than Syntac and G-Bond or Clearfil S3 Bond and demonstrates the best results in the All-in-One group of adhesives.

## iBOND® Self Etch – In vitro studies

### Marginal integrity at enamel and dentine

#### In vitro evaluation of the marginal quality of class II composite fillings adjacent to dentin when using a new All-in-One adhesive

##### Source

Bernd Haller, University Ulm, Germany. Data on file.

##### Objective

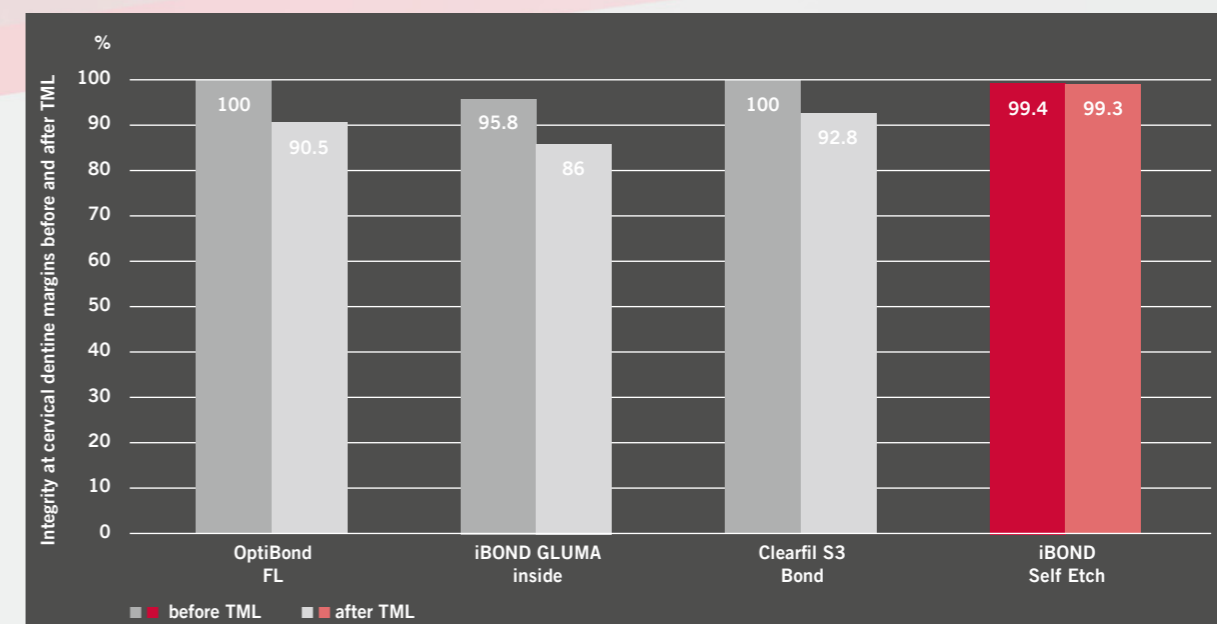
The aim of this in vitro study was to investigate, with the aid of quantitative SEM marginal analysis, the extent to which iBOND Self Etch could prevent the formation of marginal gaps at the proximal enamel margins and cervical dentine margins in class II composite fillings with a dentine interface.

#### Materials and Methods

2 two-surface class II cavities were prepared in 20 caries free extracted third molars and each cavity was filled with composite (Venus, Heraeus Kulzer). One of the follow-

ing bonding systems was used for 10 of the test cavities: Clearfil S3 Bond (Kuraray), iBOND GLUMA inside (Heraeus Kulzer), iBOND Self Etch (Heraeus Kulzer) and OptiBond FL (Kerr). After the fillings were finished and polished, the teeth were stored in water for 24 h at 37 °C. An impression was then taken of the restored proximal surfaces using a low viscosity A-silicone (Flexitime, Heraeus Kulzer). The test teeth were then subjected to thermocycling (1500x, 55/5 °C, 25 s) and mechanical loading (TML) in a masticatory load simulator (50,000 x 50 N) and a new impression was then taken. The silicone impressions were used for fabricating plastic resin replicas, which were sputtered with gold. The replicas were assessed in the SEM at 300–500 x magnification based on the marginal criteria of seamless transition, marginal gap, tooth margin fracture and composite margin fracture. Furthermore, a dye penetration test was performed on the test teeth using 0.5% basic fuchsin solution (24 h, 37 °C). The Kruskal-Wallis H test and the Wilcoxon test were used for statistical analysis.

#### Results



#### iBOND Self Etch reveals outstanding marginal integrity

#### Conclusion

The marginal adaptation of iBOND Self Etch at the dentine margins was not only very good initially but also stable after loading. The dentine marginal integrity in the SEM after thermomechanical loading was comparable to that of Clearfil S3 Bond and it was significantly superior not only to that of its forerunner iBOND GLUMA inside but also to that of the

OptiBond FL multi-step, etch-and-rinse system. Phosphoric acid etching (OptiBond FL) at the enamel margins produced optimal marginal integrity without any marginal gaps, though there was no significant difference in enamel marginal integrity between iBOND Self Etch and Clearfil S3 Bond.

## iBOND® Self Etch – In vitro studies

### Shear bond strength of iBOND® Self Etch on primary tooth dentine

#### SBS comparison of 1-step dentin bonding systems on primary tooth dentin.

##### Source

B. Nelson, R. Grabowsky, H. Lu, W. Okumura, J. Peterson, Loma Linda University, Loma Linda, USA, J Dent Res 86 (Spec Iss A): 1992, 2007

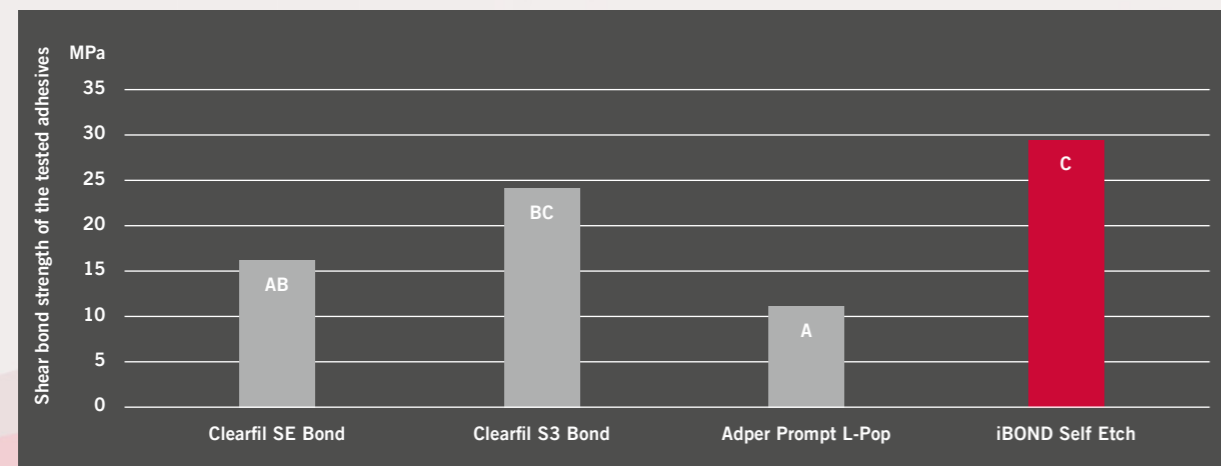
##### Objective

To compare shear bond strengths (SBS) of composite materials to primary dentine when used with various 1-step dentine bonding agents.

#### Materials and Methods

Extracted primary teeth were divided into 4 groups of 15 specimens each. The teeth were mounted in phenolic rings with acrylic resin and wet-ground to expose an experimental dentine testing surface of at least 2.5 mm in diameter. The following bonding agents were used in each group: group I (control) – Clearfil SE Bond (Kuraray), group II – Adper Prompt L-Pop (3M ESPE), group III – iBOND Self Etch (Heraeus Kulzer), and group IV – Clearfil S3 Bond (Kuraray). A 2.38 mm projection of Herculite XRV Unidose composite (Kerr) was bonded to the dentine surface. After 1000 cycles of 5–55°C thermocycling, the specimens were tested in MTS machine with shear force until failure occurred. Load at failure was recorded in Newton, and bond strength was calculated into Mega-Pascal. The debonded surfaces were evaluated for cohesive or adhesive failures.

#### Results



Bonding System	Mean (SD)
Clearfil S3 Bond	24 (6)
Clearfil SE Bond	17 (10)
Adper Prompt L-Pop	12 (6)
iBOND Self Etch	29 (6)

Means with the same superscripted letter are not statistically different from each other at  $p < 0.05$ .

#### iBOND Self Etch reveals outstanding bonding abilities to deciduous teeth

6 specimens in iBOND Self Etch group had cohesive failures in dentine, while all the other specimens broke in the bonding interface. Means of SBS (MPa) are listed in the following table with standard deviation in parentheses. A 1-way ANOVA test showed that the bonding agent had a statistically significant influence on SBS.

#### Conclusion

Different dentine bonding agents created different shear bond strengths between the composite and the primary dentine. iBOND Self Etch appears to have the highest bonding strength on primary tooth dentine, when taking cohesive failure into account.

## iBOND® Self Etch – In vitro studies

### Microtensile bond strength of iBOND® Self Etch

#### In vitro microtensile strength of different bonding systems to human enamel and dentine.

##### Source

Jeffrey Y. Thompson, University of Texas, San Antonio, USA, Erica Teixeira, University of North Carolina, Chapel Hill, USA. Data on file

##### Objective

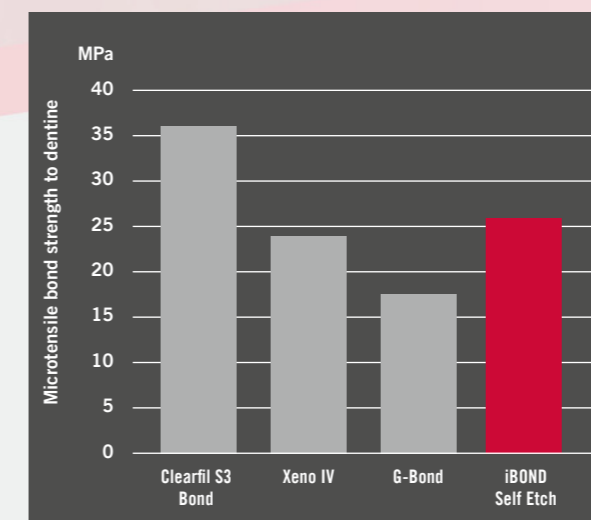
The objective of this in vitro study was to examine microtensile bond strengths to human dentine and enamel of different adhesives.

#### Materials and Methods

Human teeth were cleaned of debris. In half of the teeth, the occlusal surface was ground flat until exposure of the dentin, and the other half, until exposure of enamel. The bonding procedures followed the manufacturers' recommendations.

The adhesive systems evaluated in this study were: GLUMA Comfort Bond (Heraeus Kulzer), Prime&Bond NT (Dentsply), Xeno IV (Dentsply), G-Bond (GC), Clearfil SE Bond (Kuraray), Clearfil S3 Bond (Kuraray), and iBOND Self Etch (Heraeus Kulzer). Six to seven teeth (min. three for enamel and three for dentine groups) were prepared for each material. A crown was built up incrementally over the adhesive resin using a resin composite (Venus, Heraeus Kulzer) for all groups. The roots were then removed, and the pulp chambers were sealed with composite resin. The bonded assemblies ( $n=20$  per group) were stored in water for one day at 37°C and then sectioned perpendicular to the bonded interface into approximately 1 mm thick beams with a diamond saw. Microtensile bond tests were performed for all specimens using a table-top material tester (EZ test, Shimadzu Co., Kyoto, Japan) at a crosshead speed of 1 mm/min. Bond strength data was subjected to one-way ANOVA followed by Tukey test at 95% level of confidence.

