

**kuraray**

*Noritake*

**CLEARFIL™**  
**Universal Bond Quick**

**TECHNICAL INFORMATION**



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## INTRODUCTION

It's been 38 years since Kuraray introduced the total-etch adhesive system: CLEARFIL™ BOND SYSTEM F. Now, following extensive research and development into new adhesion technologies, Kuraray Noritake Dental has developed CLEARFIL™ Universal Bond Quick: the single layer, single application adhesive system that penetrates dentine immediately delivering predictable, lasting and consistent results.

This technical information guide provides an insight into the technologies behind our new adhesive along with R&D results and evaluations carried out by the scientific community.

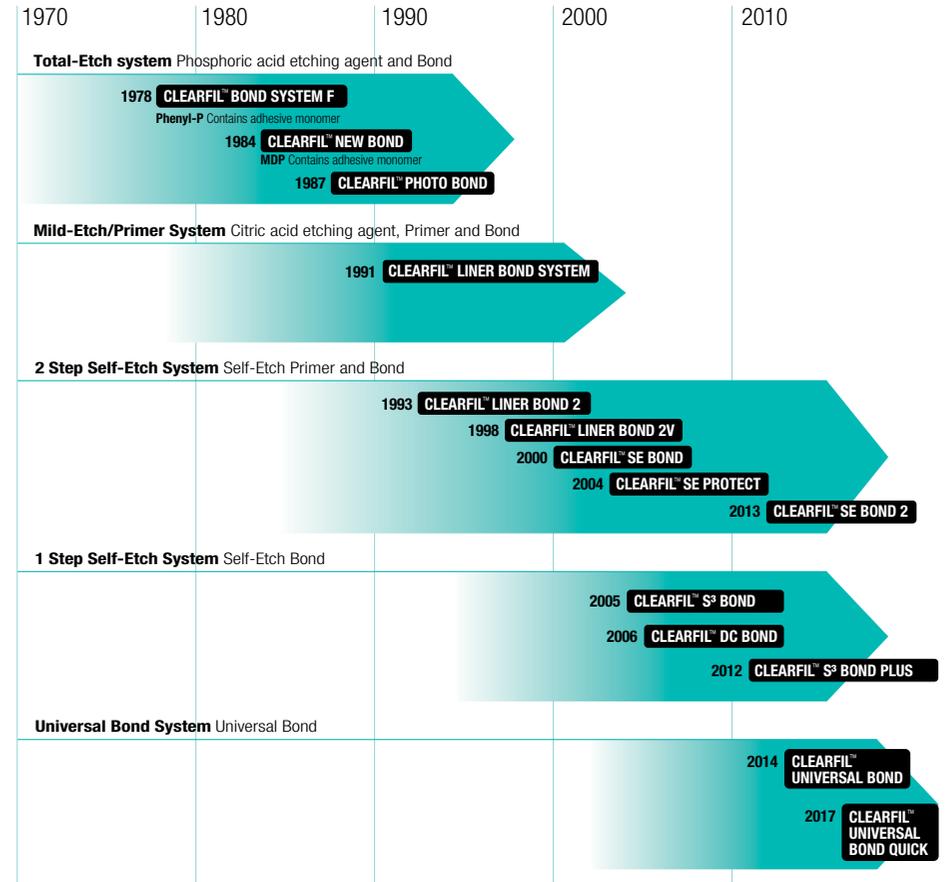


## HISTORY OF OUR ADHESIVE TECHNOLOGY

Kuraray founded its dental business in Japan in the early 70s. Our first product was the GK-101 system, which selectively removed carious tooth structure without pain, using a chemical solution. At that time, we started to establish our first adhesive and composite which were designed to adhere to tooth tissue directly, enabling a minimally invasive approach.

The development of functional monomer technologies was central to the launch of our first adhesive system where the connection between the adhesive and hydroxyapatite was made on a molecular level. Several more years of development led to the invention of the phosphate ester monomer: Phenyl-P.

Phenyl-P wasn't the only technology needed to bond to enamel and dentine; good polymerization is also an essential factor in adhesion. Unfortunately the conventional BPO/amine polymerization initiator system wasn't compatible with the acidic functional monomer Phenyl-P due to the acidic monomer neutralizing the effectiveness of the amine. After testing several variations, one extra initiator was selected. Tertiary polymerization initiator (a salt of aromatic sulfinic acid) was added to the mix. With this tertiary polymerization initiator, the BPO/amine polymerization initiator system worked to cure the adhesive. Together these curing technologies and functional monomer Phenyl-P formed the first installment of technologies in our adhesive products making it possible to launch the total-etch adhesive system: CLEARFIL™ BOND SYSTEM F.



A brief history of the development of bonding materials by Kuraray Noritake Dental

## ADVANCEMENTS IN FUNCTIONAL MONOMER RESEARCH

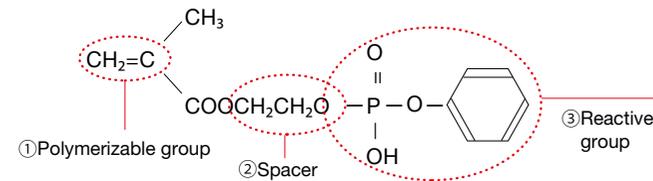
After the success of CLEARFIL™ BOND SYSTEM F, a new R&D goal was set: to develop a monomer that performed better than Phenyl-P, making it possible to achieve higher bond strengths and as a result, long lasting composite restorations. To begin with, the chemical composition of Phenyl-P was analysed in depth. Each of the three main parts of this functional monomer (the polymerizable group, spacer and reactive group) were then studied in detail (see Fig. 1). One study involved variations in the length of the spacer while the other components remained the same. The results showed the length of the spacer was clearly influencing the bond strength to human dentine and Ni-Cr alloy.

A similar test was carried out by varying the reactive group (see Fig. 2. and Fig. 3.). These researchers gave valuable insights into the composition of the ideal functional monomer. The results from our countless tests were as follows:

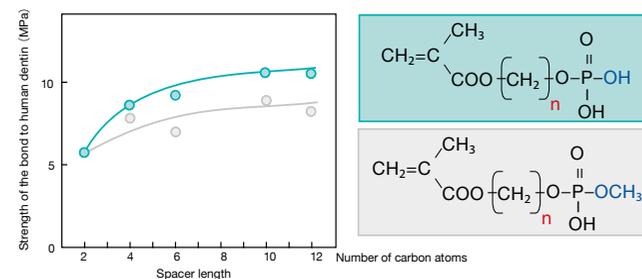
- \* The spacer must be a hydrophobic group with 4 or more carbon atoms.
- \* The reactive group must be a divalent phosphate group.
- \* There must be a radical polymerizable group.

Figure 4 shows the order of the possible reactive groups, both for bonding to dentine and Ni-Cr-alloy. (Fig.4)

Applying these lessons to hundreds of functional monomer variations led to the development of a functional monomer still in use today: Methacryloyloxydecyl Dihydrogen Phosphate (MDP). We like to call it 'The Original MDP Monomer' (Fig. 5).

