

Bonding from 1955:  
The current status of bonding to  
dentine



Now we have  
Bondodontology!

We thought that  
this was bonding!



# Baldwin 1897

“I was struck by the readiness by which the oxyphosphate cement laid hold of the amalgam.

This composite filling is suitable for all which are considered suitable for amalgam alone.”





1875

The function of a traditional luting cement is to provide *retention* by interlocking the minor irregularities on the prepared tooth surface and the restoration surface.

1875



**NOT TODAY!**

Smith, Wright and Brown, 1986

1875

1875

# Zinc Phosphate

<b>Advantages</b>	<b>Disadvantages</b>
<p data-bbox="580 475 1044 532">History of success</p> <p data-bbox="519 572 1105 629">Adjustable working time</p> <p data-bbox="529 669 1095 726">High impact resistance</p> <p data-bbox="665 766 960 823">High rigidity</p> <p data-bbox="496 863 1128 921">Mechanical retention only</p>	<p data-bbox="1444 475 1895 532">Post-op sensitivity</p> <p data-bbox="1500 572 1839 629">Long set time</p> <p data-bbox="1495 669 1844 726">Mix technique</p> <p data-bbox="1284 766 2056 823">No measurable shear adhesion</p> <p data-bbox="1498 863 1842 921">High solubility</p> <p data-bbox="1347 961 1992 1018">Low compressive strength</p> <p data-bbox="1302 1058 2038 1115">Low diametral tensile strength</p> <p data-bbox="1381 1155 1959 1212">Low fracture toughness</p>

# Luting Materials

**ACTIVE  
LUTING**

PASSIVE  
LUTING

Moving on to the  
1980s

# The retention of gold crowns on human dentine preparations — a comparison of eight cements

By S M BLACK BDS; and G CHARLTON BDS MDS FDSRCS; Department of Conservative Dentistry, University of Edinburgh, Old Surgeons' Hall, Edinburgh

Experiments were carried out to compare the retentive properties of eight dental luting cements, using gold crowns cemented onto human dentine. The order of retention of the cements was: 1 Composite (Panavia-Ex, J & S Davis); 2 Glass-ionomer (AquaCem, DeTrey); Glass-ionomer (Ketac-Bond, Cottrell); and Polycarboxylate (Bondalcap, Vivadent); 3 Polycarboxylate (Poly F Plus, DeTrey); Zinc phosphate (DeTrey); and Zinc phosphate (Phosphacap, Vivadent); and 4 Zinc oxide/eugenol, alumina, EBA (Opotow, Teledyne Getz).

has shown that recementation affects the retention of cement lutes.

## Methods and materials

Eight cements were used as shown in Table 1.

The crown preparations were made on extracted human teeth. Before preparation the teeth were kept in water at room temperature, and after preparation they were stored at 37°C and 100 per cent humidity. Fig 1 shows the dimensions of the

Which cement is indicated for  
luting all-ceramic restorations?

2002

2002



# Are Adhesive Technologies Needed to Support Ceramics? An Assessment of the Current Evidence

F.J.Trevor Burke<sup>a</sup>/Garry J.P. Fleming<sup>b</sup>/Dan Nathanson<sup>c</sup>/Peter M. Marquis<sup>d</sup>

**Abstract:** Despite large variations in the reported fracture strengths of dispersion strengthened, glass infiltrated, castable, pressable and machinable ceramics utilised for the construction of all-ceramic crowns, the annual clinical failure rate reported for these materials in the dental literature is remarkably consistent at ca 3%. These results emphasise that there may be little correlation between the average fracture strength and resultant clinical performance. Consequently, if ceramics are to be used for dental applications, then clearly more detailed information on the statistical variations in strength combined with the influence of cementation media are required.

The effect of adhesive technology has been examined in laboratory and clinical studies. The laboratory studies focused on the effect of cement lute on crown performance, whilst surface degradation and strengthening effects with different systems were examined utilising conventional materials science techniques. Clinical studies focused on the failure rates of conventionally luted and adhesively luted crowns and inlays.

There would appear to be evidence from clinical studies that crowns luted with a resin cement and with the placement procedure incorporating a dentine bonding stage have enhanced rates of survival. It is therefore concluded that the available research strongly suggests that the use of resin as a luting material for ceramic restorations is indicated, given the research from three differing sources – laboratory fracture studies comparing restorations luted with resin vs other materials, clinical studies, and laboratory studies examining the surface sealing/strengthening effect of resin on ceramic. Laboratory studies also confirm the enhanced resistance to fracture of crowns cemented with an adhesive procedure.

Which cement is indicated  
for all-ceramic restorations?

AGAINST 4

IN FAVOUR OF CERAMIC 28

# Take home message

Resin luting materials have excellent physical properties and are indicated for all-ceramic restorations.

# Additionally.....

resin cements may be  
used as part of an  
adhesive approach  
where preparation  
geometry is suboptimal

1996

1996

## Retentive properties and film thickness of 18 luting agents and systems

Development of new dental materials has resulted in significantly more luting agents over the past decade than in the previous 100 years. Some newer luting systems reach such high retentive values that one cannot help but wonder how much retention is needed to retain a casting. According to Shillingburg et al.<sup>1</sup> and Dryer-Jørgenson,<sup>2</sup> a direct relationship exists between retention and convergence angle, crown height, and total surface area of the preparation.

Enamel and dentin bonding and fluoride release are required attributes of newer generation cements. Adhesive forces like those generated through chelation by polycarboxylate and glass ionomer cements are weak compared to those systems for which dentin primers are recommended in conjunction with the luting component. Hypersensitivity following use of resin or hybrid cements appears to be of little concern, in contrast to experience with some glass ionomer cements.<sup>3</sup> There is no persuasive evidence for this hypersensitivity, although possibilities have been noted.<sup>4</sup> However, calcium hydroxide ( $\text{Ca}[\text{OH}]_2$ ) used as a liner under crowns has been shown to reduce inflammation.<sup>5</sup> Resin and hybrid cements or ionomer resins are the newest additions to luting agents. One such cement (Biomer, L.D. Caulk & Co., Milford, DE), tested for pulp reactions in primates, caused little irritation after 5 days; after 26 and 60 days, the initial mild irritation had been resolved.<sup>6</sup> Since postoperative hypersensitivity is common, research has been directed at finding explanations

als, and developing new ones to improve patients' postcementation comfort, while increasing long-term success.

Retentive properties of 18 current luting materials/systems, out of more than 45 systems tested, are reported on here. In addition, film thickness was measured according to American Dental Association (ADA) Specification No. 8.

### Methods and materials

Virgin, caries-free mandibular premolars, recently extracted for orthodontic reasons, were used for the crown preparations. Extracted teeth were stored in water until the experiment. The method used here, except for minor modifications, resembled that reported

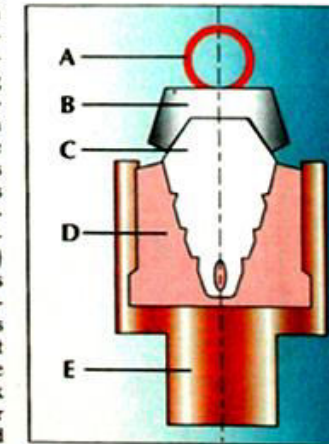


Fig. 1. Cross section of the experimental design. A = the ring to be attached to the Instron to apply a tensile force; B = the casting; C = the crown preparation; D = resin securing the

Pameijer and Jefferies, Gen.Dent.1996

- ✎ 18 luting materials
- ✎ Extracted premolars
- ✎ Standardised cone-shaped preparations with  $33^{\circ}$  taper
- ✎ Gold copings made and cemented
- ✎ Tensile force applied after 24h



- ✚ Polycarboxylate cement produced lowest value
- ✚ Ketac-Cem value was X2 that of phosphate
- ✚ Dentine bonding produced higher values for retention

Think adhesive cementation!

## Retentive properties and film thickness of 18 luting agents and their success

Development of new luting materials has resulted in a new ones to more luting agents, while increasing decade the success.

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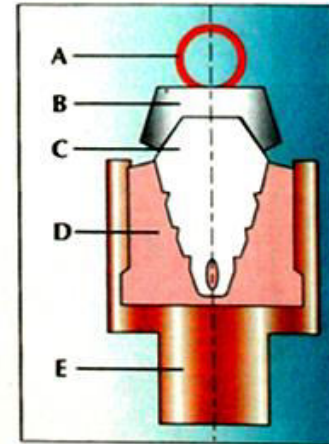


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# Think adhesive cementation!

Zidan & Ferguson 2003

- ✧ Complete crowns prepared with three different tapers, luted with four different cements
- ✧ Retention of the adhesive resins investigated were 20% higher at 24-degree taper than the retentive values of conventional cements at 6-degree taper.