#### Results 7<sup>th</sup> generation bondings



#### iBOND Self Etch convinces with good bond strength

The mean results with standard deviation for microtensile bond strength to enamel/dentine were: GLUMA Comfort Bond, 28.4±9.6/46.3±10.2; Prime&Bond NT, 28.7±12.3/42.1±9.8; Clearfil SE Bond, 28.8±9.8/54.7±16.4; Clearfil S Bond, 19.5±9.9/36.2±12.5; Xeno IV, 18.0±7.2/23.2±12.6; G-Bond, 17.8±7.3/17.1±7.6; iBOND Self Etch, 17.4±7.0/25.7±9.6.

#### Conclusion

iBOND Self Etch was equivalent to the other self-etching bonding agents in regard to microtensile bond strength to enamel, except for Clearfil SE Bond, which had a statistically higher mean strength. For microtensile bond strength to dentine, iBOND Self Etch was statistically the same as the other self-etching bonding agents, except for Clearfil SE Bond and Clearfil S3 Bond.

## iBOND® Self Etch – In vitro studies

### Marginal integrity of iBOND® Self Etch

**In vitro investigation on the marginal and internal adaptation of different bonding agents and composites in class II cavities.**

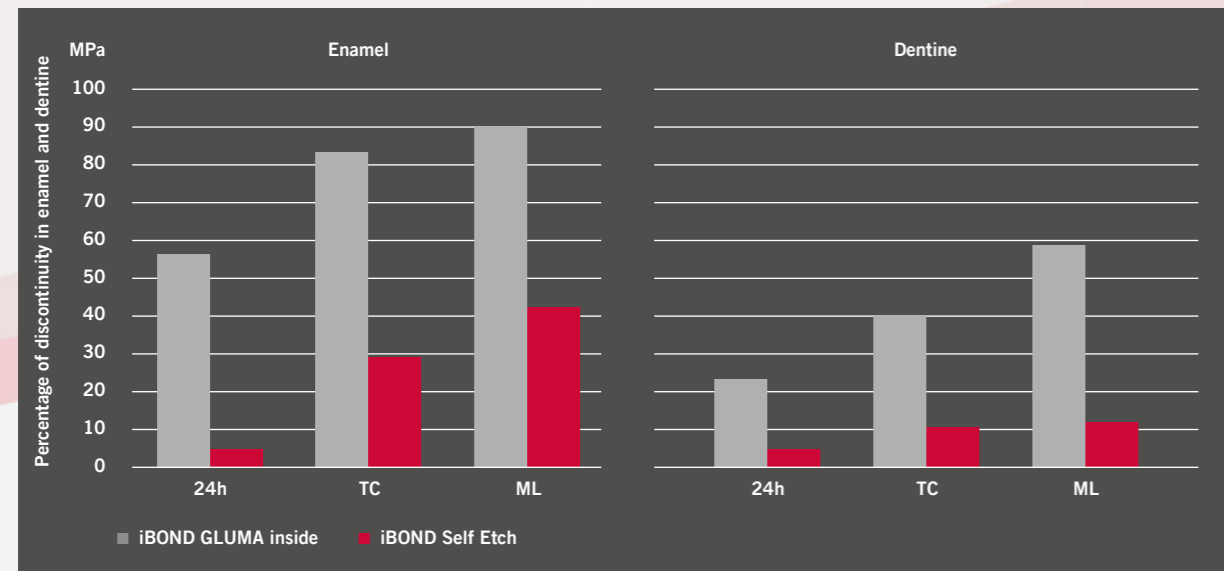
**Source**  
Matthias Hannig, University of Saarland, Homburg, Germany. Data on file.

**Objective**  
The purpose of this in vitro study was to investigate the marginal and internal adaptation of different bonding agents and composites.

**Materials and Methods**  
Class II cavities with small occlusal cavity, cervical margin in cementum, and chamfered proximal enamel margins were prepared using caries-free, extracted human teeth.

The two adhesives were applied according to the manufacturer's instructions, and the composite restoration was prepared using the incremental technique. Inspection then took place using the incident light microscope. The analysis of marginal adaptation was performed by SEM marginal gap analysis by means of the replica method after storage for 24 hours in water (24h), thermocycling (TC) (1500 x 2/60 °C, 45/7/45 s), and chewing simulation (ML) (200,000 x). Analysis of internal adaptation was done using the dye penetration test after chewing simulation. Here, discontinuity was defined as follows: an interruption in the transition from composite to dental substance (e.g. marginal gaps, hairline cracks, crevices). The following adhesives were examined: iBOND GLUMA inside (Heraeus Kulzer) and iBOND Self Etch (Heraeus Kulzer). Venus A3 (Heraeus Kulzer) was used as the composite material.

#### Results



**iBOND Self Etch achieves good marginal integrity**

**Conclusion**  
In strain tests, iBOND Self Etch demonstrates more than 50% fewer marginal gaps compared to iBOND GLUMA inside. With iBOND Self Etch, after storage in water for 24 hours, no marginal gaps were found on enamel or dentine.

## iBOND® Self Etch – In vitro studies

### Microtensile bond strength on enamel and dentine

**µ-TBS on enamel and dentin.**

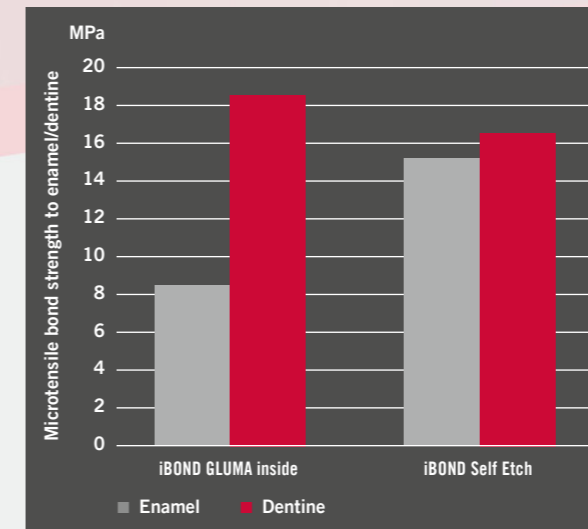
**Source**  
Bart van Meerbeek, University of Leuven, Belgium. Data on file.

**Objective**  
The objective of this in vitro study was to investigate the bonding effectiveness and interaction with enamel and dentine of iBOND Self Etch compared to iBOND GLUMA inside.

**Materials and Methods**  
The adhesives iBOND Self Etch (Heraeus Kulzer) and iBOND GLUMA inside (Heraeus Kulzer) were examined. The enamel samples were produced by grinding the lingual and buccal enamel from extracted human third molars.

The occlusal third of the teeth was removed to produce the dentine samples. A thin layer was removed at the surface using a high speed medium-grit (100 µm) diamond grinder in order to obtain a standardized application layer. The adhesives were applied according to the manufacturer's instructions, and the composite Z100 (3M ESPE) was built up to a height of 5–6 mm. The samples were then stored in water for 24 hours at 37 °C. The teeth were cut perpendicular to the bonding surface into rectangular samples. The 48 samples obtained were shear-loaded to failure using an LRX test machine at a displacement speed of 1 mm/min.

#### Results



**iBOND Self Etch has better bonding performance on enamel as its ancestor iBOND GLUMA inside**

The microtensile bond strengths in MPa with standard deviation for enamel/dentine were 15.6±11.8/16.2±4.3 for iBOND Self Etch and 8.3±15.2/18.7±10.0 for iBOND GLUMA inside.

**Conclusion**  
Compared with iBOND GLUMA inside, iBOND Self Etch demonstrates better bond strength to enamel, whereby a clinical improvement of the marginal integrity is to be expected.

## iBOND® Self Etch – In vitro studies

### Shear bond strength and marginal adaptation to dentine

#### Test on the shear bond strength and marginal adaptation at the dentine of AdheSE One, Xeno V and iBOND Self Etch.

##### Source

Research & Development, Heraeus Kulzer Wehrheim, Germany. Data on file.

##### Objective

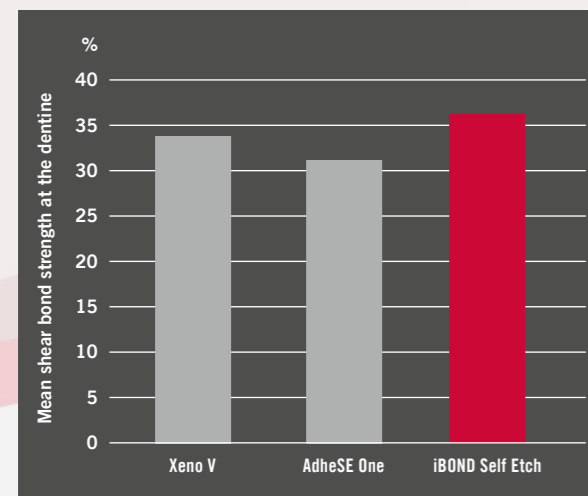
The aim of this in vitro study was to test the shear bond strength and marginal adaptation at the dentine of three new self-etching All-in-One adhesives.

##### Materials and Methods

The self-etching All-in-One adhesives tested were AdheSE One (Ivoclar Vivadent), Xeno V (Dentsply) and iBOND Self Etch (Heraeus Kulzer). The adhesives were used according to the manufacturer's instructions in both tests. The shear

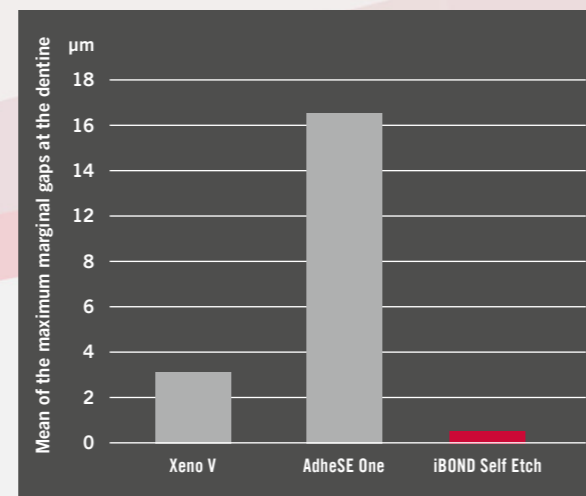
bond strength was determined using the Ultradent technique (template with a 2.38 mm diameter) on extracted human molars with an exposed dentine surface (n=8). The composite used for the tests was Venus (Heraeus Kulzer). Following preparation, the test teeth were stored in water for 24 h at 37 °C. The shear strength was determined in a universal testing machine (Zwick Z010) with a thrust speed of 1 mm/min. In order to test the marginal gap, extracted human molars (n=8) were cut down to the dentine; class I cavities were prepared in the dentine and filled with Venus composite (Heraeus Kulzer) after application of the adhesive. The test teeth were then stored for 10 minutes in water. The marginal gap was determined by surface analysis of the digitized images using the Analysis Soft Imaging programme (Olympus) with measurement of the largest marginal gap respectively.

#### Results



iBOND Self Etch demonstrates excellent behaviour on dentine

The shear bond strength at the dentine was 31.2±10.7 MPa for AdheSE One, 34.1±8.6 MPa for Xeno V and 35.7±2.1 MPa for iBOND Self Etch. With regard to gap-free marginal adaptation at the dentin of the teeth tested, AdheSE One attained 0%, Xeno V 50% and iBOND Self Etch 100%.



#### Conclusion

iBOND Self Etch exhibited the best results at the dentine with regard to shear bond strength and marginal adaptation.