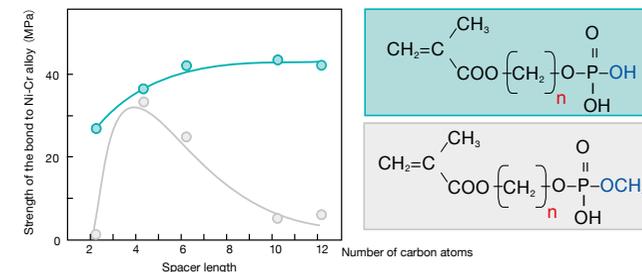


**Fig. 1 The chemical structure of adhesive monomer (Phenyl-P)**



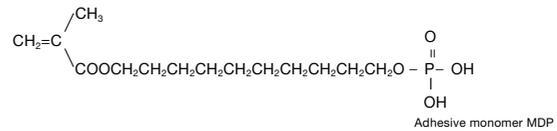
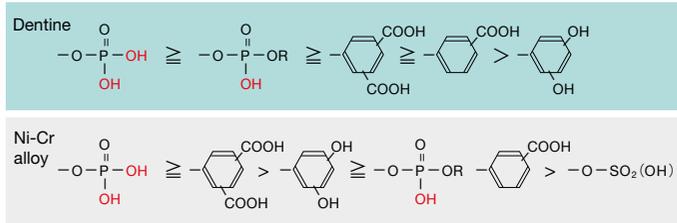
**Fig. 2 Optimizing the chemical structure of the adhesive monomer**

### Effect on the bond strength to Ni-Cr alloy

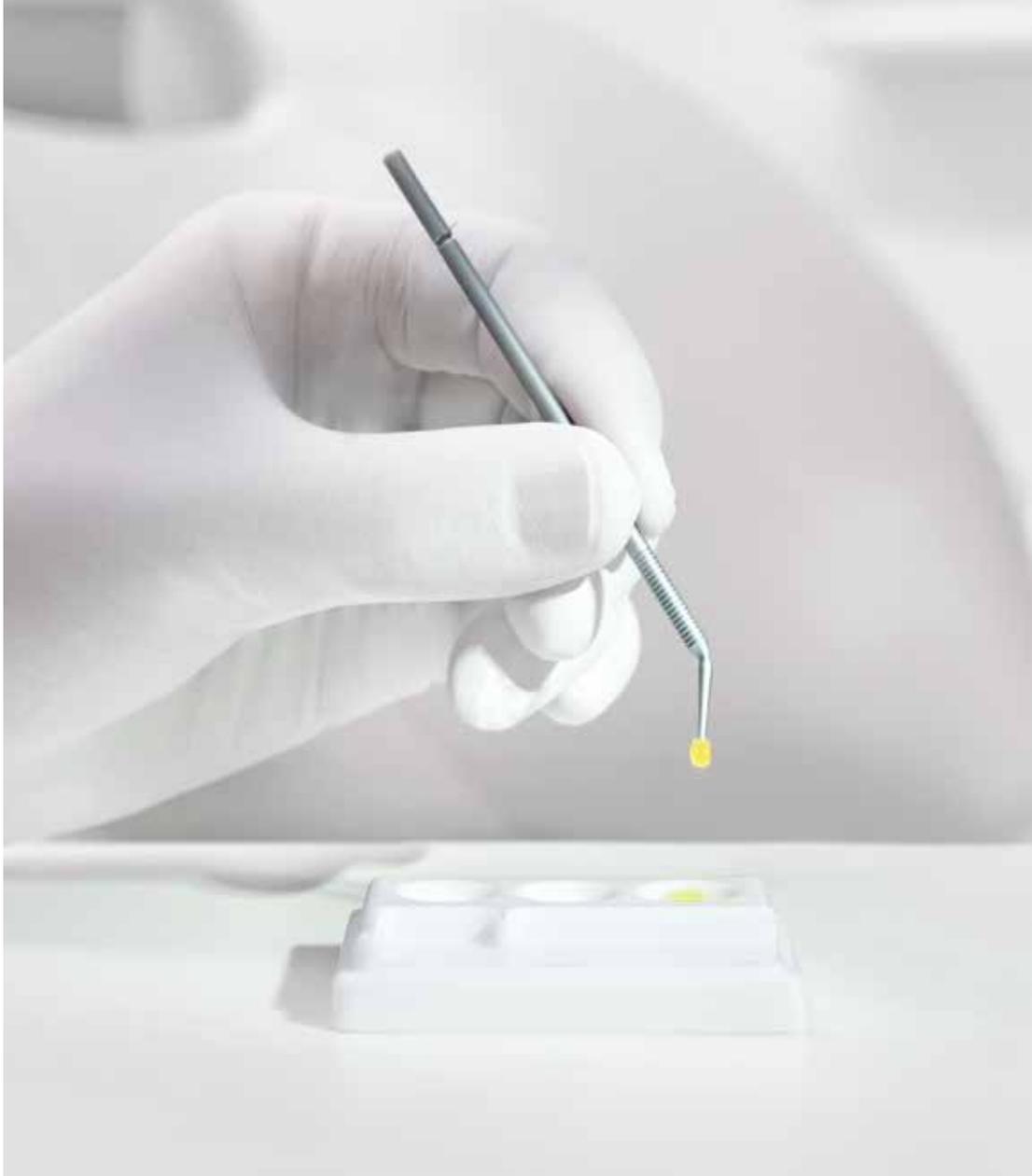


**Fig. 3 Optimizing the chemical structure of the adhesive monomer**

### The chemical structure of the reactive group



**Fig. 4 Optimizing the chemical composition of an adhesive monomer**



## THE ORIGINAL MDP MONOMER: THE SECRET BEHIND CLEARFIL™ AND PANAVIA™ PERFORMANCE

Kuraray applied a patent\* on The Original MDP Monomer in 1981. It was used in the first resin cement PANAVIA™ EX (launched in 1983). The Original MDP Monomer in PANAVIA™ connected the cement to both hydroxyapatite and metals at the same time. The Original MDP Monomer is the secret behind the global success of PANAVIA™ and has been used in all CLEARFIL™ adhesives and PANAVIA™ cements ever since.

Over time, it became clear that The Original MDP Monomer also bonded to metal oxides like zirconia and alumina, making it an exceptionally versatile functional monomer. As a result it delivered a strong bond to tooth structures (e.g. dentine, enamel), metals (e.g. gold alloy, silver alloy, titanium, Ni-Cr alloy), metal oxides (e.g. zirconia, alumina) and composite resins that include inorganic fillers.

All of this is due to its unique structural formula: a polymerization group, a dihydrogen phosphate group and a long carbon chain spacer. However, what does the science say? The solubility of the calcium salt of the adhesive monomer has been studied extensively. Lower solubility in water indicates that a highly stable chemical bond is formed with the hydroxyapatite surface. Studies conducted using atomic absorption spectroscopy have demonstrated major differences between the adhesive monomers, with The Original MDP Monomer outperforming others<sup>1</sup>. The soluble stability of the calcium salt of The Original MDP Monomer (6.79 mg/L) is about 200 times greater than that of the 4-MET monomer (1.36 g/L). The calcium salt created from The Original MDP Monomer is thus hardly soluble in water and highly effective in chemically bonding to dentine and enamel.

1) Yoshida et al., J Dent Res 83, 2004

\* JP-A-Sho-58-21607  
JP-A-Sho-58-21687  
US4539382(A)  
US4612384(A)  
US4650847(A)

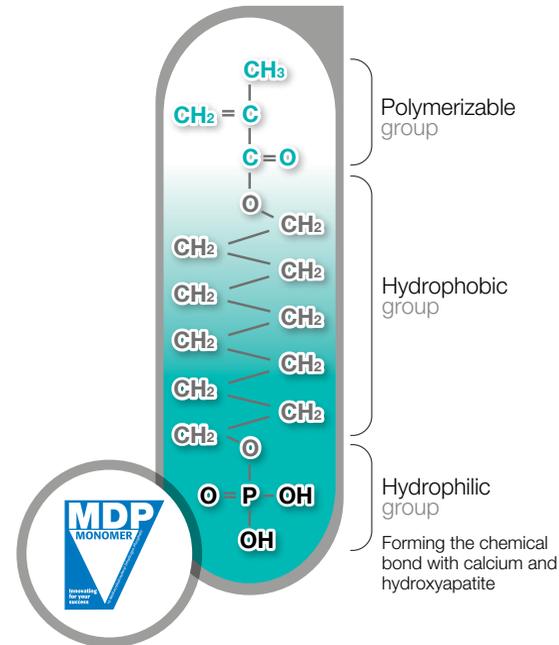


Fig. 5 The structure of The Original MDP Monomer

Other manufacturers have started using MDP in their adhesive products. However it is one of the most difficult ingredients to produce, as incorporating the adhesive elements is a complicated process. In recent years research has shown the remarkable effect of purity and impurity of different MDP solutions<sup>2</sup>. This study, conducted with three different MDP monomers provided by three different manufacturers, revealed that MDP produced by Kuraray Noritake Dental was of a higher purity and demonstrated superior hydrolytic stability. In addition, adhesives containing The Original MDP Monomer resulted in significantly higher bond strengths. (see Fig. 6).