# Think adhesive cementation!

👤 As the resin luting materials provided retention that was double the values of zinc phosphate or conventional cements, these results provide an ***overwhelming indication for the use of adhesive luting.***

Zidan O, Ferguson GC The retention of complete crowns prepared with three different tapers and luted with four different cements. J.Prosthet.Dent.2003;89:565-571 .

Heintze SD

Crown pull off test (crown retention test) to evaluate the bonding effectiveness of luting agents.

Dent.Mater.2010:26:  
193-206.

**Systematic review including 18 studies**

**Most important factors for crown dislodgment were stump height, convergence angle and luting agent.**

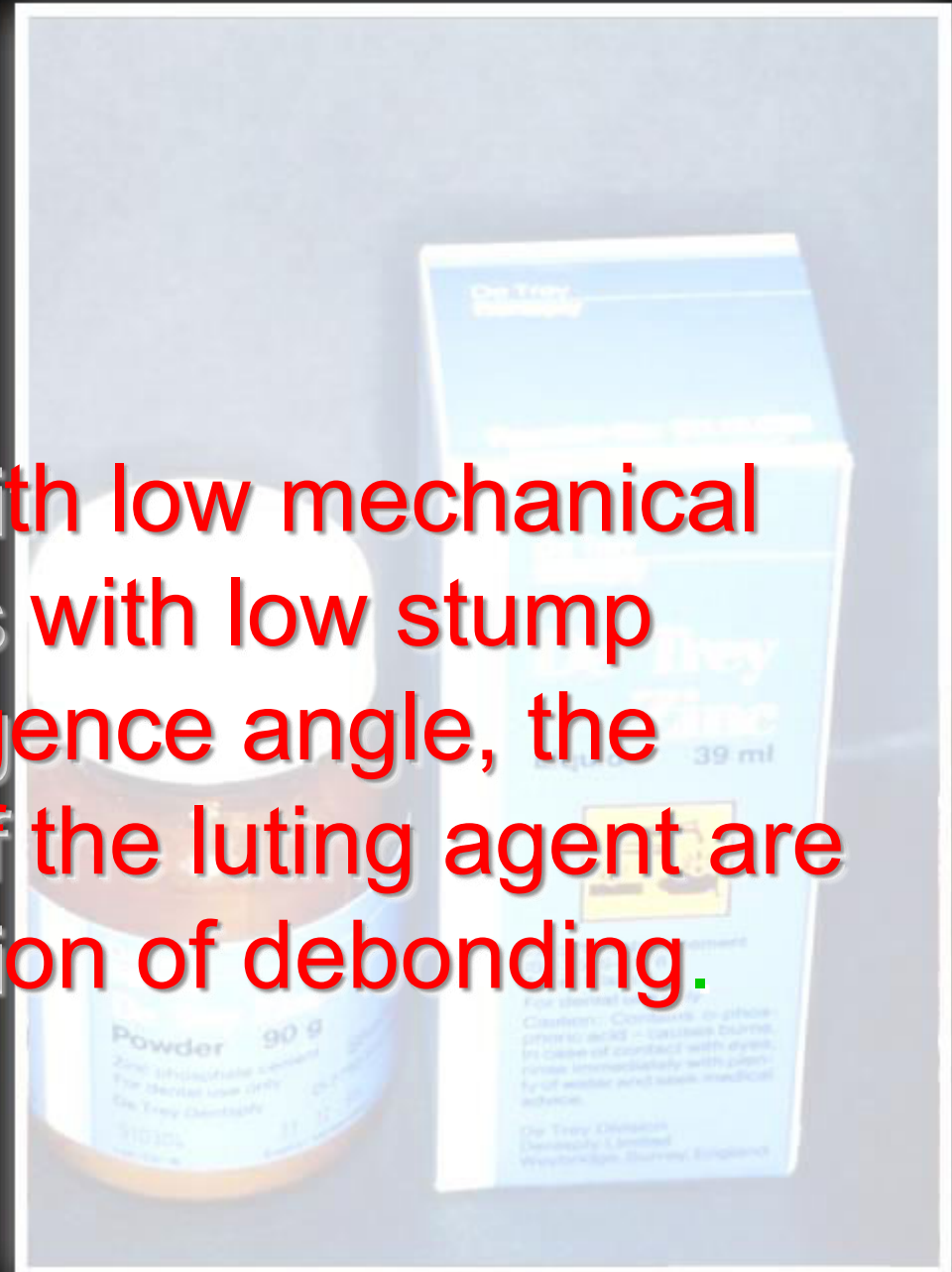
**Frequency of debonding was higher for restorations luted with zinc phosphate than all other types.**

Heintze SD

Crown pull off test (crown retention test) to evaluate the bonding effectiveness of luting agents.

Dent.Mater.2010:26:  
193-206.

**In clinical situations with low mechanical retention, or situations with low stump height or high convergence angle, the adhesive properties of the luting agent are crucial for the prevention of debonding.**



# Take home message

For the day when I cannot get an ideal taper ( $6^{\circ}$  taper, Shillingburg 1995) I need (adhesive) resin luting !



# Resin cements

## Advantages

- Not soluble in oral environment
- High compressive & tensile strengths
- Good fracture toughness
- Capable of bonding to tooth structure via DBA

## Disadvantages

- Requires acid etch technique
- Requires dentine bonding
- Technique sensitive
- Moisture control is critical
- Clean –up time is critical

Resin cements taught us a lot about adhesion!

...resin luting has  
become much simpler  
since the introduction of  
self-adhesive luting  
materials

# The first self-adhesive resin luting material, 2002





## 15-Year Clinical Performance

3M™ RelyX™ Unicem Self-Adhesive Resin Cement + + + + +

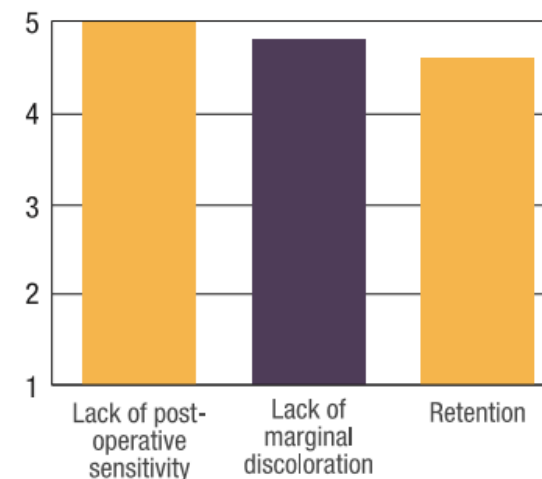
### Lack of Marginal Discoloration

Ninety-five percent of the recalled restorations cemented with **RelyX Unicem** showed no marginal discoloration, while 98% of restorations cemented with **RelyX Unicem 2** exhibited no discoloration at the margins (Figure 3). Discoloration was exhibited by graying at the margin of ceramic restorations. Graying was observed in 5% of the restorations. In half of these, the graying was minimal; in 1% the graying was moderate; and in the final 1.5%, the graying was more severe, requiring the replacement of about 35 restorations. It is important to note that the discoloration seemed to get worse with time. Less discoloration was observed when the restorations were cemented with **RelyX Unicem 2**.

### Retention

One hundred and eight (4.8%) of the recalled restorations debonded over the 15-year evaluation period (Figure 3). In 90% of these debonds, the cement was in the restoration and not on the prepared tooth. It was not unusual to notice grey or black stain on many of the debonded restorations.

Fig. 3: Results of 15-year recall of restorations cemented with 3M™ RelyX™ Unicem.



### Summary:

**RelyX Unicem Self-Adhesive Resin Cement** has proven to be very reliable over the 15-year recall period. This product received a 96% clinical performance rating.