## iBOND Self Etch – In vitro studies

### “Battle of the Bond” –

### Shear bond strength of iBOND® Self Etch

#### In vitro evaluation of the dentin bond strength of the experimental self-etching system iBOND Self Etch.

##### Source

Michel Degrange, Biomaterials Lab, University of Paris, France. Data on file

##### Objective

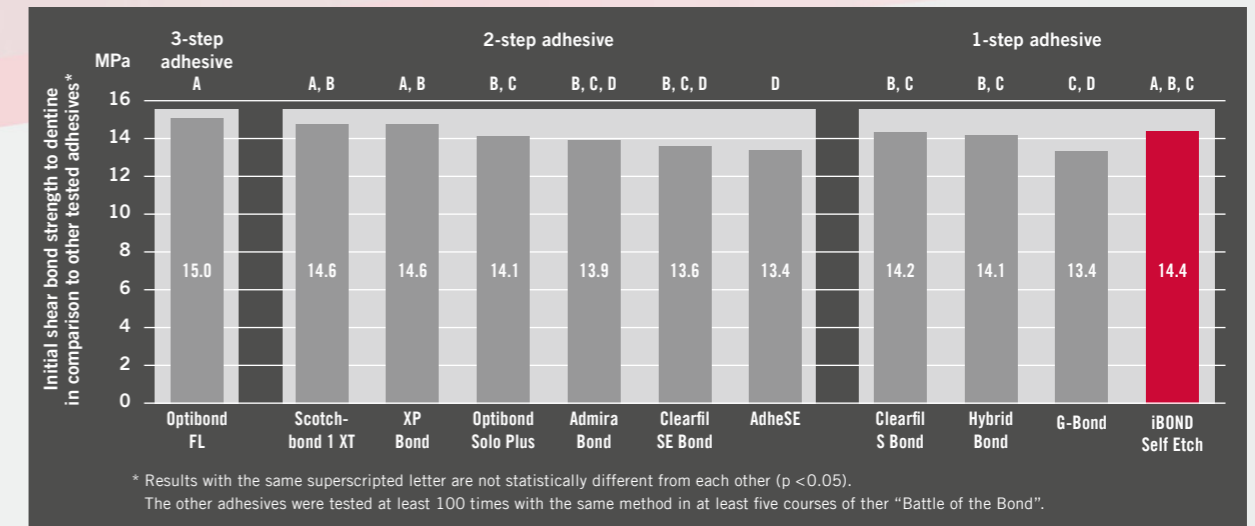
The objective of this in vitro study was to assess the dentine bond strength of iBOND Self Etch.

##### Materials and Methods

iBOND Self Etch was tested in four practical courses of the “Battle of the Bond”. The trials took place in meeting rooms especially equipped for this experiment. Sufficient specimens (extracted human molars) were prepared in advance for each series of tests according to the numbers of partici-

pants. The teeth were embedded in acrylic resin, and flat dentine surfaces were produced by wet grinding on SiC paper # 800. To achieve the specimens, the practitioners used Teflon split molds. After the application of the adhesive, the molds were filled in 2 increments (lightcured for 20 seconds each) with a composite resin. Only one composite material was used for all the trials (Z 100, 3M ESPE). The light intensity emitted by the available units was checked before using (a threshold of 600 mW/cm<sup>2</sup> was required). The bonded samples were stored in water and tested approximately 10 minutes after bonding. Shear bond strength was measured using a guillotine-type device on the tensile machine at a cross-head speed of 5 mm/min until fracture occurred. The shear bond strength values were recorded in an Excel table as the tests were conducted. Shear bond data were statistically analyzed with a Student's test at the level of p=0.05.

#### Results



\* Results with the same superscripted letter are not statistically different from each other (p < 0.05). The other adhesives were tested at least 100 times with the same method in at least five courses of their “Battle of the Bond”.

iBOND Self Etch performs on dentine as a 3-step-adhesive

In total, 106 specimens of iBOND Self Etch were tested. The shear bond strength of iBOND Self Etch was 14.39±4.5 MPa

#### Conclusion

The main advantage of the “Battle of the Bond” was to record a large database extracted from tests made by general practitioners. In this study, more than one hundred tests were performed with iBOND Self Etch. Recently, a publication grouping together all the clinical trials of dentin bonding systems has shown a positive correlation between this data and the clinical behavior of the same dentine bonding systems (Peumans et al., 2005).

## iBOND® Self Etch – In vitro studies

### Bond strength testing of All-in-One adhesives on enamel and dentine

#### SBS comparison of All-in-One adhesive systems on enamel and dentine.

##### Source

G. Kugel, R.D. Perry, M. Finkelman, and R. Perry, Tufts University, Boston, USA, J Dent Res 89 (Spec Iss A): 19, 2010

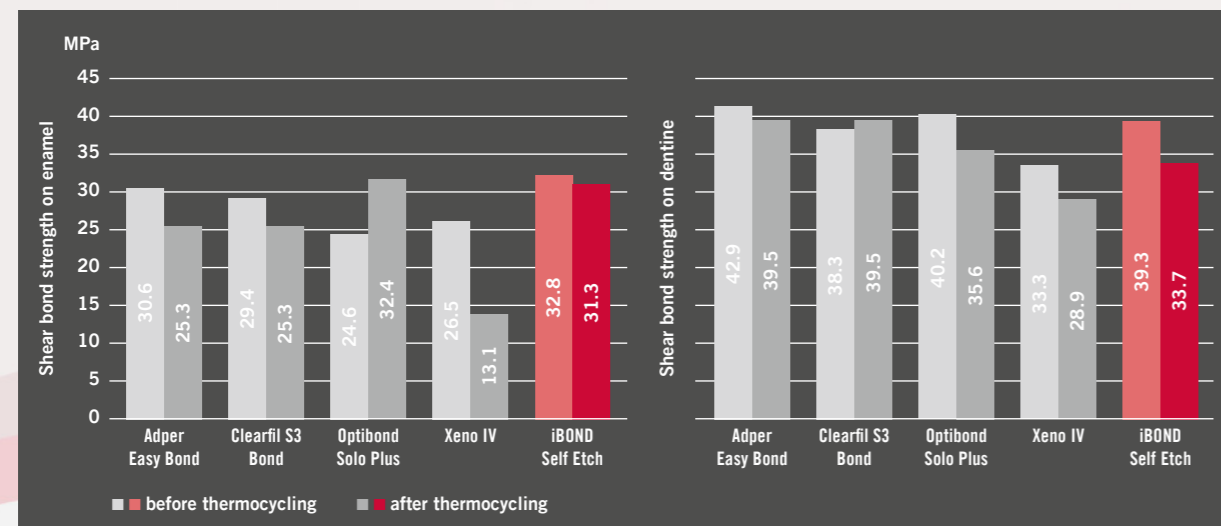
##### Objective

Comparison of shear bond strength (SBS) of 5 All-in-One adhesive systems on enamel and dentine at 24 hours and 10,000 cycles.

#### Materials and Methods

The adhesives iBOND Self-Etch (Heraeus Kulzer), Clearfil S3 Bond (Kuraray), Adper Easy Bond (3M ESPE), Optibond Solo Plus (Kerr) and Xeno IV (Dentsply) were evaluated for shear bond strength on enamel and dentine. 160 human molars were randomly divided into 20 groups (n=8). Flat enamel and dentine surfaces were prepared. Venus Diamond composite (Heraeus Kulzer) was applied using the Ultradent equipment. Light-activation of adhesives and composite was done by a Translux Power Blue (Heraeus Kulzer). Shear bond strength was determined after 24h water-storage and after thermocycling (10,000 cycles at 5 and 55°C). Statistical analysis was done by three-way ANOVA, with post-hoc analysis conducted via Tukey's HSD.

#### Results



#### Bond Strength of iBOND Self Etch on enamel convinces

#### Conclusion

The All-in-One adhesives had significantly higher SBS when applied to dentine than when applied to enamel. Bond values were higher prior thermocycling (TML). iBOND Self Etch performed superior to the other self-etching adhesives on enamel before TML and demonstrated the most stable result after TML. On dentine iBOND Self Etch was equivalent to competitor products before and after TML.

## iBOND® Self Etch – In vitro studies

### Shear bond strength using the All-in-One self etch-technique

#### Shear bond strength evaluation on enamel and dentine.

##### Source

Research & Development, Heraeus Kulzer GmbH Wehrheim, Germany. Data on file.

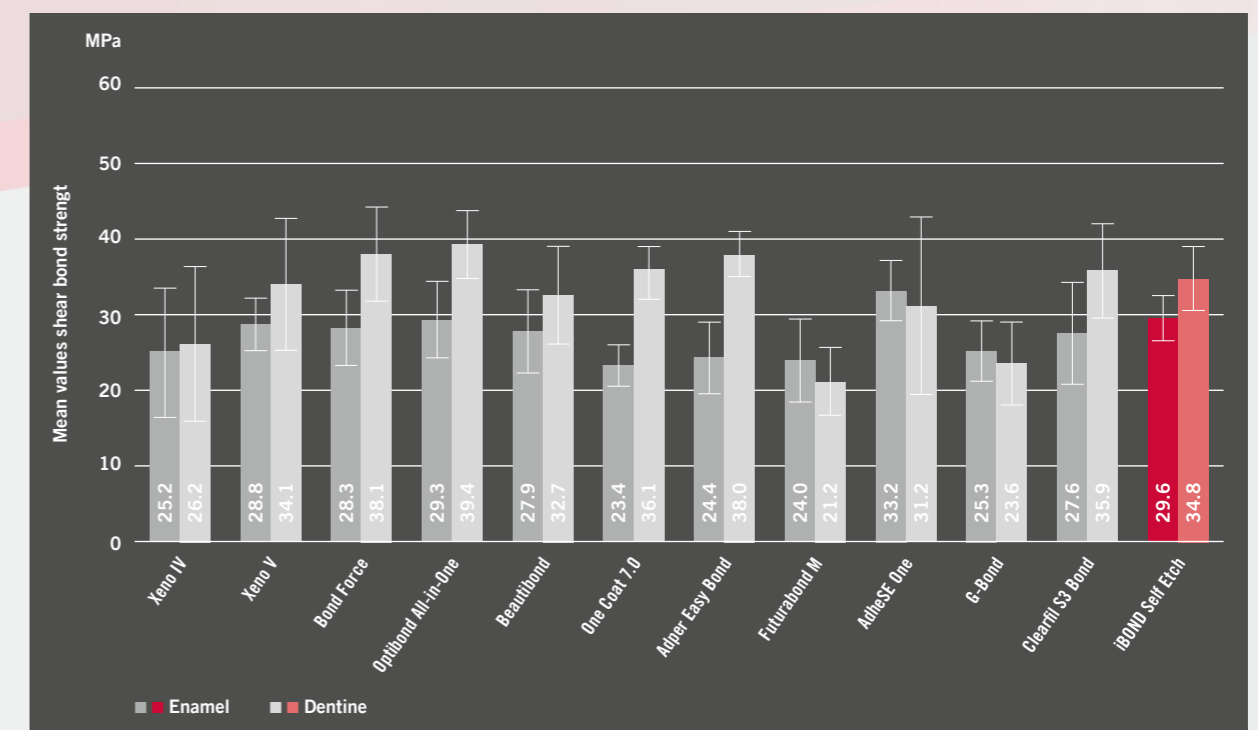
##### Objective

The purpose of this trial was to compare the in vitro shear bond performance of iBOND Self Etch to enamel and dentine with competitor All-in-One adhesives.

#### Materials and Methods

Twelve All-in-One adhesives were tested on adhesion to enamel and dentine surfaces. The materials used were iBOND Self Etch (Heraeus Kulzer), Xeno IV (Dentsply DeTrey), Xeno V (Dentsply DeTrey), BondForce (Tokuyama), Optibond All-in-One (Kerr), BeautiBond (Shofu), One Coat Bond 7.0 (Coltene/Whaledent), Adper Easy Bond (3M Espe), Futurabond M (Voco), AdheSE One (Ivoclar Vivadent), GBond (GC) and Clearfil S3 Bond (Kuraray). Shear bond strength was determined using the Ultradent technique on extracted human permanent teeth (n=8). The composite used for the tests was Venus Diamond (Heraeus Kulzer). Adhesive and composite were cured separately by a Translux Power Blue (Heraeus Kulzer). Following preparation, the specimens were stored for 24 hours in water. The shear strength was determined in a universal testing machine.