Kuraray Noritake Dental has more than 30 years of experience in the use of The Original MDP Monomer which is why it's a key component of CLEARFIL™ Universal Bond Quick.

2) Yoshihara et al., Adhes Dent Vol. 33 No. 4 2015

#### Micro-tensile bond strength to dentine with experimental adhesives with MDP\*

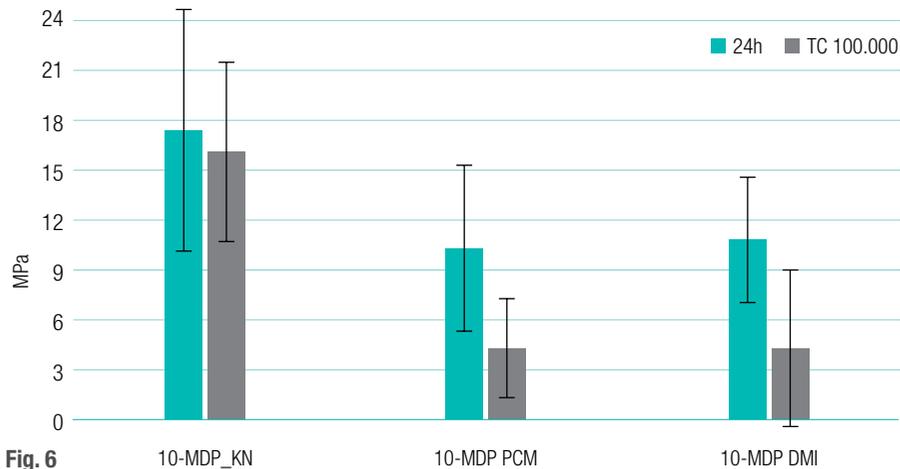


Fig. 6

\* The experimental adhesives were prepared consisting of 15 % wt. 10-MDP functional monomer provided by three different sources: KN (Kuraray Noritake Dental Inc.), PCM (PCM Products GmbH) and DMI (Designer Molecules, Inc.). The experimental primer was applied for 20s followed by gently air-drying, after which the bonding agent of CLEARFIL™ SE BOND was applied, and subsequently air-thinned and light-cured.

#### To summarize the benefits of The Original MDP Monomer

- Its high chemical bonding capacity to hydroxyapatite results in good adhesion to the enamel, without the use of a phosphoric acid etching agent.
- MDP is mildly acidic, enabling The Original MDP Monomer an opportunity to bond to the remaining hydroxyapatite in the dentine.
- Its chemical structure contains a unique hydrophobic, long carbon chain and a hydrophilic phosphate group, which allows for easy penetration into dentine, due to its superior surface-active property.
- A chemical bond with hydroxyapatite is established quickly. A stable adhesive bond is created directly during clinical application.
- The solubility of the calcium salt that is formed is extremely low. This significantly improves the long-term adhesive effect to enamel and dentine.
- The Original MDP Monomer has excellent adhesion durability to both enamel and dentine, as well as to metals, metal oxides and composites.

## ADHESIVE DENTISTRY STARTED WITH TOTAL-ETCH

Modern adhesives are developing at a frenetic pace. Today they are easier to use, versatile and stronger than ever before. Across the world, research institutions including our own have developed bonding systems to improve adhesion to teeth and to simplify the bonding procedure.

All adhesive systems must fulfil the following functions: (1) demineralize the tooth structure; (2) penetrate into the tooth structure; and (3) polymerize. However, the adhesive performance varies greatly from system to system, in particular bonding to dentine (including collagen, hydroxyapatite and water) which is challenging to bond to.

A total-etch system first etches the tooth surface with a phosphoric acid etching agent. Then a primer/bonding agent is applied to the treated tooth surface. Even though the acidity of the phosphoric acid damages the dentine by removing much of the hydroxyapatite and exposing the collagen, the total-etch technique is still widely used today.

In order to reduce the damage caused to the tooth structure by the etching agent, we developed the CLEARFIL™ LINER BOND SYSTEM in the mid-80's which included a mild etching agent that contained citric acid and calcium chloride which are milder than phosphoric acid.

Around 1990 while the total-etch system was gaining popularity on the global market we began to develop a self-etch system. The objective was to improve the bond strength to dentine and to create a simplified bonding procedure. Our self-etch system consisted of a self-etch primer that etched and primed the tooth structure with a separate bonding agent that had excellent curing properties.

As its main ingredients Kuraray's self-etch primer includes an acidic monomer, water and a hydrophilic monomer. As a result both demineralizing and priming take place simultaneously. With this self-etch system a dense high quality 'resin-impregnated layer' is created between the tooth structure and the bonding agent resulting in an ideal adhesive solution.

### Development of One-Step Self-Etch

In 2005 Kuraray developed the first one-step self-etch adhesive CLEARFIL™ S<sup>3</sup> BOND, the aim of which was to deliver ease of use. This one-bottle adhesive didn't exhibit phase separation (the adhesive remained homogenous over time), due to our unique proprietary technology (Molecular Dispersion Technology), ensuring both primer and bonding liquids of CLEARFIL™ SE BOND were successfully incorporated into one-bottle.

The improved CLEARFIL™ S<sup>3</sup> BOND PLUS was the successor of CLEARFIL™ S<sup>3</sup> BOND, incorporating a new photo-initiator for enhanced curing and sodium fluoride for fluoride release. This self-etch adhesive demonstrated an improved bond strength and physicochemical quality. In addition to direct restorations it could also be used without a separate activator for core build-up restorations in combination with our CLEARFIL™ DC CORE PLUS.

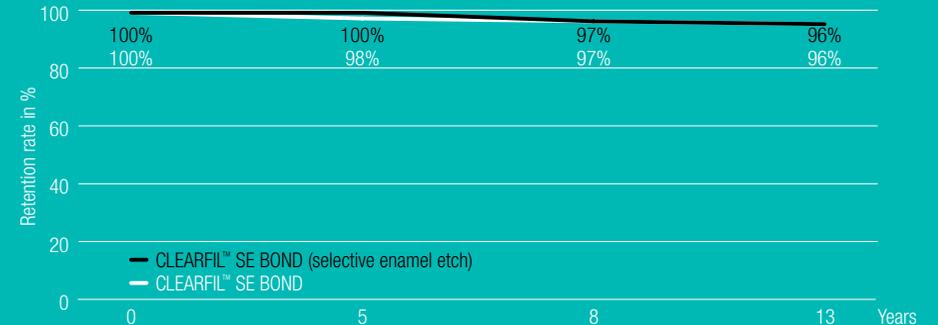
### Universal Adhesive

Kuraray Noritake Dental developed its first universal adhesive, CLEARFIL™ Universal Bond in 2014 for all direct and indirect restorations in combination with all etching techniques (Total-Etch, Self-Etch or Selective-Etch). The adhesive could also be used for the surface treatment of zirconia and silica-based glass ceramics (e.g. lithium disilicate). CLEARFIL™ Universal Bond could be used directly in combination with CLEARFIL™ DC CORE PLUS or PANAVIA™ SA Cement Plus for core build-up restorations and cementation.