# RelyX Unicem has been extensively tested in clinical studies

Principle Investigator	Study Length (Years)	Lava™ Frame Restoration Types	Cement	Secondary Caries
Burke <sup>1</sup>	5	Anterior and Posterior 3 and 4-unit Bridges	RelyX™ Unicem Aplicap™, Maxicap™, or Clicker™	0%
Pelaez <sup>2</sup>	4	Posterior 3-unit Bridges	RelyX™ Unicem Aplicap™, Maxicap™, or Clicker™	0%
Zenthöfer <sup>3</sup>	3	Cantilever Bridges	RelyX™ Unicem Aplicap™, Maxicap™, or Clicker™	0%
Gherlone <sup>4</sup>	3	Anterior and Posterior Crowns	RelyX™ Unicem Aplicap™, Maxicap™, or Clicker™	0%
Perry <sup>5</sup>	2	Anterior and Posterior Crowns and Bridges	RelyX™ Unicem Aplicap™, Maxicap™, or Clicker™	0%
Raigrodski <sup>6</sup>	2	Anterior Crowns	RelyX™ Unicem Aplicap™, Maxicap™, or Clicker™	0%

# Direct placement restorations



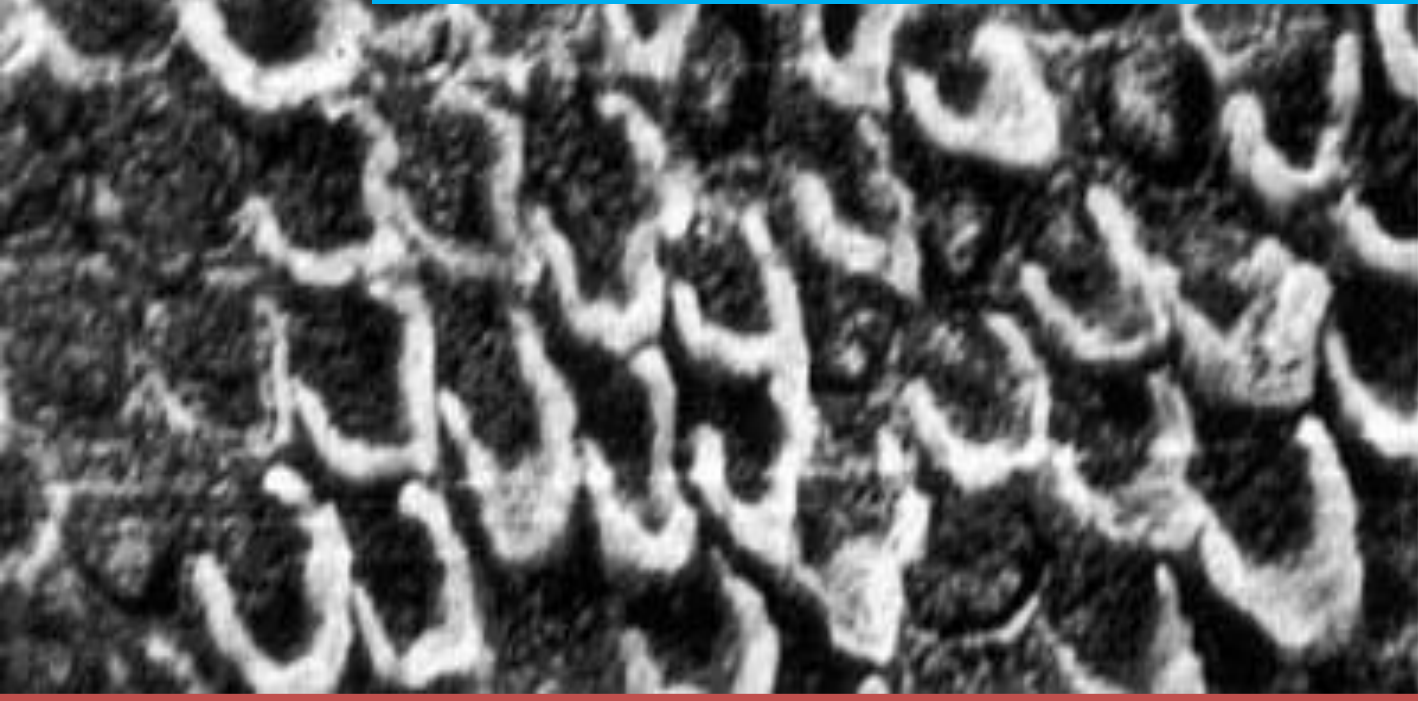
# In the old days!

1970 and earlier

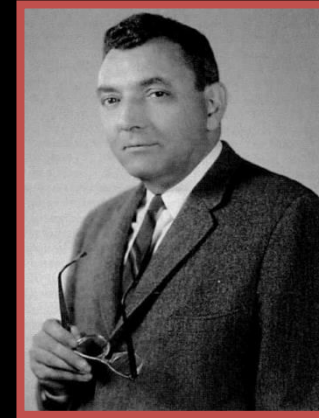


← The first dentine bonding agent!

# Bonding to enamel is easy!



Michael  
Buonocore



Buonocore MG. A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. J.Dent.Res.1955:34(6):849-853.

# History Of Bonding

<b>Year</b>	<b>Discovery</b>	<b>Main Points</b>
<b>1955</b>	<b>Acid Etching</b>	Buonocore advocates etching to achieve better bonding to tooth structure
<b>1963</b>	<b>Recognition Of Different Substrates</b>	Buonocore discusses differences in bonding to enamel and dentin
<b>Late 1960's</b>	<b>Resin Tags</b>	Buonocore discusses resin tags as the principal adherents to etched enamel
<b>1990's</b>	<b>Shorter Etching Time</b>	15 Seconds is about enough for dentin

Kugel, G., The Science of Bonding: From First To Sixth Generation, JADA, 131, 20-25 (2000)

# COMPOSITION OF DENTINE

70% Inorganic

20% Organic

10% Water

It  
is  
a  
vital  
substrate

Bonding to dentine is therefore  
more difficult

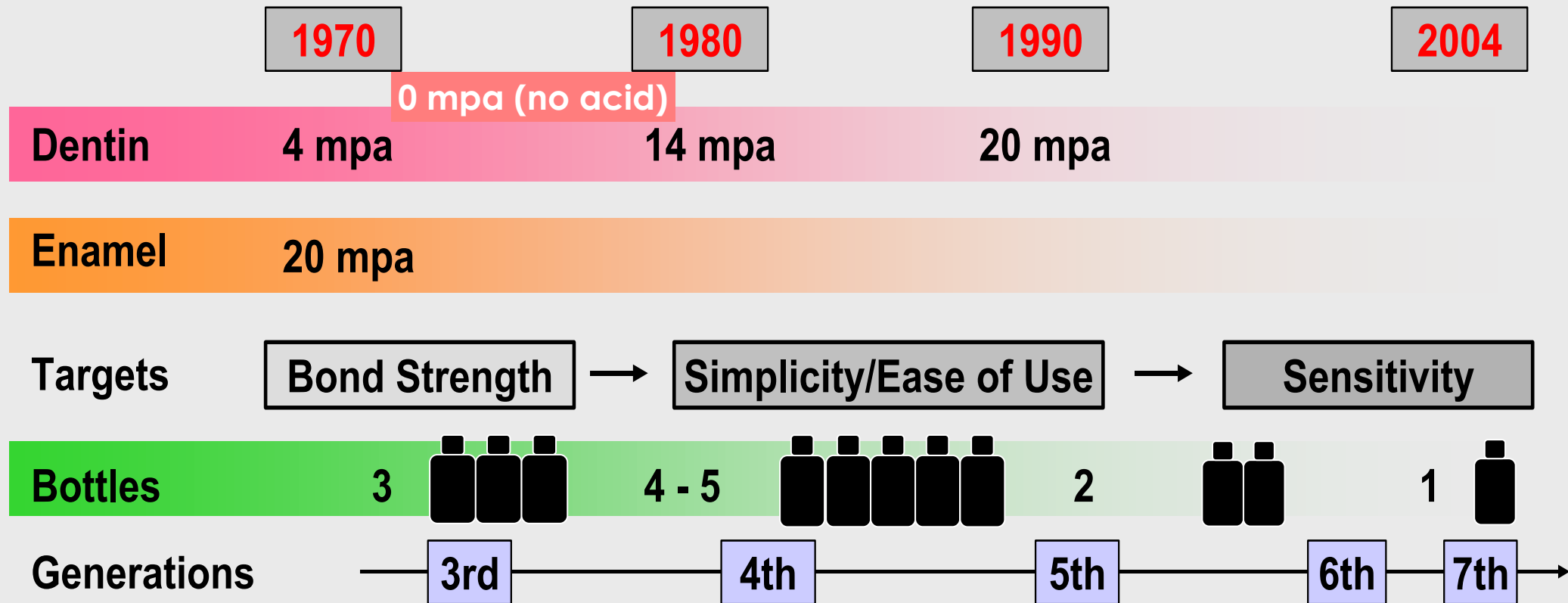
# Therefore, for dentine ( as compared with enamel)

- less predictable bonding because:
  - greater variability of the dentine surface
  - higher organic content

# History & Evolution of Adhesives

FROM: *acid on dentin taboo..... to all utilize acid*

## Adhesives Market Timeline



# Total-Etch: Dentine

- What happens if the tooth surface is overdried?
  - Collapsed collagen decreases porosity and reduces adhesive absorption:  
**Increases chance for sensitivity**
- The tooth surface needs to be moist!
  - Expanded collagen is porous and will absorb adhesive:  
**Minimizes post-op sensitivity**

**Dull dentin appearance  
indicates dehydration**



# Total-Etch (etch and rinse) Adhesives

## 4<sup>th</sup> and 5<sup>th</sup> Generations

- ✎ Use for all indications **including uncut enamel**
- ✎ Clinical history
- ✎ Proven bond strength