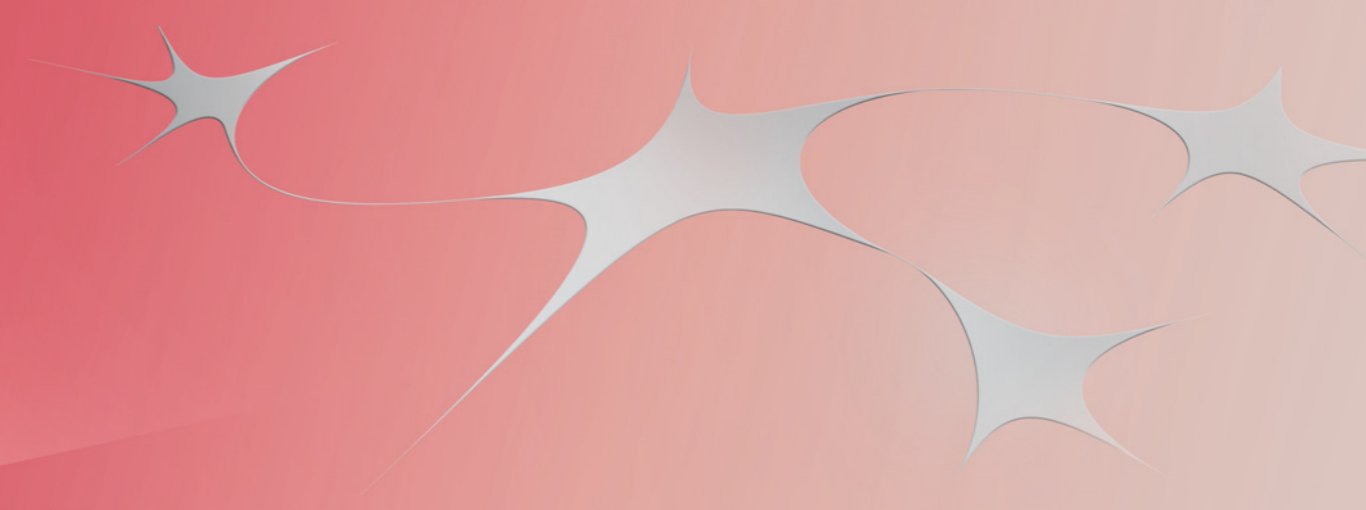
#### Results



#### iBOND Self Etch demonstrates supreme bonding abilities

#### Conclusion

iBOND Self Etch depicts excellent results of shear bond strength to enamel and dentine.



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Hands-on tests

[MPa]

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100  
80  
60  
40  
20  
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## iBOND® Self Etch – Hands-on test

### Evaluation of iBOND® Self Etch under everyday clinical conditions

#### iBOND Self Etch evaluation under everyday conditions

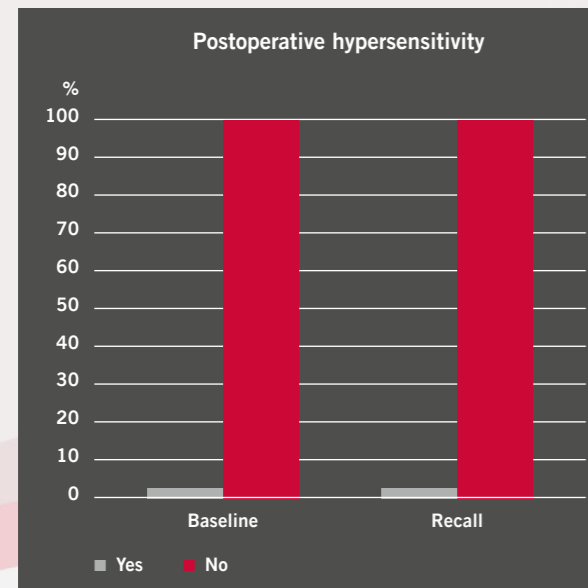
##### Source

Internal data. Data on file

##### Objective

The objective of this hands-on test was to evaluate the clinical performance (marginal quality and postoperative hypersensitivity) of iBOND Self Etch (Heraeus Kulzer) under everyday clinical conditions.

##### Results



#### iBOND Self Etch shows clinically outstanding performance

56 and 66 restorations were evaluated after 2 to 8 weeks (median: 3.5 weeks). Class distribution was: 3 class I, 13 class II, 3 class III, 5 class IV and 29 class V. None of the restorations showed postoperative hypersensitivity or any marginal discolouration directly after placement (baseline) or at recall.

#### Materials and Methods

After product registration (CE mark), iBOND Self Etch was given to 6 dental practitioners (DP). Altogether, 66 restorations in classes I through V were placed with iBOND Self Etch as the adhesive and the DP's preferred composite. iBOND Self Etch was used according to the manufacturer's instruction: apply one coat, agitate for 20 seconds, air blast, and then light cure for 20 seconds. The restorations were evaluated for marginal discolouration and postoperative sensitivity by the DP directly after placement and then again after 2 to 8 weeks. Evaluation criteria were only the answers "yes" or "no" to facilitate integration into the routine of the dental office.

#### Conclusion

Practice-based research can be an adequate tool to evaluate clinical performance of new products under everyday conditions. The results of this test show excellent marginal quality and prevention of postoperative hypersensitivity under clinical conditions. However, evaluation of a larger amount of restorations, and over a longer period of time, is needed.

## Hands-on test

### Europe-wide user test of iBOND® Self Etch

#### iBOND Self Etch hands-on observation

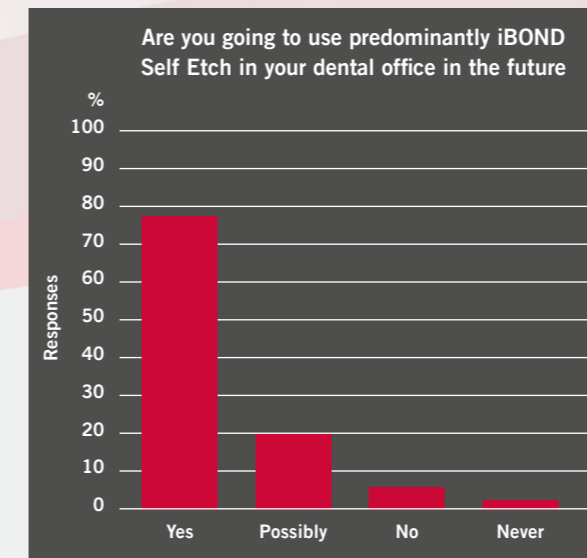
##### Source

Internal data. Data on file

##### Objective

The objective of this test was to evaluate the new iBOND Self Etch adhesive under practical conditions before introduction to the market.

##### Results



#### Dental practitioners are highly pleased using iBOND Self Etch

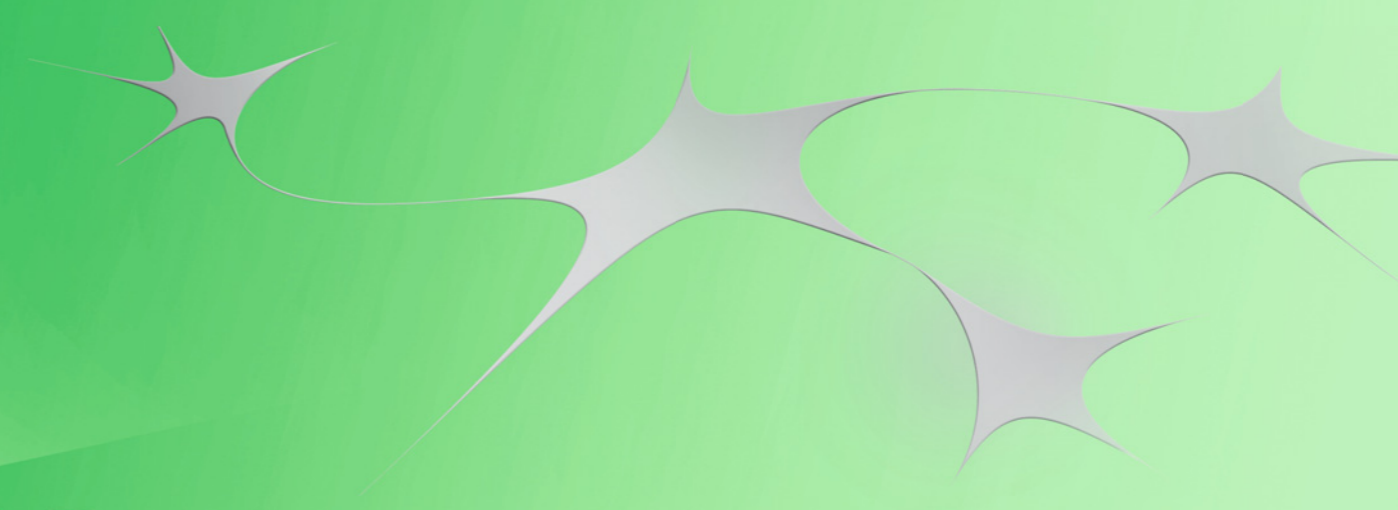
Altogether, 310 completed questionnaires were returned, and a total of 5,950 fillings were prepared using iBOND Self Etch during this user test. Results showed that 75% of the dentists found iBOND Self Etch to be better than the bonding agent(s) they had previously used, and 93% of the participants would recommend it to their colleagues. After the test, 75.6% of the dentists surveyed indicated they would continue to use iBOND Self Etch as the main bonding agent in their practices.

#### Materials and Methods

After product registration (CE mark), iBOND Self Etch (Heraeus Kulzer) was provided to 350 practitioners in Germany, France, Italy, and Great Britain, together with a questionnaire for testing.

#### Conclusion

In almost 6,000 fillings tested under everyday conditions, dentists were overwhelmingly satisfied with the easy handling and fast application of iBOND Self Etch.



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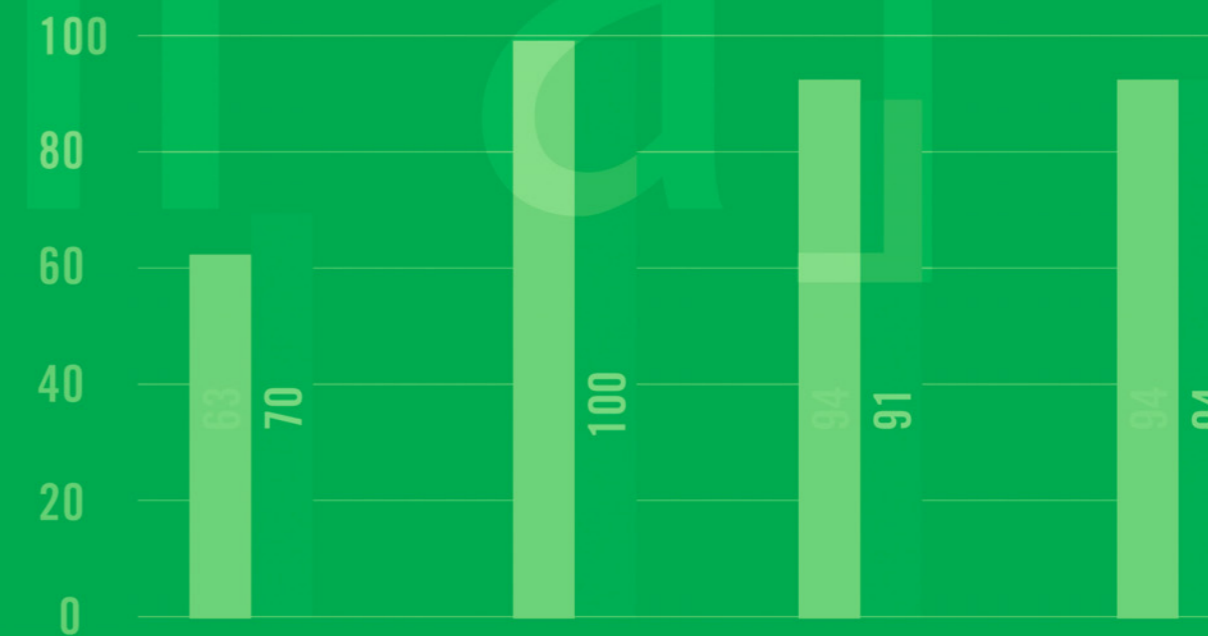
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iBOND® Total Etch