## CLEARFIL™ SE BOND: THE SELF-ETCH GOLD STANDARD

Kuraray Noritake Dental's adhesive CLEARFIL™ SE BOND is recognized across the world as being the gold standard for self-etch adhesives. The clinical study of Marleen Peumans et al. demonstrates its clinical performance over 13 years. Never before has an adhesive showed a retention rate of 96% after 13 years of class V restorations in situ (Graph 6).

**Graph 6: CLEARFIL™ SE BOND self-etch vs. selective enamel etch**



M. Peumans, J. De Munck, K Van Landuyt, B. Van Meerbeek. Thirteen-year randomized controlled clinical trial of a two-step self-etch adhesive in non-carious cervical lesions. KU Leuven-BIOMAT, department of oral Health sciences, KU Leuven & Dentistry, University Hospitals Leuven, Leuven, Belgium

### From One-Step to Universal

To simplify the usage of adhesives, manufacturers have developed one-step bonding agents. Total-etch one-step bonding agents have been available for a longer period. After the year 2000, the first self-etch one-step systems were introduced to the market. For several years, the market has seen a steady flow of new or renewed one-step self-etch adhesives.

The latest market trends can be found in the development of universal bonds. In general, a universal bond can be qualified as a system that:

1. Can be used as self-etch, selective etch or total-etch
2. Contains surface conditioning ingredients for the priming of indirect materials
3. Can be used with or without a special activator for those indications where polymerization light cannot be used, such as placement of posts or certain indirect restorations
4. Is a one-bottle system



Self-etch  
(no phosphoric acid)



Selective-etch  
(phosphoric acid on enamel)



Total-etch  
(phosphoric acid on enamel and dentine)

Kuraray Noritake Dental has introduced several successful bonding agents in the one-step or universal bond category with CLEARFIL™ S<sup>3</sup> BOND PLUS and CLEARFIL™ Universal Bond.

### Basic Handling of Adhesives

In adhesive technology, we have seen the reduction of components in the total-etch and self-etch segment. In spite of this reduction the basic handling of adhesives remains the same. Rubbing, waiting or refreshing liquid and application of multiple layers are still required. Dentists still have to follow specific instructions for use to avoid a reduction in quality of the restoration. This requires a thorough understanding of the instructions for use and following these instructions exactly. We have developed CLEARFIL™ Universal Bond Quick to offer an adhesive which is:

1. Less technique sensitive than existing one-step materials on the market.
2. Offers long lasting sealing of the cavity and excellent durability
3. Has high bond strengths
4. Offers the versatility of a Universal bond

With **CLEARFIL™ Universal Bond Quick** we have taken the next step in bonding agents.

Since CLEARFIL™ Universal Bond Quick does not require any waiting, multiple layers or extensive rubbing, we have created the solution for uniform results and optimum adhesion, treatment after treatment.



Please follow the Instructions for Use

\* APPLY with a rubbing motion AND PROCEED

## CLEARFIL™ Universal Bond Quick

CLEARFIL™ Universal Bond Quick is our latest and most innovative bonding agent to date. We qualify this as a universal adhesive that works instantly. Just apply, dry and light cure. That's all. No waiting, no multiple layers, no extensive rubbing required. Instead CLEARFIL™ Universal Bond Quick uses Kuraray Noritake Dental's Rapid Bond Technology to achieve durable bond strengths, in one simple procedure. Uniform results, optimum adhesion.

CLEARFIL™ Universal Bond Quick reliably bonds all direct restorations, core build-ups, indirect restorations and repairs. Unlike other one-bottle universal adhesives which utilize 'slow monomers' requiring time to penetrate the tooth, there's no need to wait for CLEARFIL™ Universal Bond Quick to penetrate the dentine before you proceed.



Prepared dentine with smear layer.

*Due to the hydrophilicity of dentine, an ultra hydrophilic adhesive is required to enable optimal penetration of the dentine.*



Dentine bonded with CLEARFIL™ Universal Bond Quick.

*During polymerization, CLEARFIL™ Universal Bond Quick creates a highly cross-linked polymer network. As a result, the bond exhibits very low water sorption, providing long lasting restorations.*

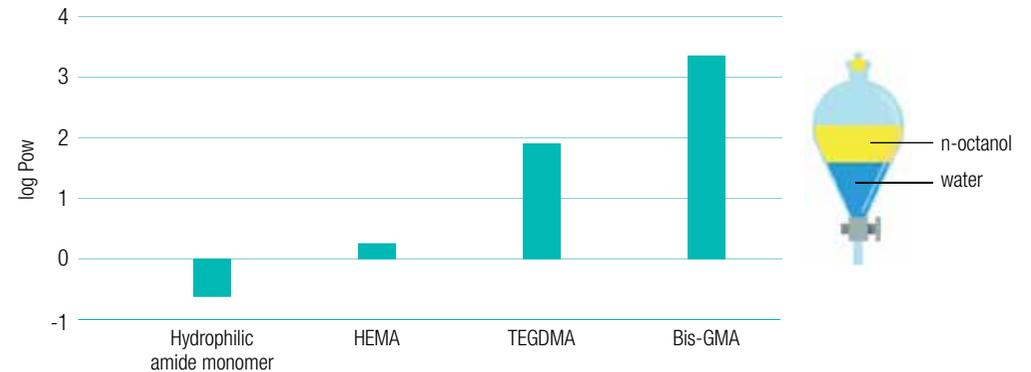
### Rapid Bond Technology

Our Rapid Bond Technology combines The Original MDP Monomer with new hydrophilic amide monomers, which work together to deliver optimal stability and resistance to moisture for a lasting result. MDP creates a strong chemical bond to hydroxyapatite. Having been in use for over 20 years, our MDP has proven excellence in adhesion.



Kuraray Noritake Dental's new hydrophilic amide monomer is one of the key factors in developing Rapid Bond Technology. Bonding to dentine isn't easy; the adhesive solution needs to be able to penetrate wet dentine. CLEARFIL™ Universal Bond Quick uses our new hydrophilic amide monomer technology to quickly and efficiently penetrate dentine. It has extremely high hydrophilicity compared to hydrophilic HEMA-monomers.

**Graph 8. Amide monomer hydrophilicity (Partition coefficient; log Pow)**



$$\text{Partition coefficient} = \log_{10} \text{Pow} = \log_{10} \frac{C_{\text{n-octanol}}}{C_{\text{water}}}$$

$C_{\text{n-octanol}}$ : Concentration of the monomer in n-octanol layer (mol/L)

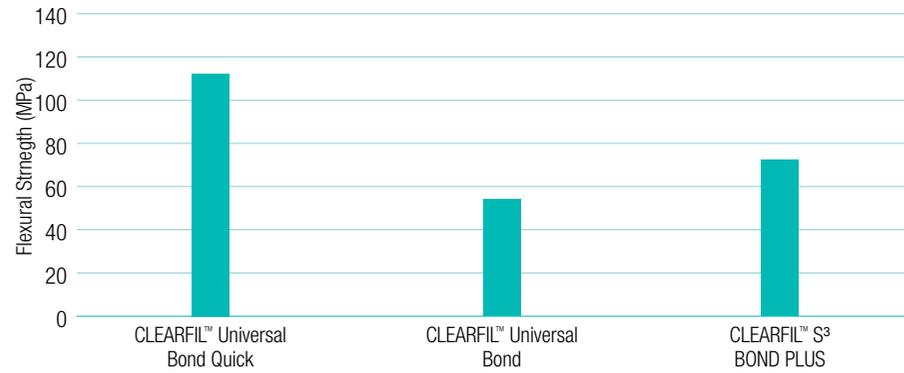
$C_{\text{water}}$ : Concentration of the monomer in water layer (mol/L)

Source: Kuraray Noritake Dental Inc.S

## Flexural Strength

Our new hydrophilic amide monomers have a high cross-linking property as well as excellent hydrophilicity, offering optimal mechanical strength and stability due to its highly cross-linked polymer network after curing.