# Tips for Preventing Sensitivity: Total Etch Adhesives

- Isolate area to prevent contamination
- Do not over-etch
- Do not pre-dispense adhesive
  - Evaporation degrades adhesion
  - Lowers bond strength
- Consider using a self-etch adhesive



# Etch & Rinse

The dentine is etched with 35% phosphoric acid (1), this is rinsed off (2), then dried (3) bond then applied (4)

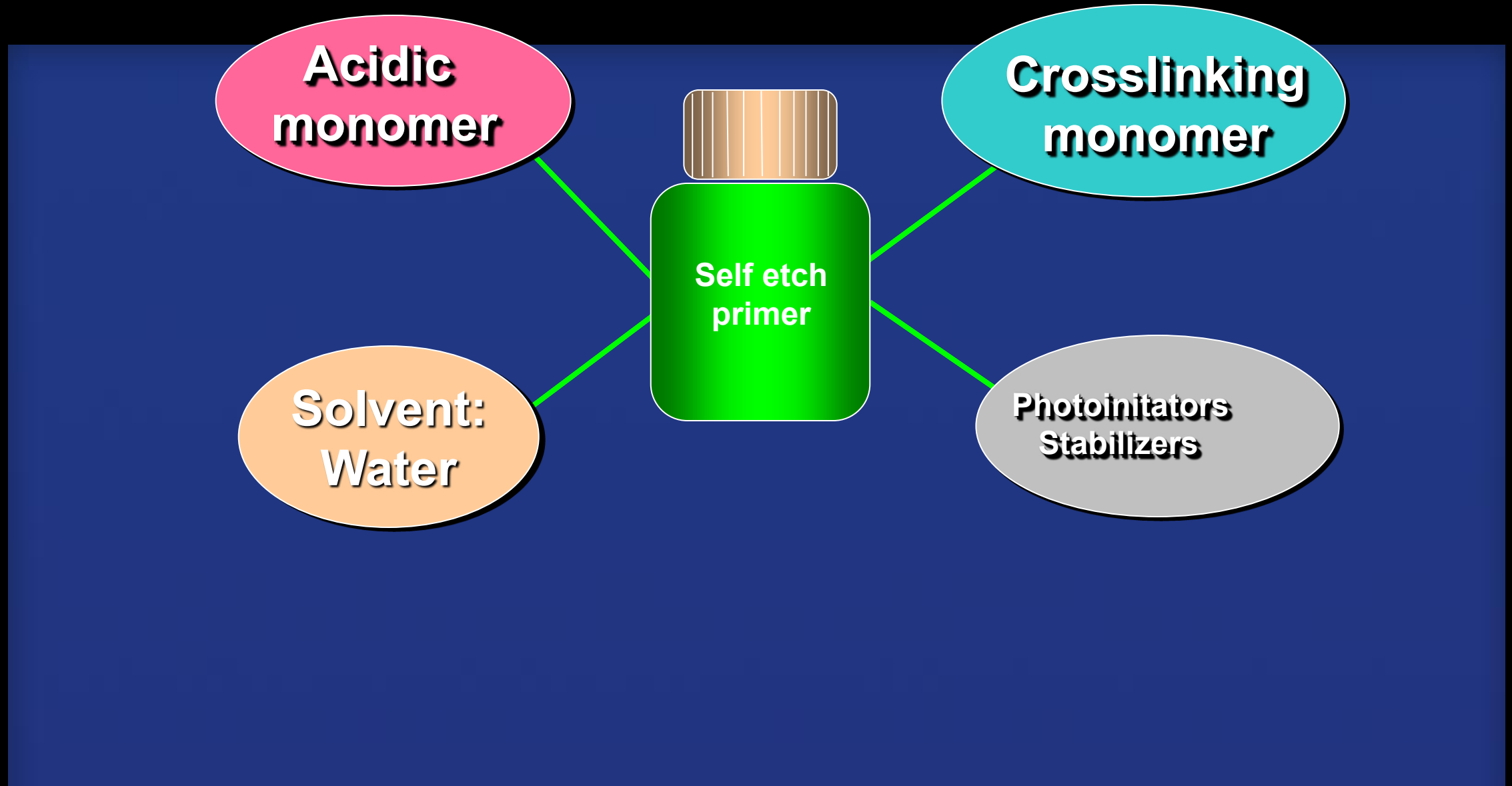
Four steps, I can make a mistake  
with any of them!

# Trends in the late 1990s

- ✎ To reduce post-op sensitivity (SE)
- ✎ To make easier procedure/
- ✎ Fewer steps
- ✎ High, consistent bond strengths

Hence the advent of the self etch adhesives!

# Composition of self etch adhesives



# ....Self-Etch Adhesives

- **Low post-op sensitivity**
  - **Post-op sensitivity drove self-etch market... better patient comfort!**

## CRA Review Nov/Dec 2003

**1. Do self etch primer adhesives result in less post-op sensitivity?**

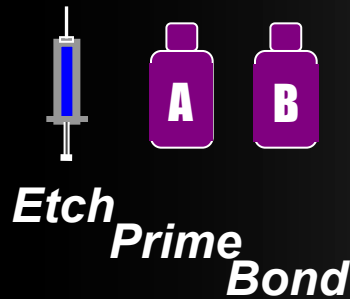
**Total-etch adhesives had 2x incidence of sensitivity than self-etch adhesives**

# Adhesive Review: early 1990s

## "Total-Etch"

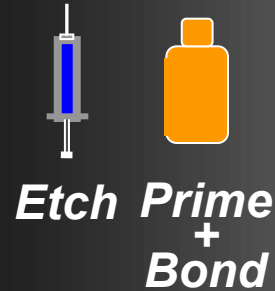
## "Self-Etch"

### 4<sup>th</sup> Generation



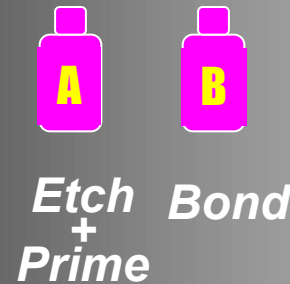
*Scotchbond Multipurpose*  
*Optibond FL*

### 5<sup>th</sup> Generation



*Scotchbond 1 XT*  
*Prime & Bond NT*  
*Optibond Solo*

### 6<sup>th</sup> Generation



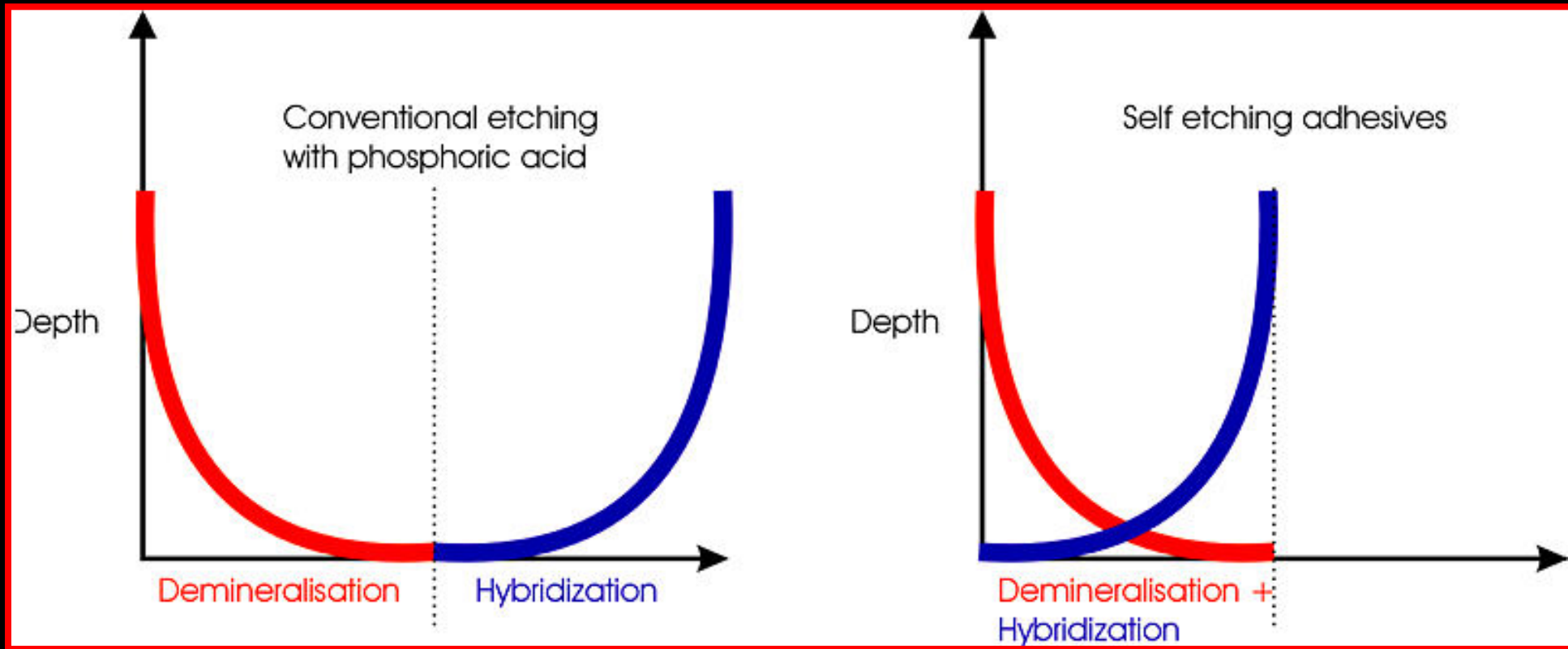
*Scotchbond™ SE*  
*Prompt L-Pop*  
*Clearfil™ SE Bond*  
*Brush & Bond™*