[IMPala]



Study Group	University	Country	Study Type	Title	Results
Prof. A. Cerutti	University of Brescia	Italy	in vivo	Restorations with Venus Diamond Flow and iBOND Total Etch	available, see page 40
Dr. B. Haller	University of Ulm	Germany	in vitro	In vitro evaluation of marginal quality of class II composite restorations with an experimental etch & rinse bonding system	available, see page 44
Dr. G. Ibarra	University of Washington	USA	in vitro	Microleakage of class V composites restored with different dentin adhesives	available, see page 45
Dr. F. Özer	University of Pennsylvania	USA	in vitro	Microtensile bond strengths of some current adhesive systems to intact and carious affected root dentin surfaces	available, see page 46
Dr. M. Miller	Reality Research Lab	USA	in vitro	Shear bond strength of iBOND Total Etch	available, see page 47
Prof. L. Breschi	University of Trieste	Italy	in vitro	Immediate and 6-months bonding effectiveness of different 2-step etch & rinse adhesives	available, see page 49
Prof. R. Perry	Tufts University	USA	in vitro	Bond strength testing of total-etch adhesives on enamel and dentin	available, see page 50
Dr. R. Foxton	King's College London Dental Institute	UK	in vitro	Effect of mechanical loading on the interfacial morphology and microtensile bond strength of class II MOD direct composite restorations	available



# iBOND® Total Etch

## Product description

iBOND Total Etch is a light-curing etch&rinse (2-step) bonding agent that meets all the requirements of a modern 5th generation bonding system. With iBOND Total Etch, priming, bonding and desensitising can be done in one step. Due to the innovative system based on nanofillers, iBOND Total Etch not only attains high bond strengths both on enamel and dentine but also ensures optimal marginal adaptation and is ideal for desensitising hypersensitive areas. These outstanding properties have been verified and confirmed by numerous universities and dental practitioners worldwide. iBOND Total Etch achieved excellent results in comparison with competitive products.

Unlike some competitors' products, iBOND Total Etch is applied in only 1 step after etching and rinsing; the time-consuming rub-in stage is also eliminated. A shiny surface, an indication for effective cross linking of adhesive and tooth surface, is easily attained by air drying. iBOND Total Etch is not blown off the surface due to its enhanced consistency and produces a homogeneous adhesive layer on dentine and enamel, providing the basis for outstanding, durable restorations.

### Composition

iBOND Total Etch is an ethanol based solution of light-activated, adhesive resins. Before using iBOND Total Etch, the dental hard substance is conditioned with an etching gel (etch&rinse).

### iBOND Total Etch contains:

- Methacrylates
- Ethanol
- Fillers
- Photoinitiators
- Glutaraldehyde

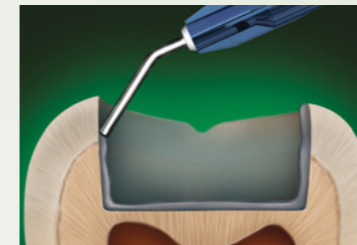
### Indications

- Adhesive fixing of direct composite, Polyglas® and compomer restorations
- Adhesive fixing of indirect laboratory-fabricated ceramic, Polyglas® and composite restorations (inlays, onlays, veneers and crowns)
- Treatment of hypersensitive tooth regions

# Clinical application

## Application of iBOND® Total Etch

### iBOND Total Etch – Step-by-step application



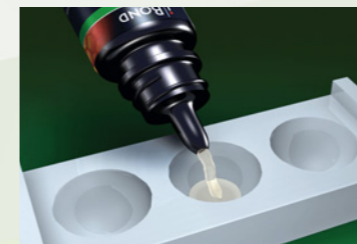
Enamel 20 sec. and dentine 15 sec.



Rinse with water for 20 seconds



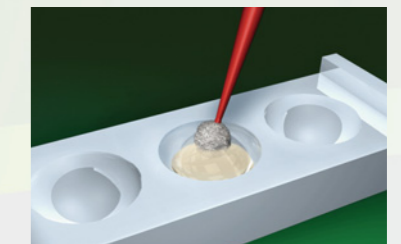
Air dry



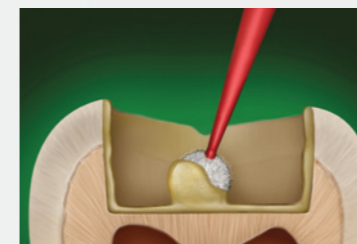
Dispense



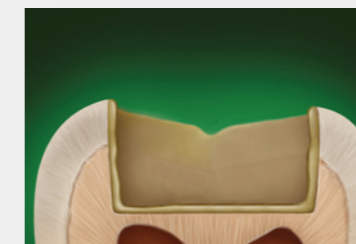
Close immediately



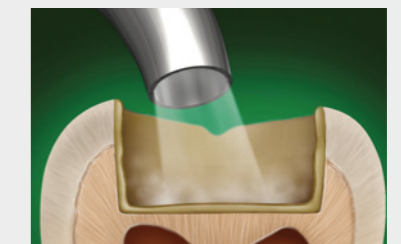
Dip brush



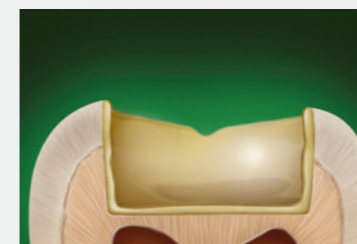
Apply 1 x to enamel, then to dentine



Leave it for 15 sec / dwell time 15 sec.



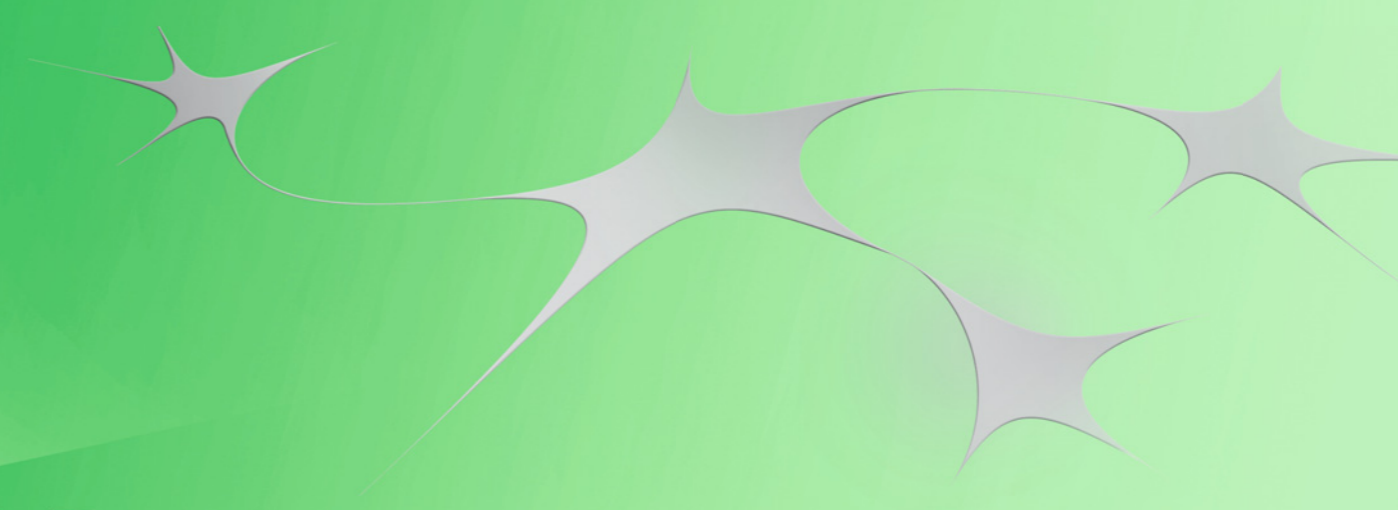
Air dry



Shiny surface (or apply additional coats)



Light cure for 20 sec.



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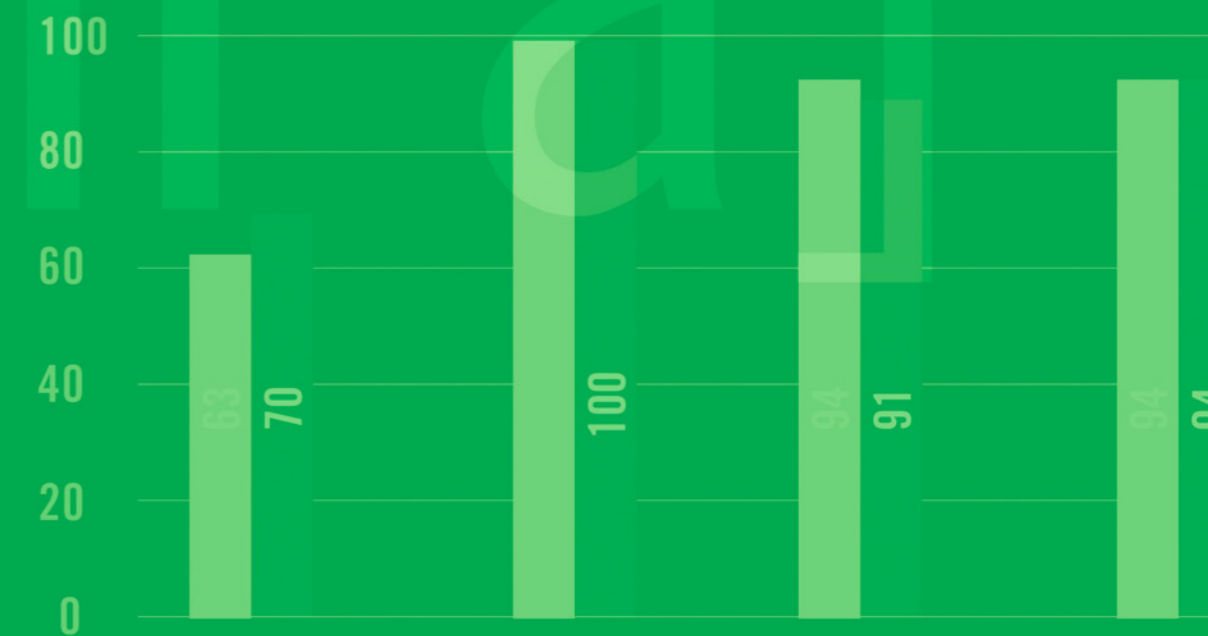
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In vivo studies

[IMP 2a]



## In vivo studies

### First clinical results with iBOND® Total Etch

#### Restorations with Venus Diamond Flow and iBOND Total Etch

##### Source

Antonio Cerutti, University of Brescia, Italy. Report 2010. Data on file.