**Graph 9. Flexural strength of cured adhesives.**



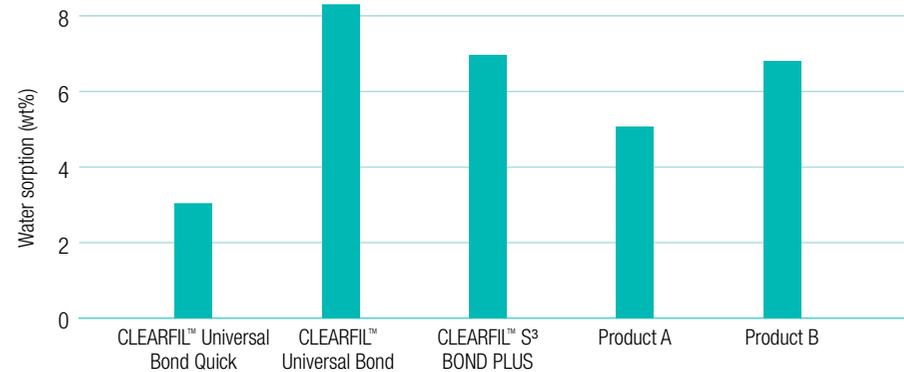
Source: Kuraray Noritake Dental Inc.  
Samples (beam shape; 25 x 2 x 2 mm). The solvents of each material were removed by blowing mild air prior to the test.

## Water Sorption

Having low water sorption is one of the most significant characteristics of adhesives. The organic matrix of the adhesive absorbs water over time. High water sorption of adhesives is cited as a factor in the deterioration of physical characteristics and secondary caries.

CLEARFIL™ Universal Bond Quick showed the lowest water sorption among the tested materials, even though it contains highly hydrophilic amide monomers. This is attributed to the high cross-linking property of our new hydrophilic amide monomers.

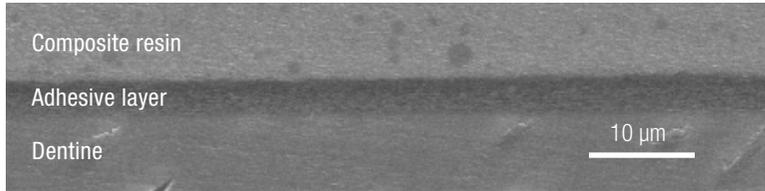
**Graph 10. Water sorption after curing the adhesives.**



Source: Kuraray Noritake Dental Inc.  
Samples (disk-shaped; diameter: 15 mm, thickness: 1,0 mm). The solvents of each material were removed by blowing mild air prior to the test.

### Thin Film Layer

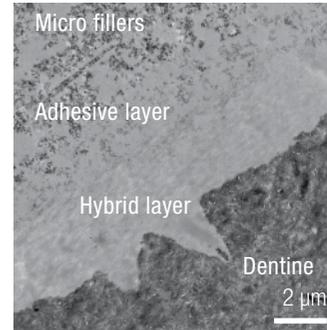
CLEARFIL™ Universal Bond Quick comprises a thin film layer of only 5 to 10 µm, ensuring it is esthetically pleasing even in the most demanding anterior restorations. Our innovative new amide monomers create multiple cross-links, improving the stability of the thin film layer. This delivers an advanced hydrophobic adhesive layer with excellent marginal esthetics.



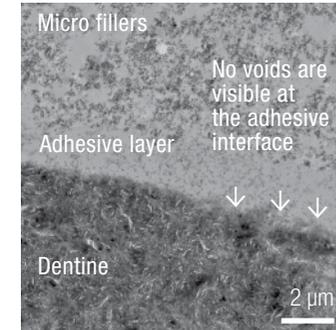
Source: Kuraray Noritake Dental Inc.

### Optimal Dentine Bonding

Dentine is a challenging substrate to bond to. Our Rapid Bond Technology ensures quick and effective bond penetration to all tooth substrates especially dentine. CLEARFIL™ Universal Bond Quick delivers a complete, void-free dentine seal. The below TEM's highlight a superior interaction between CLEARFIL™ Universal Bond Quick and hydroxyapatite in both total and self-etch modes.



Total-etch mode TEM



Self-etch mode TEM

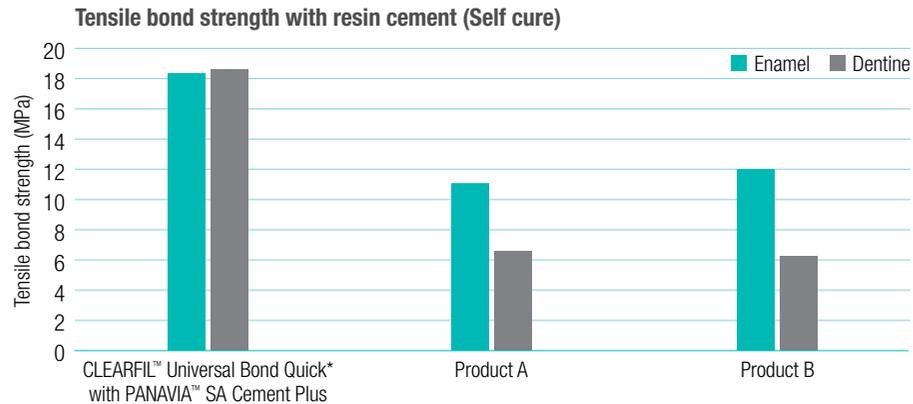
TEM images courtesy of Dr. Kumiko Yoshihara and Dr. Noriyuki Nagaoka, Okayama University, Japan

### Compatible with Self & Dual-Cure

CLEARFIL™ Universal Bond Quick may be used with PANA VIA™ SA Cement Plus or CLEARFIL™ DC CORE PLUS as a self or light-cure adhesive.

The bond strength of PANA VIA™ SA Cement Plus to tooth structure is highly enhanced when used in combination with CLEARFIL™ Universal Bond Quick.

CLEARFIL™ Universal Bond Quick not only bonds to the root canal dentine, it also bonds to your post. The self-curing feature of the core build-up composite CLEARFIL™ DC CORE PLUS ensures effective curing around the entire post. All out of CLEARFIL™ DC CORE PLUS? Simply mix one drop of CLEARFIL™ DC Activator with one drop of CLEARFIL™ Universal Bond Quick to create a dual-cure bond that can be used with any dual-cure, core build-up composite resin materials.



Source: Kuraray Noritake Dental Inc.

\* In this research, CLEARFIL™ Universal Bond Quick is applied with rubbing motion for 3 seconds



### Procedural Freedom

CLEARFIL™ Universal Bond Quick exhibits excellent curing properties, enabling a highly cross-linked polymer network within the adhesive. The result is a strong bond that creates a lasting, durable adhesive layer with exceptionally low water sorption.

Unlike traditional dental adhesives that require waiting time, extensive rubbing and multiple layers in order to deliver an optimum result, CLEARFIL™ Universal Bond Quick simplifies the restorative process, minimising procedural complications, for maximum predictability.

With the introduction of Rapid Bond Technology, application time is greatly reduced benefitting both patient and clinician.