### 7<sup>th</sup> Generation



*Easy Bond*  
*Xeno® IV*  
*iBond®*  
*Clearfil™ S<sup>3</sup>*





Why we don't get post-op sensitivity from the so-called self-etch adhesives

# Burke FJT. What's new in dentine bonding? Dent.Update 2004;31:580-589.



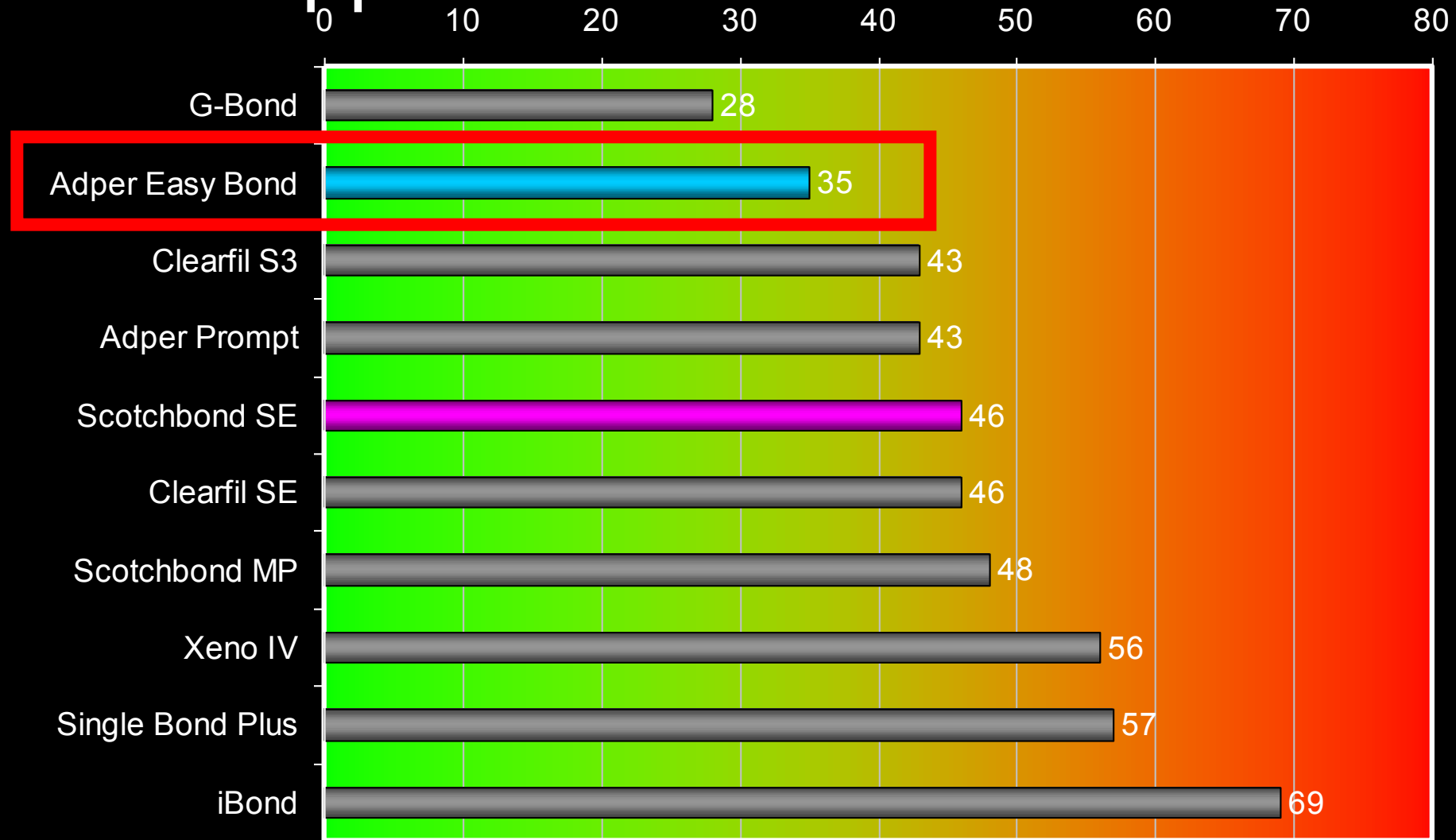
# Self-Etch Adhesives

(6<sup>th</sup> and 7<sup>th</sup> Generations)

- Low post-op sensitivity
- Less technique sensitive
- Moisture tolerant
- Good bond strengths
- Growing clinical history

# The 1990s: *SPEED!*

## Application Times in seconds



# Advantages of self-etching systems

- Simultaneous demineralisation and resin-infiltration
- No post-conditioning rinsing
- Possible time-saving application procedure
- Not sensitive to degree of wetness/dryness
- Low technique sensitivity

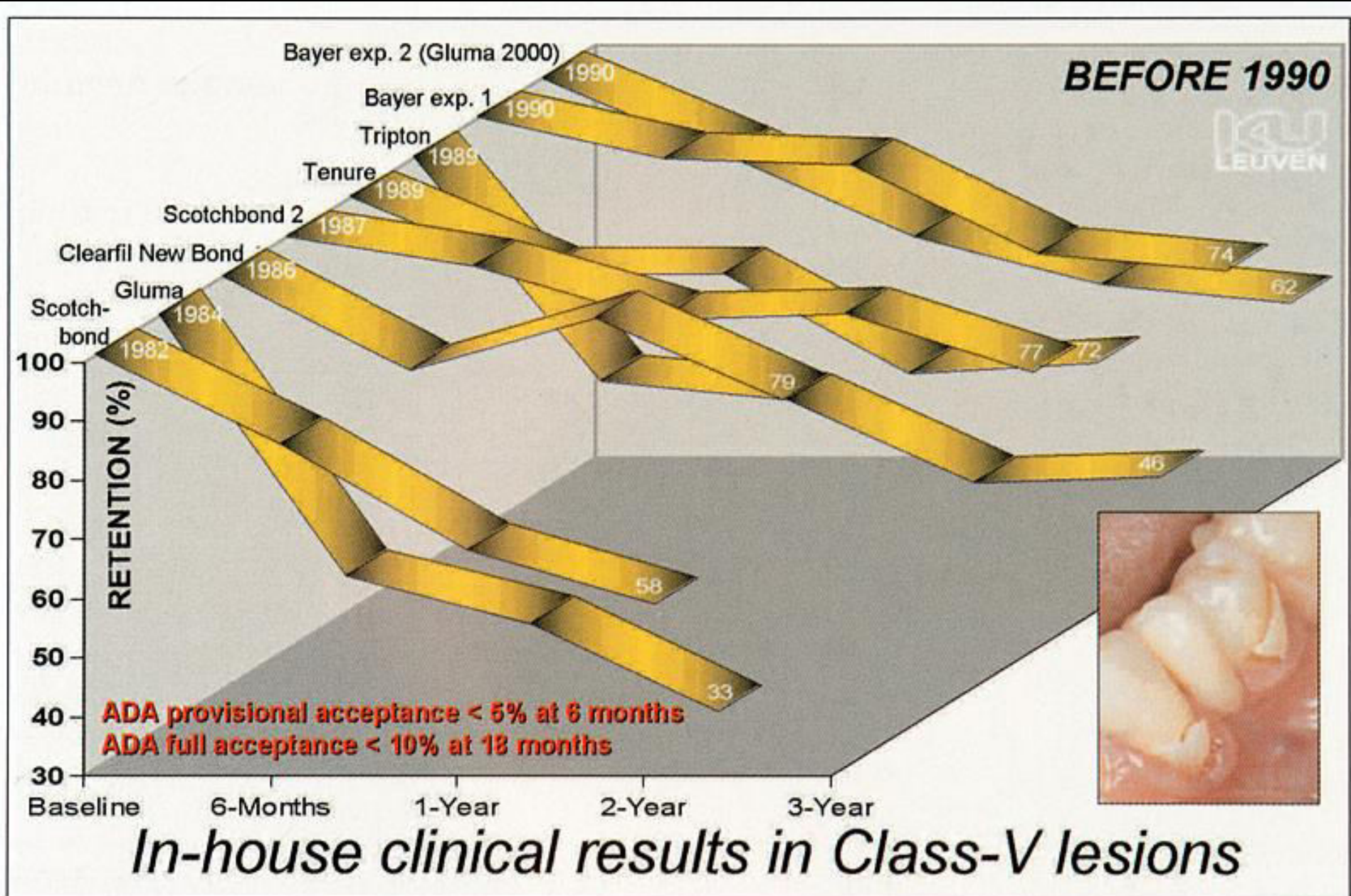
# Advantages of self-etching systems

- Single dose packaging possible
- Less risk of cross infection
- Consistent and stable composition
- Possibility for particle-filled adhesive
- Effective dentine desensitiser

Bonding, and technique  
sensitivity was improving!