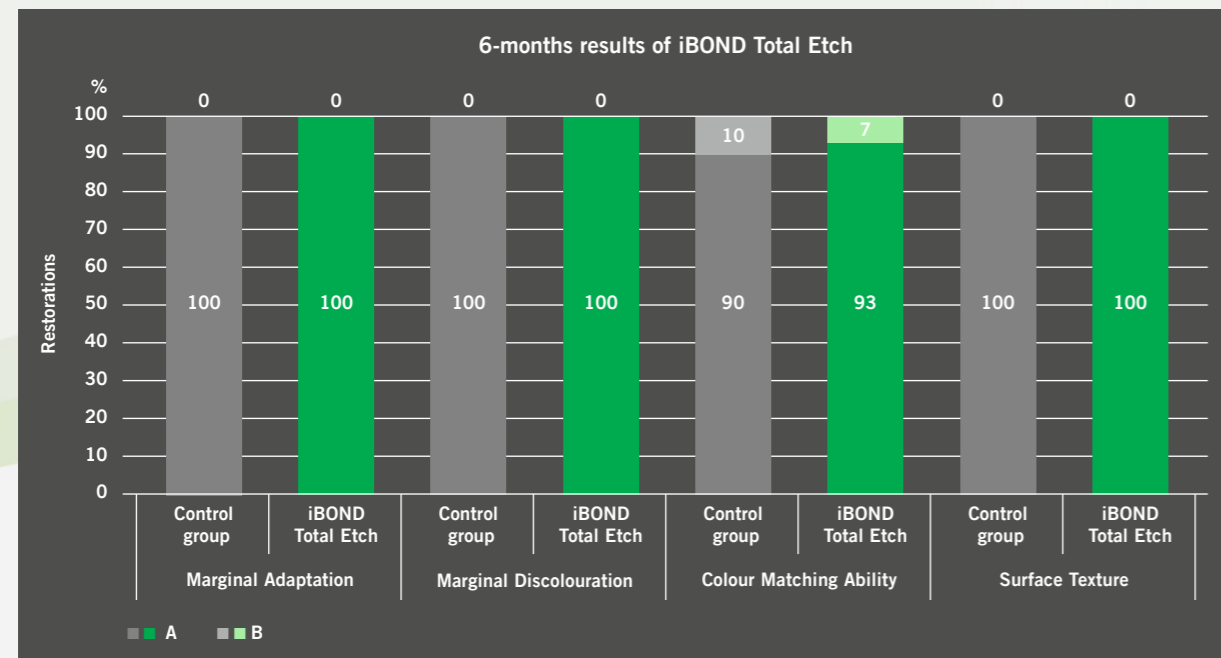
##### Objective

This clinical trial should assess the clinical and aesthetic performance of Venus Diamond Flow and iBOND Total Etch in class V restorations and to compare the results with a control group in a controlled randomised split-mouth study design.

#### Materials and Methods

60 class V restorations were performed by one expert clinician. The used composite and adhesive materials were: Venus Diamond Flow & iBOND Total Etch (Heraeus Kulzer) respectively Tetric EvoFlow & ExciTE (Ivoclar Vivadent) as control group. Both groups were polished with Venus Supra (Heraeus Kulzer). Clinical evaluations were made at baseline and 6 months and will take place also at 1 and 2 years. The evaluated criteria were marginal adaptation, marginal discolouration, anatomical form, secondary caries, colour matching ability, surface texture, fracture of restoration, retention, tooth vitality, pulpitis, post-operative sensitivity to temperature and occlusion and the patient satisfaction. The ratings were A, B, C and D for marginal adaptation, A, B and C for marginal discolouration, anatomical form, surface texture and colour matching ability, whereas A represents optimal and B clinical acceptable results.

#### Results

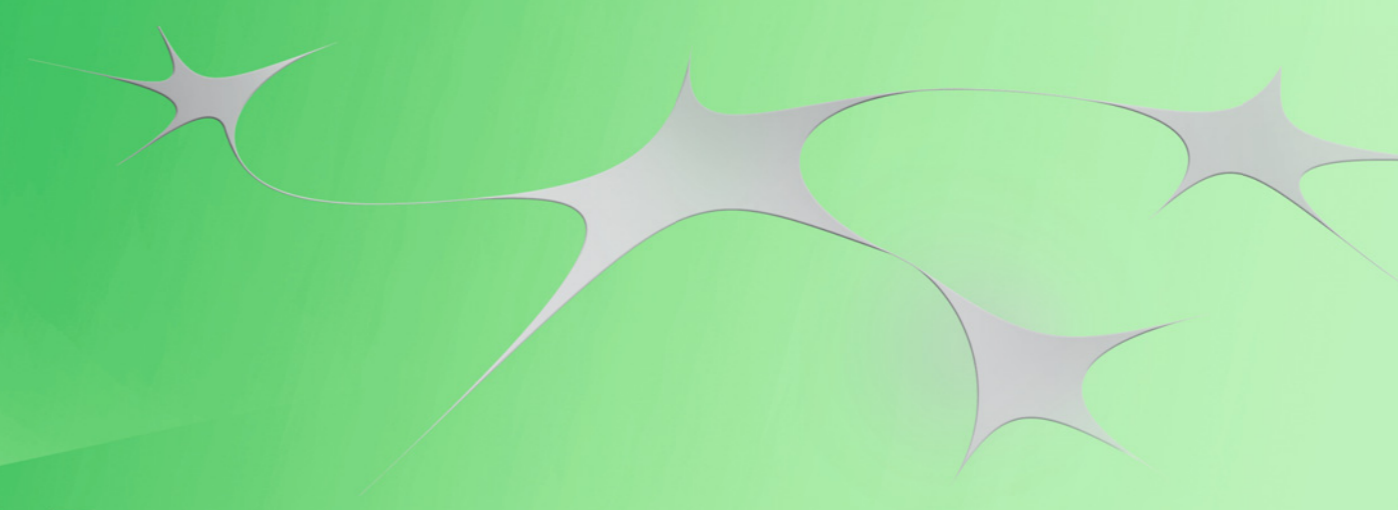


#### iBOND Total Etch works clinically excellent

Every restoration keeps its anatomic form. All study teeth remain caries-free and all fillings are intact. All restorations in both groups were present at the recall. All study teeth are vital and sound. No tooth exhibits post-operative discomfort. The patient satisfaction is in each group 100%.

#### Conclusion

iBOND Total Etch in combination with Venus Diamond Flow performs clinically as good as the control group after 6 months.



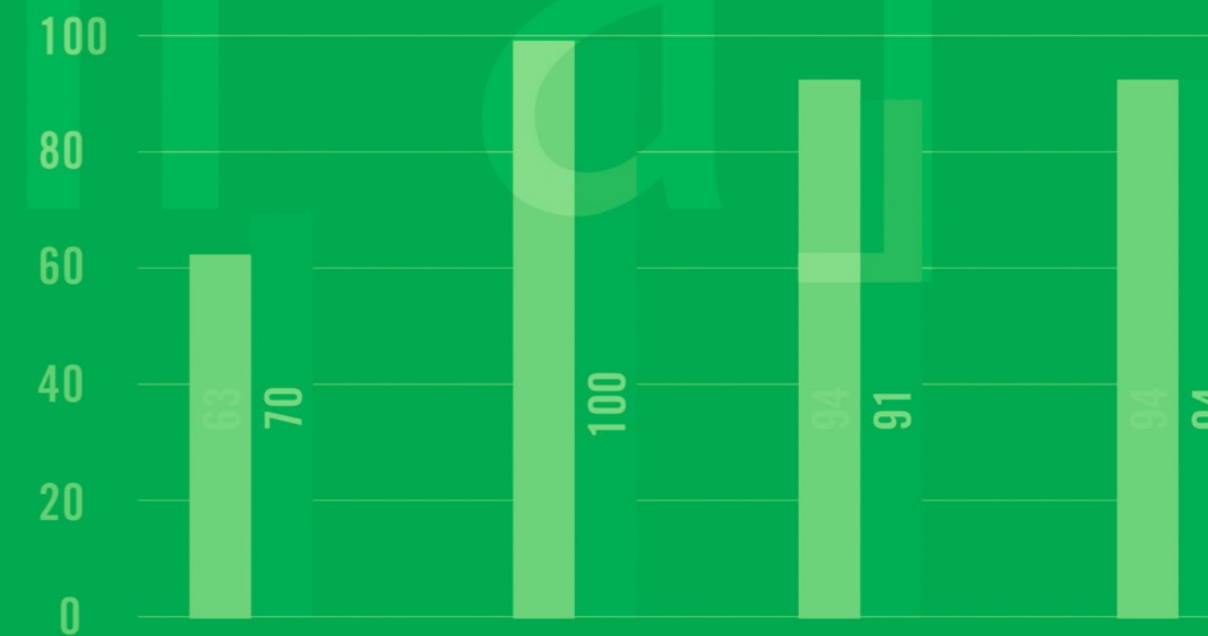
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In vitro studies



[IMP 2a]

## iBOND® Total Etch – In vitro studies

### Dentinal marginal adaptation and dye penetration of different bonding agents in class II cavities

#### In vitro evaluation of marginal adaptation of class II dentine bordered composite restorations using an experimental etch & rinse adhesive

##### Source

B. Haller, A. Rathke, University of Ulm, Department of Operative Dentistry, Ulm, Germany. Test report 2008. Data on file.

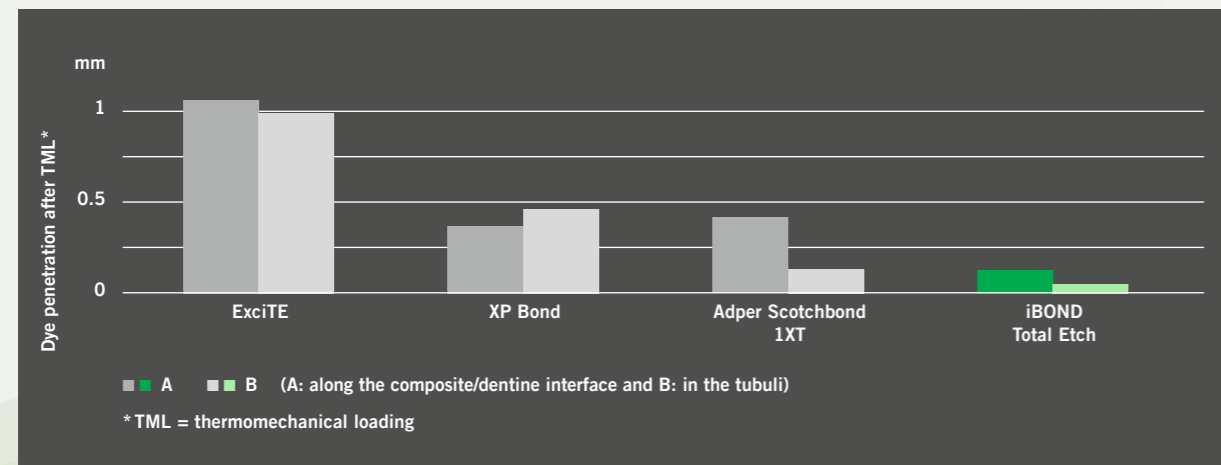
##### Objective

The study was conducted to evaluate marginal adaptation and microleakage of iBOND Total Etch in comparison to different well known etch & rinse 1-Bottle adhesive systems.

#### Materials and Methods

Two class II cavities (cervical margin in dentine) each were prepared in 20 extracted, but caries-free human molars. Cavities were restored incrementally using Venus (Heraeus) composite. The adhesive systems evaluated in this study were: iBOND Total Etch (Heraeus Kulzer), Excite (Ivoclar Vivadent), XP Bond (Dentsply DeTrey) and Adper Scotchbond 1XT (3M Espe). The analysis of marginal adaptation was performed by SEM marginal gap analysis (replica technique) initial after 24 hours storage in water and after thermocycling (1,500x; 5/55°C; 25s) combined with chewing simulation (50,000x; 50N). Analysis of microleakage was performed engaging the dye penetration test (0.5% basic fuchsin solution, 24h, 37°C).

#### Results



#### iBOND Total Etch shows outstanding marginal integrity

Marginal adaptation in enamel was perfect at all tested products. Also in dentine were no significant differences of the marginal adaptation amongst the materials found. Thermocycling showed a significant decrease of marginal adaptation at all adhesives on dentine: iBOND Total Etch (88,6% continuous margin), Excite (87,0%), XP Bond (81,1%) and Adper Scotchbond 1XT (95,8%). There was no significant difference between iBOND Total Etch and the other adhesives. The microleakage was significant superior of iBOND Total Etch performed compared to XPBond and Excite.

#### Conclusion

iBOND Total Etch ends up in nearly 100% perfect enamel margins. The result shows the reliability of iBOND Total Etch. Enamel margins are perfect initially and after thermal and mechanical load application. Further, iBOND Total Etch convinces in sealing of dentine margins. The superb sealing ability together with the incorporated desensitizer seems to be advantageous in terms of the treatment of hypersensitive teeth.