### DIRECT COMPOSITE RESTORATIONS\*

#### UNIVERSAL adhesives



	<b>CLEARFIL™ Universal Bond Quick</b> Kuraray Noritake Dental	<b>APPLY with a rubbing motion AND PROCEED</b>	Blowing mild air for more than 5 seconds	Light cure for 10 seconds**
	<b>Scotchbond Universal***</b> 3M ESPE	Apply and rub it in for 20 seconds	Gentle stream of air for about 5 seconds	Light cure for 10 seconds
	<b>Prime &amp; Bond active***</b> Dentsply	Apply and slightly agitate for 20 seconds	Dry air for at least 5 seconds	Light cure for 10-20 seconds
	<b>Xeno Select***</b> Dentsply	Agitate the adhesive for 20 seconds	Dry air for at least 5 seconds	Light cure for 10 seconds
	<b>Adhese Universal***</b> Ivoclar Vivadent	Scrub for at least 20 seconds	Disperse with compressed air until a glossy, immobile layer results	Light cure for 10 seconds

\* Please follow the Instructions for Use for detailed technique and instructions

\*\* 5 seconds for high power LED (Light intensity more than 1500mW/cm<sup>2</sup>)

\*\*\* Trademarks are property of their respective owners

Data compiled from respective manufacturer's instruction for use.

## DIRECT COMPOSITE RESTORATIONS\*

### TOTAL-ETCH adhesives



**CLEARFIL™ Universal Bond Quick**  
Kuraray Noritake Dental

APPLY with a rubbing motion AND PROCEED

Blowing mild air for more than 5 seconds

Light cure for 10 seconds\*\*



**Adper Scotchbond 1 XT\*\*\***  
3M ESPE

Apply 2-3 coats, agitate for 15 seconds with gentle agitation

Gently air thin for 5 seconds

Light cure for 10 seconds



**OptiBond Solo Plus\*\*\***  
Kerr

Apply for 15 seconds, using light brushing motion

Air thin for 3 seconds

Light cure for 20 seconds



**ExiTE F\*\*\***  
Ivoclar Vivadent

Apply and agitate for at least 10 seconds

Disperse to a thin layer with a weak stream of air

Light cure for 10 seconds



**Prime&Bond NT\*\*\***  
Dentsply

Apply and remain undisturbed for 20 seconds

Gently drying with clean, dry air from a dental syringe for at least 5 seconds

Light cure for 10 seconds

## DIRECT COMPOSITE RESTORATIONS\*

### SELF-ETCH adhesives



**CLEARFIL™ Universal Bond Quick**  
Kuraray Noritake Dental

APPLY with a rubbing motion AND PROCEED

Blowing mild air for more than 5 seconds

Light cure for 10 seconds\*\*



**CLEARFIL™ S3 BOND PLUS**  
Kuraray Noritake Dental

Apply and leave it in place for 10 seconds

Blowing mild air for more than 5 seconds

Light cure for 10 seconds



**Adper Prompt L-Pop\*\*\***  
3M ESPE

Massage it in for 15 seconds, applying pressure. Apply a second coat after dry

Use a gentle stream of air to thoroughly dry the adhesive to a thin film. Again, use a gentle stream of air to thoroughly dry the adhesive to a thin film

Light cure for 10 seconds



**OptiBond All-In-One\*\*\***  
Kerr

Apply twice with brushing motion for 20 seconds each time

Dry with gentle air first and then medium air for at least 5 seconds

Light cure for 10 seconds

### Technical specifications

Film thickness	5-10 $\mu\text{m}$
Film thickness mixed with CLEARFIL™ DC Activator	<1 $\mu\text{m}$
Working time with light blocking plate	7 min.
Working time mixed with CLEARFIL™ DC Activator	90 sec.

### Application time for direct restoration

	Self-etch	Total-etch/ Selective-etch
Phosphoric acid etching	-	10 sec.
Bond application	Apply with rubbing motion; No waiting time needed	Apply with rubbing motion; No waiting time needed
Air-dry	5 sec.	5 sec.
Light cure	10 sec.*	10 sec.*
Total application time	15 sec.	25 sec.

\*5 sec. for high power LED (Light intensity: more than 1500 mW/cm<sup>2</sup>)

### Principal ingredients

10-Methacryloyloxydecyl dihydrogen phosphate (MDP), Bisphenol A diglycidylmethacrylate (Bis-GMA), 2-Hydroxyethyl methacrylate (HEMA), Hydrophilic amide monomers, Colloidal silica, Silane coupling agent, Sodium fluoride, dl-Camphorquinone, Ethanol, Water



# RESEARCH DATA

## SHEAR BOND STRENGTH OF CLEARFIL™ Universal Bond Quick IN SELF-ETCH MODE TO BOVINE ENAMEL AND DENTINE

### Institute:

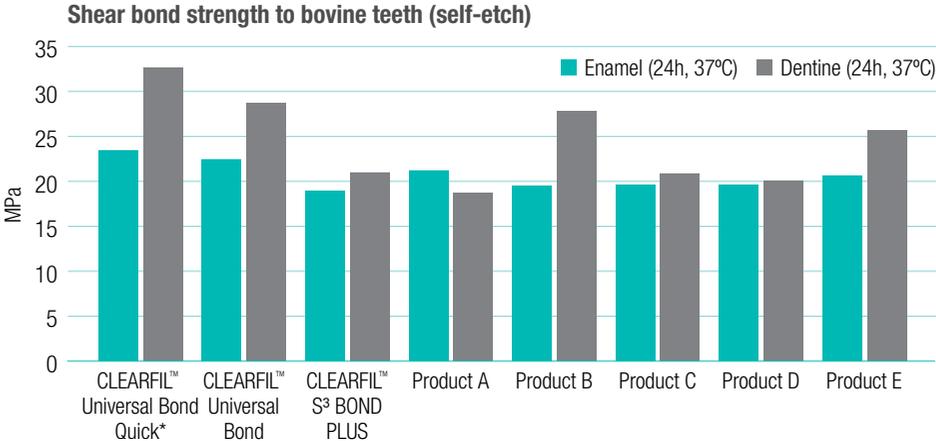
Kuraray Noritake Dental Inc., Niigata, Japan

### Objectives

The purpose of this study was to compare the shear bond strength of CLEARFIL™ Universal Bond Quick in self-etch mode to bovine enamel and dentine with 7 other commercial single-step adhesives.

### Methods

Extracted bovine teeth embedded in gypsum were polished with 600-grit Si-C paper under running water to obtain flattened enamel and dentine surfaces. Each adhesive system was applied to enamel and dentine surfaces according to each manufacturer's instructions. The cylindrical mould (Ultradent, D=2.38mm) was placed on the bonding surface, and then the composite build-up was done with CLEARFIL™ AP-X. After the specimens were stored in 37°C for 24 hours, the shear bond strength was measured at a crosshead speed of 1 mm/min using a universal testing instrument (Shimadzu).



\* In this research, CLEARFIL™ Universal Bond Quick is applied with rubbing motion for 3 seconds.

### Conclusions

CLEARFIL™ Universal Bond Quick showed the highest bond strengths to bovine enamel and dentine in self-etch mode among the single-step adhesives tested in this study.

## TENSILE BOND STRENGTH OF CLEARFIL™ Universal Bond Quick IN TOTAL-ETCH MODE TO BOVINE ENAMEL

### Institute

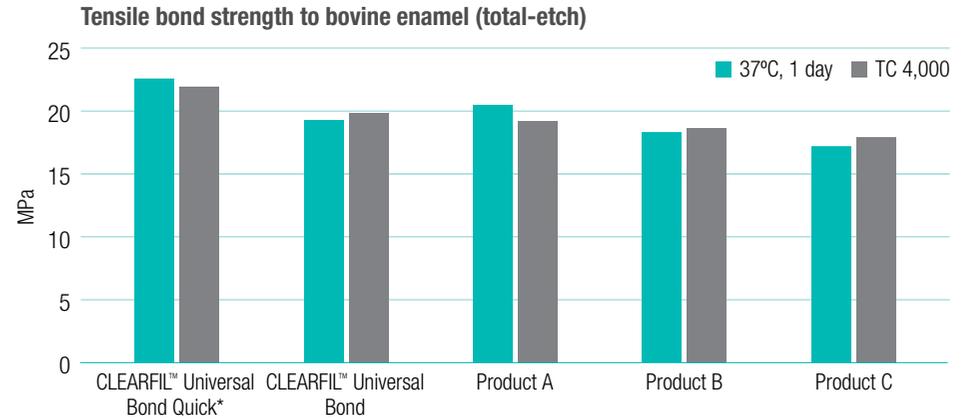
Kuraray Noritake Dental Inc., Niigata, Japan

### Objectives

The purpose of this study was to compare the tensile bond strength of CLEARFIL™ Universal Bond Quick in total-etch mode to bovine enamel with 4 other commercial single-step universal adhesives.