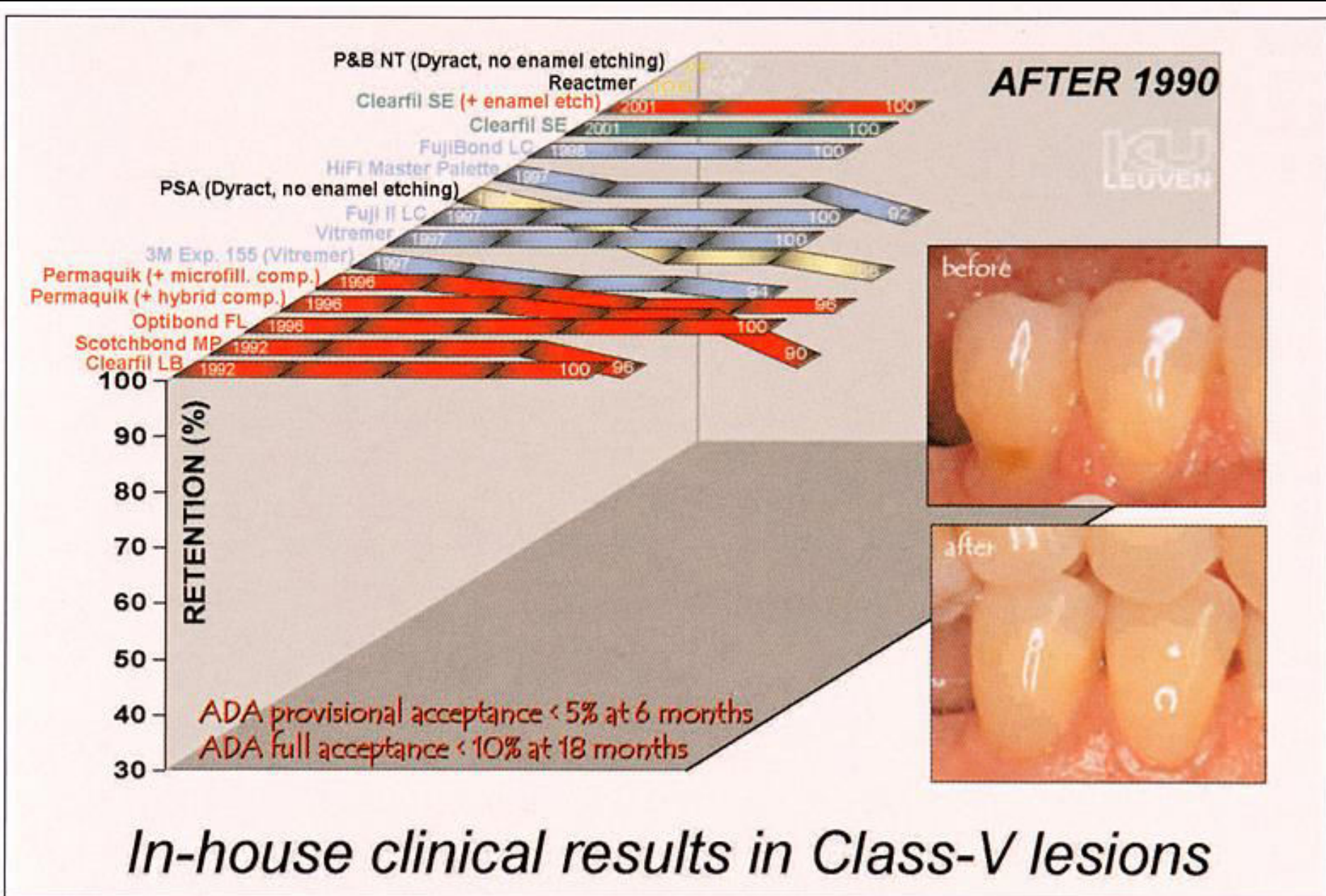


# From van Meerbeek et al., Oper Dent., 2003





# From van Meerbeek et al., Oper Dent.2003



# Self-Etch Adhesives

Acidic  
Monomers



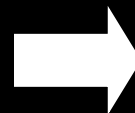
- MDP
- Di-HEMA-Phosphate
- MA 154
- Phenyl-P
- MAC-10
- 4-MET(A)

Crosslinking  
Monomers



- Bis-GMA
- UDMA
- TEGDMA
- GDMA
- HEMA

Solvent



- usually water based

# summary

Traditional  
technique

Technique  
tolerant

Long-term  
experience

**Etch  
& Rinse**

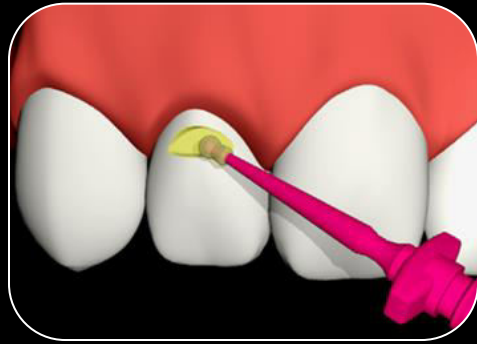
**Self  
Etch**

Time-saving

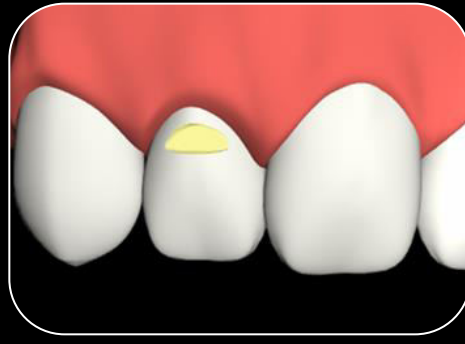
Retention  
pattern with  
optical control

Low  
post-  
operative  
sensitivity

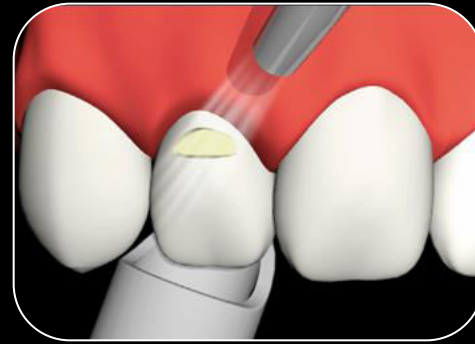
# G-BOND - Clinical technique



Apply



Wait

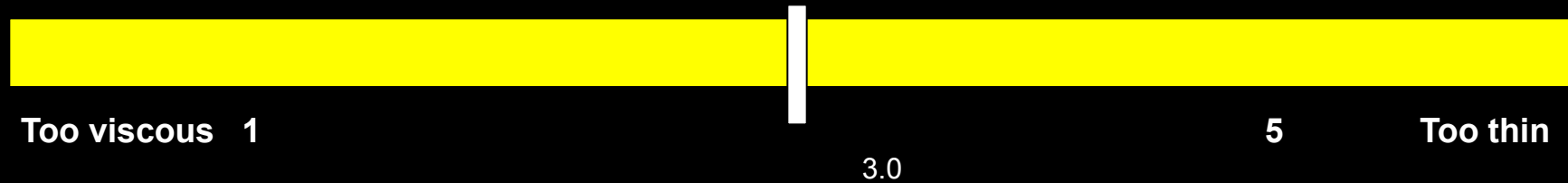


Dry



Light cure

# What the PREP Panel thought



**VISCOSITY OF BONDING AGENT**

# What the PREP Panel thought



This is a good result!