## iBOND® Total Etch – In vitro studies

### Microleakage of total etch adhesive systems

#### Microleakage of class V composites restored with different dentin adhesives

##### Source

G. Ibarra, L. Oppermann, M. Seide, S. Jacker-Guhr and W. Geurtsen, University of Washington, Seattle, USA and Hannover Medical School, Germany, J Dent Res 89 (Spec Iss B): 638, 2010

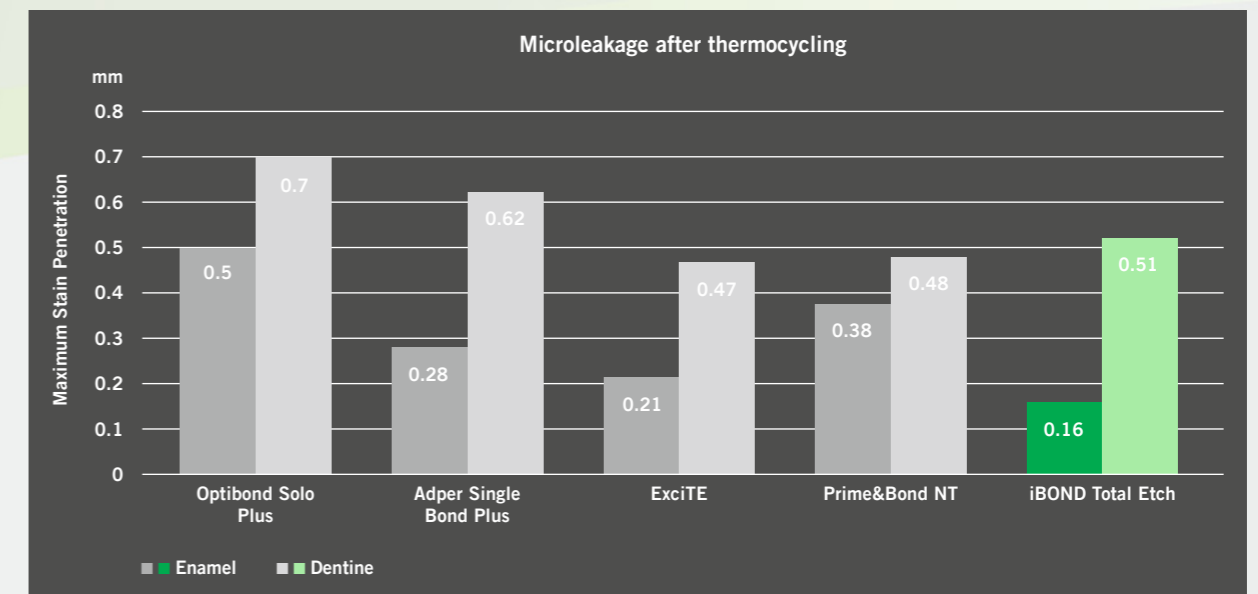
##### Objective

The aim of this study was to analyse microleakage of class V composite restorations with enamel and dentine margins using different 2-step total-etch adhesive systems.

#### Materials and Methods

Class V cavities, with mixed margins, were prepared in extracted human molars (n=8) and etched with phosphoric acid (GLUMA Etch 35 Gel, Heraeus Kulzer). Five dentine adhesives iBOND Total Etch (Heraeus Kulzer), Optibond Solo Plus (Kerr), Adper Single Bond Plus (3M ESPE), Excite (Ivoclar-Vivadent) and Prime&Bond NT (Dentsply) were applied followed by Venus (Heraeus Kulzer) restorations. After 60 hours storage in artificial saliva, all samples were thermocycled (2,000 cycles, 5/55°C), subsequently stored in 50 wt% ammoniacal silver nitrate for 4 hours and immersed in developer solution for 12 hours under light irradiation. Teeth were sectioned vertically. Microleakage was evaluated by measuring total stain penetration into dentine and enamel using a stereomicroscope at 40x. Data were statistically analyzed (one-way-ANOVA, paired t,  $\alpha=0.05$ ).

#### Results



#### Marginal sealing of iBOND Total Etch is excellent

No statistically significant differences in dye penetration were found among adhesive groups in dentine ( $p = 0.27$ ), but there was a significant difference in enamel between iBOND Total Etch and Optibond Solo Plus ( $p=0.03$ ). In addition, iBOND Total Etch, Adper Single Bond Plus and Excite showed a significantly lower penetration depth in enamel than in dentine ( $p=0.01;0.03;0.01$ ).

#### Conclusion

The marginal sealing of iBOND Total Etch at the enamel and dentine was outstanding. There is a significant difference for enamel microleakage among the products. The dentine marginal sealing was not significantly different for all products.

## iBOND® Total Etch – In vitro studies

Bond strength comparison of different adhesives on decalcified root dentine

### Microtensile bond strengths of some current adhesive systems to intact and caries affected root dentin surfaces

#### Source

F. Özer  
University of Pennsylvania, Philadelphia, USA, Test report, November 2010. Data on file.

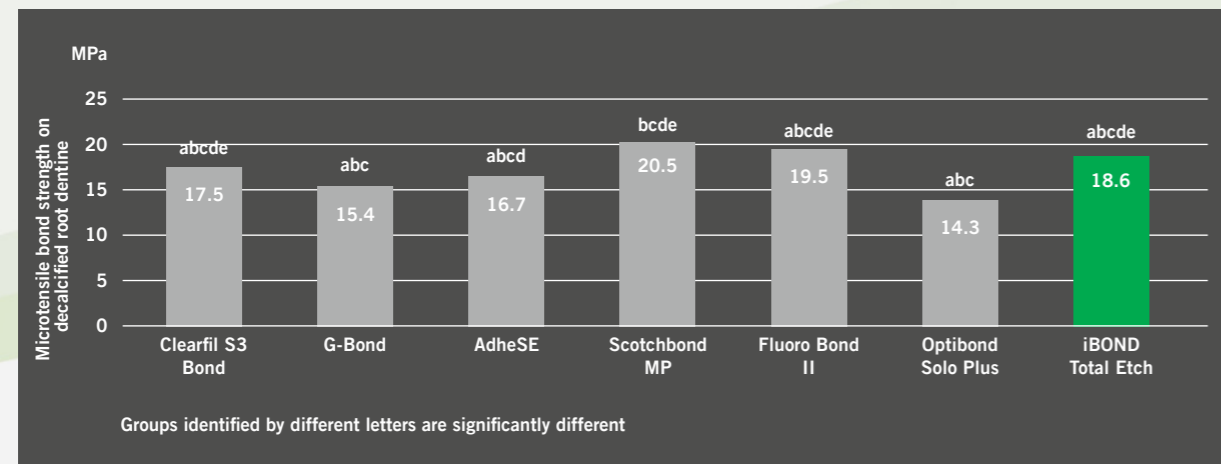
#### Objective

The purpose of this study was to compare the microtensile bond strength of different new and established adhesive bonding systems on root dentine and to evaluate the adhesive-dentine interfaces using a Scanning Electron Microscopy (SEM).

### Materials and Methods

Intact extracted human incisors were used for all specimens. Teeth were randomly divided into two groups (intact and decalcified). Each group included 56 teeth. The roots for the decalcified group were placed in a demineralization solution (pH 4.4) to produce artificial carious lesions in root dentine. Root dentine surfaces were ground prior application of one of eight adhesive systems: iBOND Total Etch (Heraeus Kulzer), Clearfil S3 Bond (Kuraray), G-Bond (GC), AdheSe (Ivoclar-Vivadent), Scotch Bond Multi Purpose (3M ESPE), Fluoro Bond II (Shofu), Opti Bond Solo Plus (Kerr). Composite cylinders were placed onto the bonding surfaces. After storage in distilled water, thermocycling (2,000 cycles) was performed. The specimens were sectioned into 1 mm thick slabs. Two slabs from each bonding system were used for SEM analysis. The slabs were subjected to microtensile testing. SEM observations were done.

### Results



### iBOND Total Etch displays good results on decalcified root dentine

iBOND Total Etch, Clearfil S3 Bond and G-Bond showed same bond strengths to both intact and decalcified dentinal root surfaces. The bond strengths of AdheSE were dramatically decreased after decalcification of root surfaces. The bond strengths of all bonding groups to decalcified root dentin surfaces were not statistically different from each other.

### Conclusion

iBOND Total Etch shows comparable high bond strength to intact and decalcified dentine root surfaces. iBOND Total Etch reveals no decrease in bond strength between intact and decalcified root dentine like some of the other tested adhesives. Hybrid layer quality and thickness are the same on intact and decalcified dentine in the iBOND Total Etch group.

## iBOND® Total Etch – In vitro studies

Comparison of two total etch adhesives with one All-in-One adhesive

### Test of shear bond strength on enamel and dentine

#### Source

M. Miller, Reality Research Lab, USA, Test report, September 2009. Data on file.

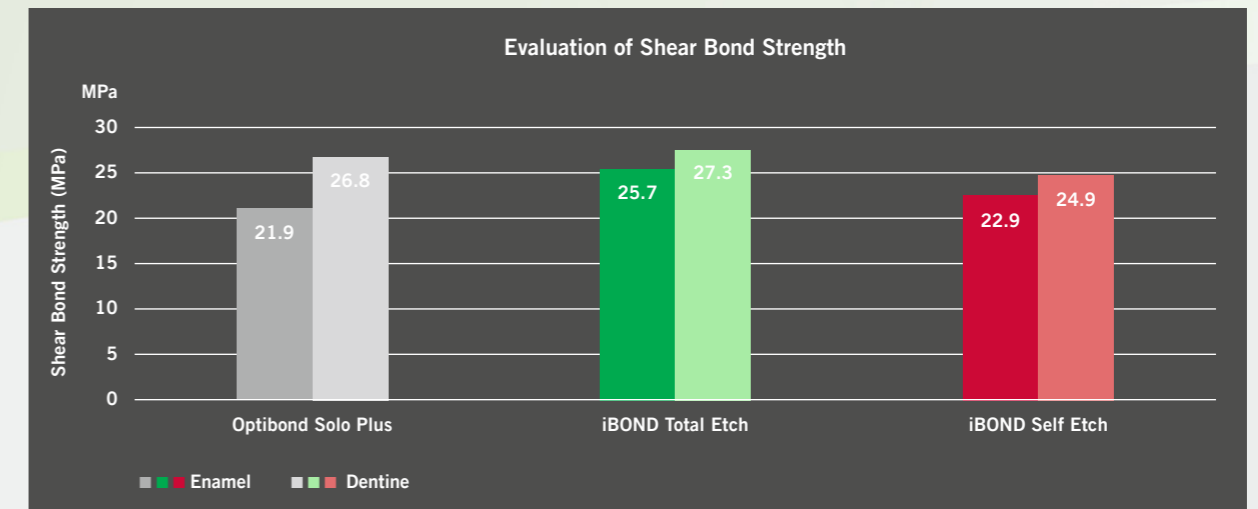
#### Objective

Aim of the study was to compare the shear bond strength of the new adhesive iBOND Total Etch to the total-etch product OptiBond Solo Plus and to the All-in-One adhesive iBOND Self Etch.

### Materials and Methods

10 specimens of human enamel and 10 of human dentine were utilised to test the shear bond strength of iBOND Total Etch, iBOND Self Etch (both Heraeus Kulzer), and Opti-Bond Solo Plus (Kerr). iBOND Total Etch was used on wet specimens after phosphoric acid etching, iBOND Self Etch was used on dry specimens after cleaning and OptiBond Solo Plus was applied on moist specimens after phosphoric acid etching. All adhesives were used as per manufacturer's instructions. Venus Diamond A2 was the restorative material and Optilux 501 (Kerr) was used for polymerisation. Bond strengths were determined immediately after light curing.