### Methods

Extracted bovine teeth were polished with 1000-grit Si-C paper under running water to obtain flattened enamel surfaces. Each universal adhesive was applied to the phosphoric acid-etched enamel surfaces covered with masking tape with 3 mm diameter hole according to each manufacturer's instructions. Light-curing composite resin (CLEARFIL™ AP-X) was further applied to the treated dentine surface, covered with a polyester film and then light cured. Stainless steel rod was cemented to the cured surface with resin cement (PANAVIA™ 21) as a test sample. After storage in 37°C water for 24 hours, the specimens were divided into two groups. Half of the samples were subjected to thermo-cycling (4°C-60°C, 1 min. each, 4,000 cycles: TC4,000). The tensile bond strength was measured at a crosshead speed of 1 mm/min using a universal testing instrument (Shimadzu).



\* In this research, CLEARFIL™ Universal Bond Quick is applied with rubbing motion for 3 seconds.

### Conclusions

CLEARFIL™ Universal Bond Quick showed the highest bond strengths to bovine enamel in total-etch mode both after 24 hours and TC4,000, among the single-step universal adhesives tested in this study.

## SHEAR BOND STRENGTH OF CLEARFIL™ Universal Bond Quick IN TOTAL-ETCH MODE TO BOVINE DENTINE

### Institute:

Kuraray Noritake Dental Inc., Niigata, Japan

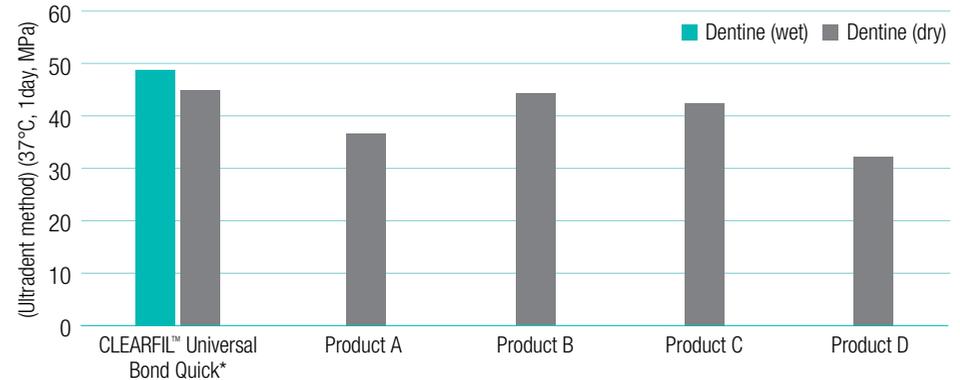
### Objectives

The purpose of this study was to compare the shear bond strength of CLEARFIL™ Universal Bond Quick to bovine dentine in total-etch mode with 4 other commercial single-step total-etch adhesives.

### Methods

Extracted bovine teeth embedded in gypsum were polished with 600-grit Si-C paper under running water to obtain flattened dentine surfaces. Each adhesive was applied to the phosphoric acid-etched dentine surfaces according to each manufacturer's instructions. With regard to CLEARFIL™ Universal Bond Quick, blot-drying (wet dentine) condition was added to the test in addition to its standard method (dry dentine). The cylindrical mould (Ultradent, D=2.38mm) was placed on the bonding surface, then the composite build-up was done with CLEARFIL™ AP-X. After the specimens were stored in 37°C for 24 hours, the shear bond strength was measured at a crosshead speed of 1 mm/min using a universal testing instrument (Shimadzu).

Shear bond strength to bovine dentine (Total-etch)



\* In this research, CLEARFIL™ Universal Bond Quick is applied with rubbing motion for 3 seconds.

### Conclusions

CLEARFIL™ Universal Bond Quick showed the highest bond strengths to bovine dentine in total-etch mode, irrespective of the dentine moisture condition.

## FLUORIDE RELEASING PROPERTY OF CLEARFIL™ Universal Bond Quick

### Institute

Kuraray Noritake Dental Inc., Niigata, Japan

### Objectives

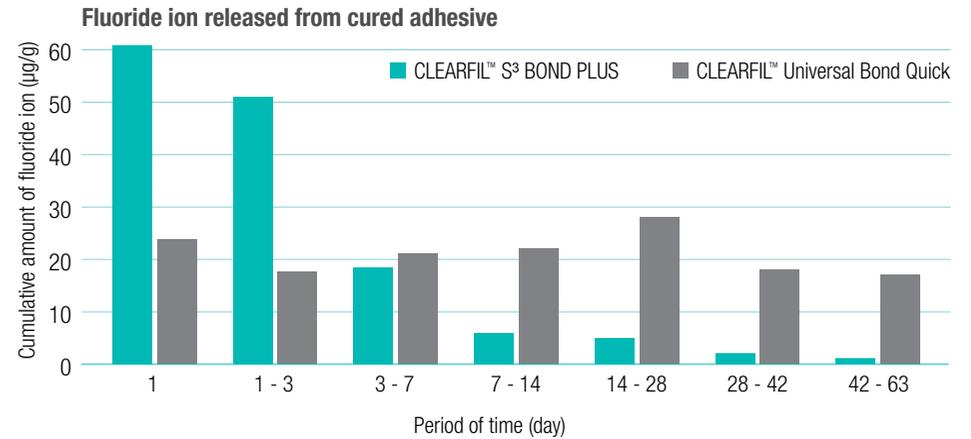
The purpose of this study was to compare the amount of fluoride release from CLEARFIL™ Universal Bond Quick with single-step self-etch adhesive CLEARFIL™ S<sup>3</sup> BOND PLUS.

### Methods

The solvents of each material were removed by blowing mild air prior to the test. Discs of each cured material were prepared and stored in phosphate buffer solutions. The amount of fluoride release was measured with fluoride ion-selective electrode at the integral time from day 1 up to day 63.

### Conclusions

CLEARFIL™ Universal Bond Quick showed a more sustainable fluoride releasing behavior compared to CLEARFIL™ S<sup>3</sup> BOND PLUS.



## SHEAR BOND STRENGTH OF PANAVIA™ SA CEMENT PLUS TO HUMAN ENAMEL AND DENTINE WITH/WITHOUT THE PRE-TREATMENT WITH CLEARFIL™ Universal Bond Quick

### Institute

Kuraray Noritake Dental Inc., Niigata, Japan

### Objectives

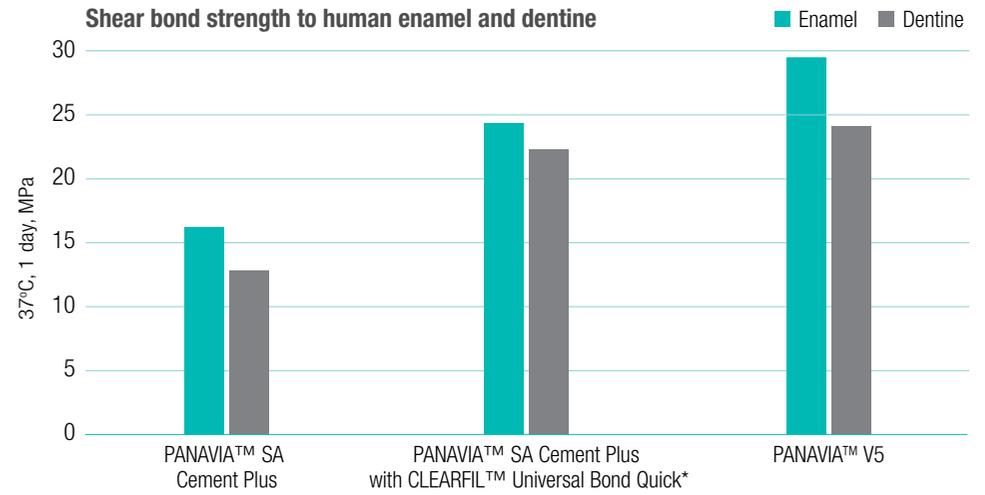
The purpose of this study was to compare the shear bond strength of PANAVIA™ SA Cement Plus to human enamel and dentine with/without the pretreatment of the adherent surface by CLEARFIL™ Universal Bond Quick, with PANAVIA™ V5.