# Classification of dentine bonding systems

Review Article

## The four generations of dentin bonding

F. J. TREVOR BURKE, DDS, MDS, MSc, FDS, MGDS & A. DAVID MCCAUGHEY, MSc, FDS, MGDS

**ABSTRACT:** The achievement of an adhesive bond between enamel and restorative materials has been an objective for generations of dental research workers. Dentin bonding systems have been classified into generations, with earliest generations showing unreliable bond strengths. Modern systems show *in vitro* shear bond strengths to dentin which are similar to the bond to enamel, this being considered an ideal property. Alongside other previously recognized ideal properties, the following may be considered to be ideal for state-of-the-art dentin bonding systems at the present time may be considered to be ideal: (1) ability to operate in moist environments and be technique insensitive. (*Am J Dent* 1995; 8: 1-6).

**CLINICAL SIGNIFICANCE:** With the availability of new materials available to the clinician, it is essential that the ideal properties of dentin bonding systems are compared with currently available systems. This paper provides guidelines for the ideal properties of dentin bonding systems and compares these with currently available materials.

**CORRESPONDENCE:** Dr F. J. Trevor Burke, Restorative Dentistry, University Dental Hospital of Manchester, Higher Cambridge Street, Manchester M15 6FH, UK.

### Introduction

The achievement of bonding between restorative materials and tooth structure has been an elusive objective for dental research and development workers. Enamel, when acid etched, shows predictable and high bond strengths to resin-based restorative materials, but the development of a strong and durable bond to dentin has been more arduous.

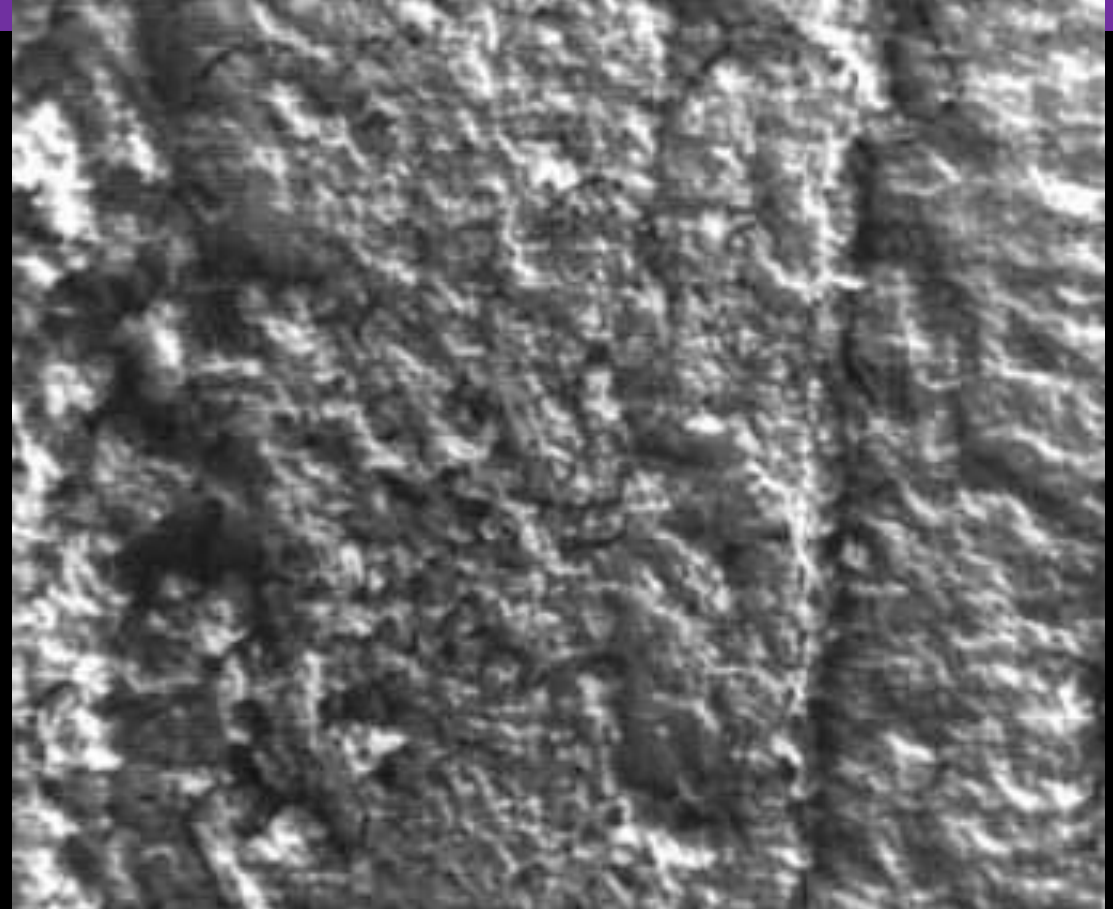
2. Provide a bond strength to dentin similar to that to enamel.
3. Show good biocompatibility to dental tissues, including the pulp.
4. Minimize microleakage at the margins of restorations.
5. Prevent recurrent caries and marginal staining.
6. Be easy to use and minimally technique sensitive.

No more generations!

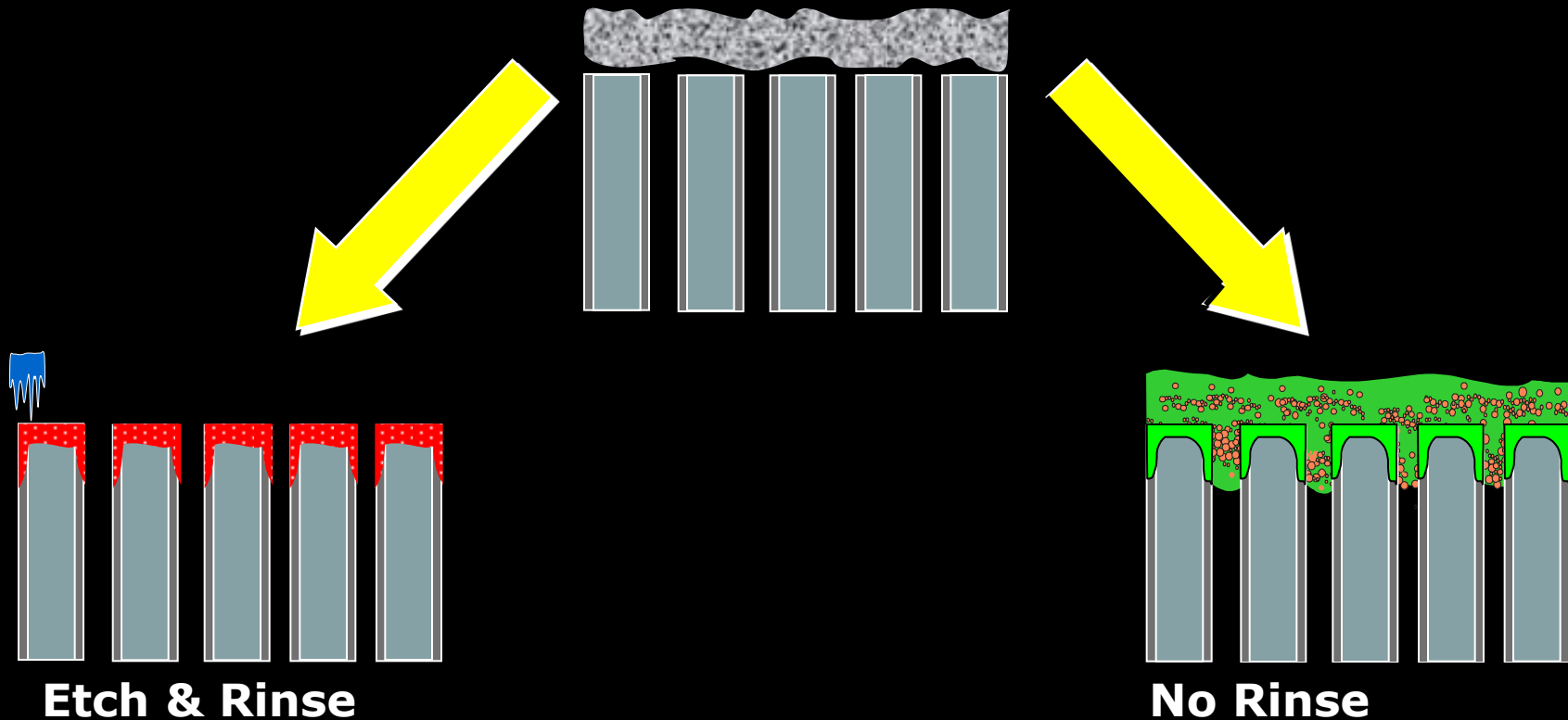


# The 1990s: The Smear Layer

- Thickness
  - 0.5 - 5.0 microns
- Will not wash off
- Weak bond to tooth
  - 2 – 3 MPa
- Soluble in weak acids



# Therefore: *Previous* Strategies to treat the smear layer



The quality of the  
hybridised  
dentine is more  
important than  
the bond  
strength

N.Nakabayashi, 2003

# Do Modern Adhesives Work (2005)?

## Abstract

The immediate effectiveness of contemporary adhesives is quite favorable, regardless of the approach used. In the long term bonding effectiveness of some adhesives drops dramatically, whereas the bond strengths of other adhesives are more stable.