### Results



### iBOND Total Etch and iBOND Self Etch reveal outstanding bonding abilities

### Conclusion

iBOND Total Etch exhibits the highest bond strength values whereas the All-in-One adhesive iBOND Self Etch convinces also compared to the two total etch systems. iBOND Total Etch is an excellent 1-component total-etch bonding agent when used on wet enamel or dentine.

## iBOND® Total Etch – In vitro studies

### Shear bond strength using total-etch-technique

#### Shear bond strength test on enamel and dentine

##### Source

Research & Development, Heraeus Kulzer GmbH Wehrheim, Germany, Test Report. Data on file.

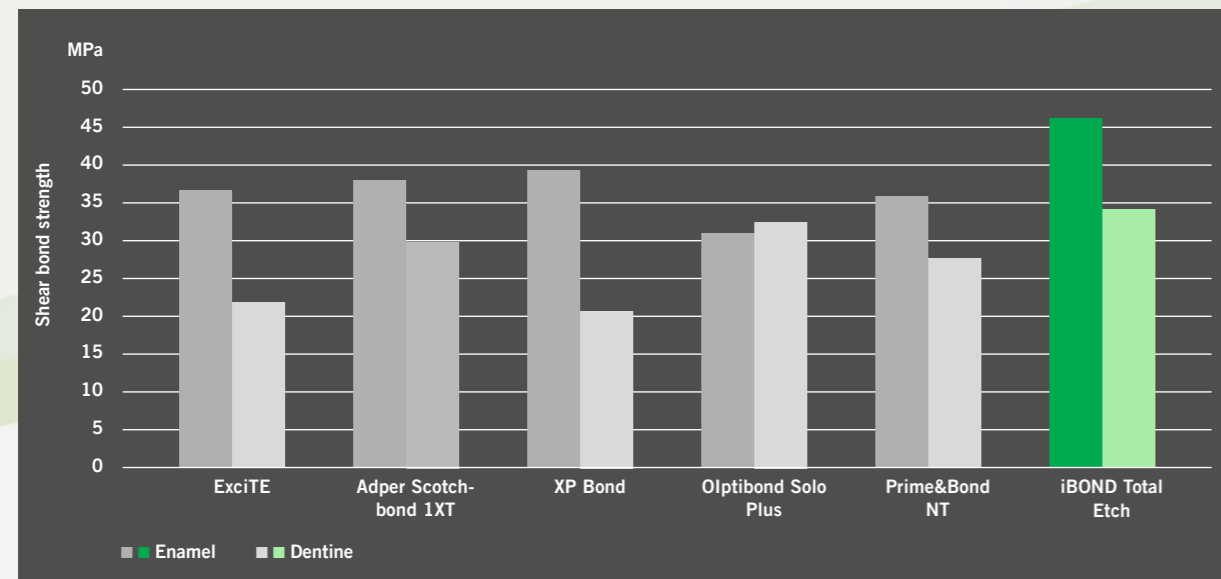
##### Objective

The aim of this in vitro study was to evaluate the shear bond strength on enamel and dentine of 1-bottle etch & rinse adhesives.

#### Materials and Methods

Six etch & rinse 1-bottle adhesives were tested on adhesion to enamel and dentine surface. The materials used were iBOND Total Etch (Heraeus Kulzer), Excite (Ivoclar Vivadent), Adper Scotchbond 1XT (3M Espe), XP Bond (Dentsply DeTrey), Optibond Solo Plus (Kerr) and Prime & Bond NT (Dentsply DeTrey). All adhesives were applied to prepared (grit 320) tooth surfaces as per manufacturer's instructions. Shear bond strength was determined using the Ultradent technique on extracted human permanent teeth (n=8). The used composite was Venus Diamond (Heraeus Kulzer). Adhesive and composite were cured separately by a Translux Power Blue (Heraeus Kulzer). Following preparation, the specimens were stored for 24 hours at 37 °C. The shear strength was determined in a universal testing machine.

#### Results



iBOND Total Etch depicts highest bond strength in this test

#### Conclusion

iBOND Total Etch presents the highest bond strength on enamel and dentine amongst the evaluated adhesives.

## iBOND® Total Etch – In vitro studies

### Long-term bond strength of different 2-step etch-and-rinse adhesives

#### Immediate and 6-month bonding effectiveness of different two-step etch-and-rinse adhesives

##### Source

Navarra CO, Mazzoni A, Di Lenarda R, Cadenaro M, Breschi L. University of Trieste, Italy, J Dent Res 89 (Spec Iss B), abstract 1346, 2010.

##### Objectives

Evaluation of the bond strength of different 2-step etch and-rinse adhesives after 6 months of storage.

#### Materials and Methods

42 human molars were cut to expose dentine and assigned to the tested adhesives (N=14) applied after etching as per manufacturers' instructions. The evaluated adhesives were iBOND Total Etch (Heraeus Kulzer), Optibond Solo Plus (Kerr), Prime&Bond NT (Dentsply). Specimen were prepared for microtensile bond strength test and pulled to failure either after 24h or 6 months of storage in artificial saliva at 37 °C. Data were analyzed by two-way ANOVA (statistical significance was set at 5%) and Tukey's post-hoc.

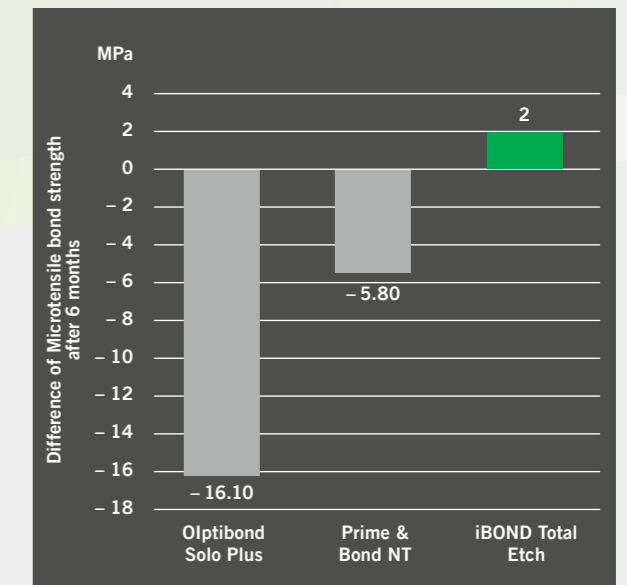
#### Results

Microtensile bond strength of the tested adhesive after 6 months	
iBOND Total Etch (a)	37.8
Optibond Solo Plus (a, c)	34.5
Prime & Bond NT (c)	27.2

Different superscript letters indicate statistical differences (p < 0.05)

#### iBOND Total Etch reveals excellent bonding stability after 6 months

The bond strength of iBOND Total Etch is 35.8±10.01 at baseline and 37.8±11.1 after 6 months. Optibond Solo Plus shows 50.4±11.3 at baseline and 34.3±11 after 6 months. Prime & Bond NT exhibits 33.0±10.3 and 27.2±10.3 after 6 months storage. Optibond Solo Plus expresses a significant decrease in bond strength whereas iBOND Total etch and Prime & Bond NT have similar bond strength values at baseline and remain stable after the 6 months of storage.



#### Conclusion

All evaluated etch-and-rinse adhesives show favourable immediate bond strength values, although after 6 months of storage in artificial saliva not all the tested adhesives report stability in the mechanical properties of the adhesive interface.

iBOND Total Etch exhibits excellent bonding even after long-term storage. Stable bonding abilities are important to maintain a strong connection between tooth and composite in order to achieve durable restorations.

## iBOND® Total Etch – In vitro studies

### Bond strength testing of total-etch adhesives after thermocycling

#### Bond strength testing of total-etch adhesives on enamel and dentin

##### Source

Perry R, Kugel K, Finkelman M, and Kugel G. Tufts University, Boston, MA, USA, J Dent Res 89 (Spec Iss A): 790, 2010

##### Objectives

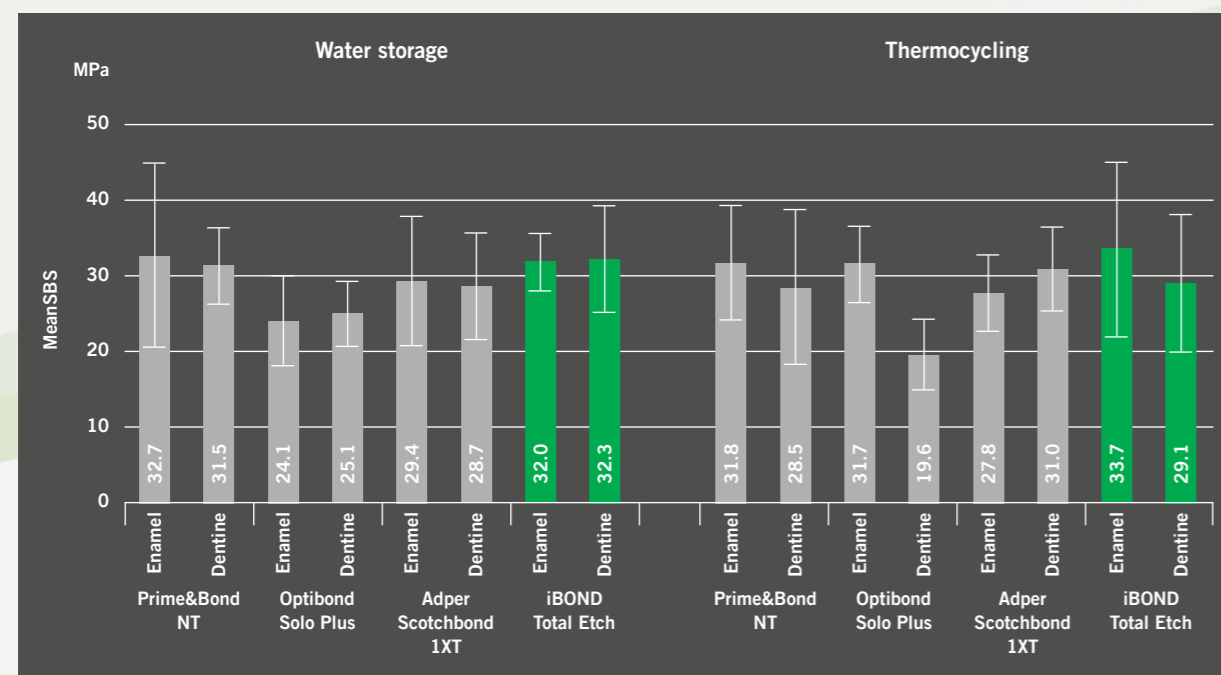
Comparison of shear bond strength of 4 total-etch adhesive systems on enamel and dentine after 24 hours and 10,000 cycles of thermal stress.

#### Materials and Methods

128 human molars were randomly divided into 16 groups. Flat enamel and dentine surfaces were prepared using SiC paper. iBOND Total Etch (Heraeus Kulzer), Adper Scotchbond 1XT (3M ESPE), Optibond Solo Plus (Kerr) and Prime&Bond NT (Dentsply) were applied according to directions for use and light cured.

Venus Diamond composite (Shade A2, Heraeus Kulzer) was filled in cylindrical plastic molds (Ultradent equipment) and cured for 20s. Light-activation was done with a Translux Power Blue curing unit (Heraeus Kulzer). Shear bond strength of specimens was determined after 24h storage in water at 37°C and after additional thermocycling (10,000 cycles, 5/55°C). Statistical analysis was performed by three-way ANOVA, with post-hoc analysis conducted via Tukey's HSD.

#### Results



iBOND Total Etch demonstrates excellent bond strength

#### Conclusion

Significant differences are found only between different adhesive systems ( $p=0.003$ ): iBOND Total Etch ( $p=0.004$ ) and Prime&Bond NT ( $p=0.013$ ) show higher shear bond strength than Optibond Solo Plus. The substrate (dentine or

enamel) and also thermocycling reveals no significant differences ( $p>0.05$ ). iBOND Total Etch exhibits excellent shear bond strength values which even remain stable after thermocycling. This stability is a crucial aspect for the longevity of restorations.

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#### Notes:

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