### Methods

Extracted human teeth embedded in acrylic resin were polished with 1000-grit Si-C paper under running water to obtain flattened enamel and dentine surfaces. Stainless steel rod (diameter 3mm) was cemented with each resin cement system according to each manufacturer's instructions. After the specimens were stored in 37°C for 24 hours, the shear bond strength was measured at a crosshead speed of 1 mm/min using a universal testing instrument (Shimadzu).

### Conclusions

Shear bond strengths of PANAVIA™ SA Cement Plus to human enamel and dentine were both significantly enhanced when used in combination with CLEARFIL™ Universal Bond Quick and its values were close to that of PANAVIA™ V5.



\* In this research, CLEARFIL™ Universal Bond Quick is applied with rubbing motion for 3 seconds.

## SHEAR BOND STRENGTH OF CLEARFIL™ Universal Bond Quick IN TOTAL-ETCH MODE TO BOVINE ENAMEL AND DENTINE

### Institute

Kuraray Noritake Dental Inc., Niigata, Japan

### Objectives

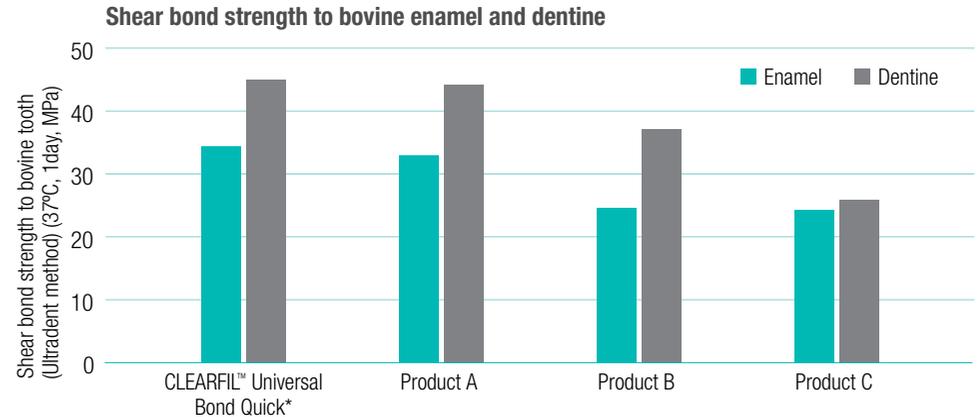
The purpose of this study was to compare the shear bond strength of CLEARFIL™ Universal Bond Quick to bovine enamel and dentine in total-etch mode with 3 other commercial single-step universal adhesives.

### Methods

Extracted bovine teeth embedded in gypsum were polished with 600-grit Si-C paper under running water to obtain flattened enamel and dentine surfaces. Each adhesive system was applied to phosphoric-acid-etched enamel and dentine surfaces according to each manufacturer's instructions. The cylindrical mould (Ultradent, D=2.38mm) was placed on the bonding surface and then the composite build-up was done with CLEARFIL™ AP-X. After the specimens were stored in 37°C for 24 hours, the shear bond strength was measured at a crosshead speed of 1 mm/min using a universal testing instrument (Shimadzu).

### Conclusions

CLEARFIL™ Universal Bond Quick showed the highest bond strengths to both bovine enamel and dentine in total-etch mode among the universal adhesives tested in this study.



\* In this research, CLEARFIL™ Universal Bond Quick is applied with rubbing motion for 3 seconds.

## Instructions for Use

CLEARFIL™ Universal Bond Quick can be used for various indications. In the flowcharts you will find the instructions for use.

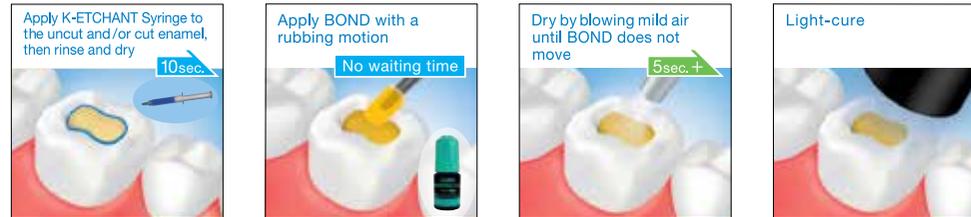
### Wide Indication Range

- ✓ Direct restorations using light-cured composite resin
- ✓ Cavity sealing as a pretreatment for indirect restorations
- ✓ Treatment of exposed root surfaces
- ✓ Treatment of hypersensitive teeth
- ✓ Intraoral repairs of fractured restorations
- ✓ Post cementation and core build-ups
- ✓ Cementation of indirect restorations

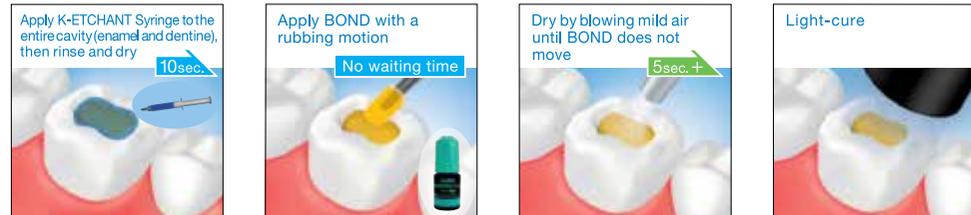
### Self-etch procedure with CLEARFIL™ Universal Bond Quick



### Selective-etch procedure with CLEARFIL™ Universal Bond Quick



### Total-etch procedure with CLEARFIL™ Universal Bond Quick





## PRODUCT RANGE

### CLEARFIL™ Universal Bond Quick BOTTLE STANDARD KIT

#282400 Bottle (5 ml),  
K-ETCHANT Syringe (3 ml),  
Applicator Brush (fine <silver>) (50 pcs),  
Needle Tip (20 pcs),  
Dispensing Dish, Light Blocking Plate



### CLEARFIL™ Universal Bond Quick UNIT DOSE STANDARD PACK

#282404 Unit Dose (50 pcs x 0.1 ml),  
K-ETCHANT Syringe (3 ml),  
Applicator Brush (fine <silver>) (50 pcs),  
Needle Tip (20 pcs)



### CLEARFIL™ Universal Bond Quick BOTTLE REFILL

#282402 Bottle (5 ml)



### CLEARFIL™ DC ACTIVATOR

#282250 1 bottle (4 ml)



### CLEARFIL™ Universal Bond Quick BOTTLE VALUE PACK

#282403 Bottle (3 x 5 ml)



### K-ETCHANT SYRINGE

#282252 K-ETCHANT Syringe (2 x 3 ml),  
Needle Tip (40 pcs)

### Needle Tips

#282253 Needle Tip (20 pcs)



## MANUFACTURER

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