... A comparison of contemporary adhesives revealed that the three-step etch-and-rinse adhesives remain the „gold standard“ in terms of durability. Any kind of simplification in the clinical application procedure results in loss of bonding effectiveness. Only the two-step self-etch adhesives approach the gold standard and do have some additional clinical benefits.

Turning the clock back!

If the tubules are  
sealed using a  
Dentine Bonding  
System.....

The modern application of the  
Hydrodynamic Theory

# The Hydrodynamic Theory of Dentinal Pain: Sensation in Preparations, Caries, and the Dentinal Crack Syndrome

Martin Brännström, DDS, Dr. Odont.

**The peculiar nature of dentin sensitivity is a source of puzzlement to the dentist. Dentin is a good insulator, but even small temperature changes that do not reach the pulp may cause pain. A series of studies are described that provide evidence that the main cause of dentinal pain is a rapid outward flow of fluid in the dentinal tubules that is initiated by strong capillary forces.**

The peculiar nature of dentin sensitivity is a source of puzzlement to the dentist. How can the neck of a tooth sometimes be so sensitive to the slightest touch? Why may an air blast directed toward exposed dentin cause so much pain while careful grinding of the same surface using a water coolant may elicit only a slight response? How can we explain tooth sensitivity associated with

the cavities was then subjected to negative pressure or desiccation. The teeth were subsequently extracted and prepared for light and electron microscopic examination.

In my first experiment on pairs of human premolars, reduced pressure using a vacuum pump was applied for 20 s and 2 min to cavities randomly selected for testing in one-half of the teeth. No suction was applied to cavities in contralateral control teeth. Pain was elicited instantly in the experimental teeth and continued until the suction was removed. Histological evaluation of these teeth revealed that odontoblast nuclei had been displaced from the odontoblast layer into the dentinal tubules beneath the area of dentin where the suction had been applied. More than 100 nuclei could be visualized in each histological section from the affected area (Fig. 1). No aspirated nuclei were seen in

# Maximising class V effectiveness

## The survival of Class V restorations in general dental practice: part 3, five-year survival

D. Stewardson,<sup>1</sup> S. Creanor,<sup>2</sup> P. Thornley,<sup>3</sup> T. Bigg,<sup>4</sup> C. Bromage,<sup>5</sup>  
A. Browne,<sup>6</sup> D. Cottam,<sup>7</sup> D. Dalby,<sup>8</sup> J. Gilmour,<sup>9</sup> J. Horton,<sup>10</sup> E. Roberts,<sup>11</sup>  
L. Westoby<sup>12</sup> and T. Burke<sup>13</sup>

### IN BRIEF

- This study reminds dentists that they are the most important factor determining the survival of Class V restorations.
- Presents evidence that has been collected from a large number of restorations placed in dental practices and is therefore likely to be particularly relevant to general practitioners.
- Identifies a number of factors associated with poor restoration survival which can help dentists improve their patient care.

### RESEARCH

**Objective** To evaluate the survival over five years of Class V restorations placed by UK general practitioners, and to identify factors associated with increased longevity. **Design** Prospective longitudinal cohort multi-centre study. **Setting** UK general dental practices. **Materials and method** Ten general dental practitioners each placed 100 Class V restorations of varying sizes, using a range of materials and recorded selected clinical information at placement and recall visits. After five years the data were analysed using the Kaplan-Meier method, log-rank tests and Cox regressions models to identify significant associations between the time to restoration failure and different clinical factors. **Results** After five years 275/989 restorations had failed (27.8%), with 116 (11.7%) lost to follow-up. Cox regression analysis identified that, in combination, the practitioner, patient age, cavity size, moisture contamination and cavity preparation were found to influence the survival of the restorations. **Conclusions** At least 60.5% of the restorations survived for five years. The time to failure of Class V restorations placed by this group of dentists was reduced in association with the individual practitioner, smaller cavities, glass ionomer restorations, cavities which had not been prepared with a bur, moisture contamination, increasing patient age, cavities confined to dentine and non-carious cavities.



Maximising class V effectiveness:  
what is associated with failure at 5 years?

Restorations involving dentine only:  
hazard of failure increased by 39%

Large restorations compared with small:  
hazard of failure increased by 85%

Major or minor moisture contamination:  
hazard of failure increased by 29%

Preparation method/rotary instrument used:  
hazard of failure decreased by 40%

Maximising class V effectiveness:  
what material is best at 5 years?

Five year survival

RMGI, compomer and composite have  
significantly longer time to failure than GI

Compomer 71.2%

Flowable composite 69%

Composite 68.3%

Glass ionomer 50.6%

# Class V meta analysis: conclusions

“The dentist shall roughen the dentine and enamel surfaces”

“Additional bevelling of enamel can be omitted”

“Isolation with rubber dam is recommended”





F J Trevor Burke

# Dental Materials: What Goes Where? Class V Restorations

**Abstract:** A large number of Class V restorations are placed per annum to restore cervical lesions. This paper evaluates the pathogenesis of these lesions, with particular reference to the role of occlusal factors, and reviews the literature in order to provide advice on the material(s) which are most likely to produce optimal longevity of a Class V restoration.

**CPD/Clinical Relevance:** Resin-modified glass ionomer materials appear to provide optimal survival for a Class V restoration, but a (flowable) composite might produce a better aesthetic result.

**Dental Update 2015; 42: 829–839**

# Bonding to dentine: How Nature Does It

# 10 MPa

As a rule of thumb – with 15 to 20 MPa of bond strength you are usually on the safe side.

E. Swift, ADA 2002, New Orleans

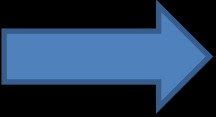

What  
Is  
20 MPa?



**So**, the classification *until recently*  
of dentine bonding systems

**1. Etch and rinse**

**(etch & bond, total etch)**

**2. Self etch**  **One bottle**  
 **Two bottles**



# Five-year Clinical Effectiveness of a Two-step Self-etching Adhesive

Marleen Peumans<sup>a</sup>/Jan De Munck<sup>b</sup>/Kirsten Van Landuyt<sup>c</sup>/Paul Lambrechts<sup>a</sup>/  
Bart Van Meerbeek<sup>a</sup>

**Purpose:** The purpose of this prospective randomized controlled clinical study was to evaluate the clinical performance of a “mild” two-step self-etching adhesive, Clearfil SE, in Class V restorations after 5 years of clinical functioning.

**Materials and Methods:** Twenty-nine patients received two or four restorations following two randomly assigned experimental protocols: (1) a mild self-etching adhesive (Clearfil SE, Kuraray) was applied following manufacturer's instructions on both enamel and dentin (C-SE non-etch); (2) similar application of Clearfil SE, but including prior selective acid-etching of the enamel cavity margins with 40% phosphoric acid (C-SE etch). Clearfil AP-X (Kuraray) was used as the restorative composite for all 100 restorations. The clinical effectiveness was recorded in terms of retention, marginal integrity, marginal discoloration, caries recurrence, postoperative sensitivity, and preservation of tooth vitality after 5 years of clinical service. The hypothesis tested was that selective acid etching of enamel with phosphoric acid improved retention, marginal integrity, and clinical microleakage of Class V restorations.

**Results:** Only one restoration of the C-SE non-etch group was lost at the 5-year recall. All other restorations were clinically acceptable. Marginal integrity deteriorated with time in both groups. The number of restorations with defect-free margins was significantly lower in the C-SE non-etch group ( $p = 0.0043$ ). This latter group presented significantly more small incisal marginal defects on the enamel side ( $p = 0.0169$ ). Superficial marginal discoloration increased in both groups, but was more pronounced in the C-SE non-etch group and was related to the higher frequency of small incisal marginal defects.

**Conclusion:** The clinical effectiveness of the two-step self-etching adhesive Clearfil SE remained excellent after 5 years of clinical service. Additional etching of the enamel cavity margins resulted in an improved marginal adaptation on the enamel side; however, this was not critical for the overall clinical performance of the restorations.

**Keywords:** adhesives, clinical trial, cervical lesions, composite restoration.

introducing a new approach....  
the concept of selective enamel  
etching  
(with so-called self-etch  
adhesives)

....introducing

a new group of dentine bonding agents

Universal bonding agents

# Treatment of the smear layer

- 👄 REMOVE (Etch & Rinse/Total etch)
- 👄 LEAVE/PENETRATE (Self etch)
- 👄 UNIVERSAL MATERIALS (Etch & Rinse, Selective enamel etch, Self etch) (use for direct and indirect)

**NEW!!**

# Scotchbond Universal Adhesive

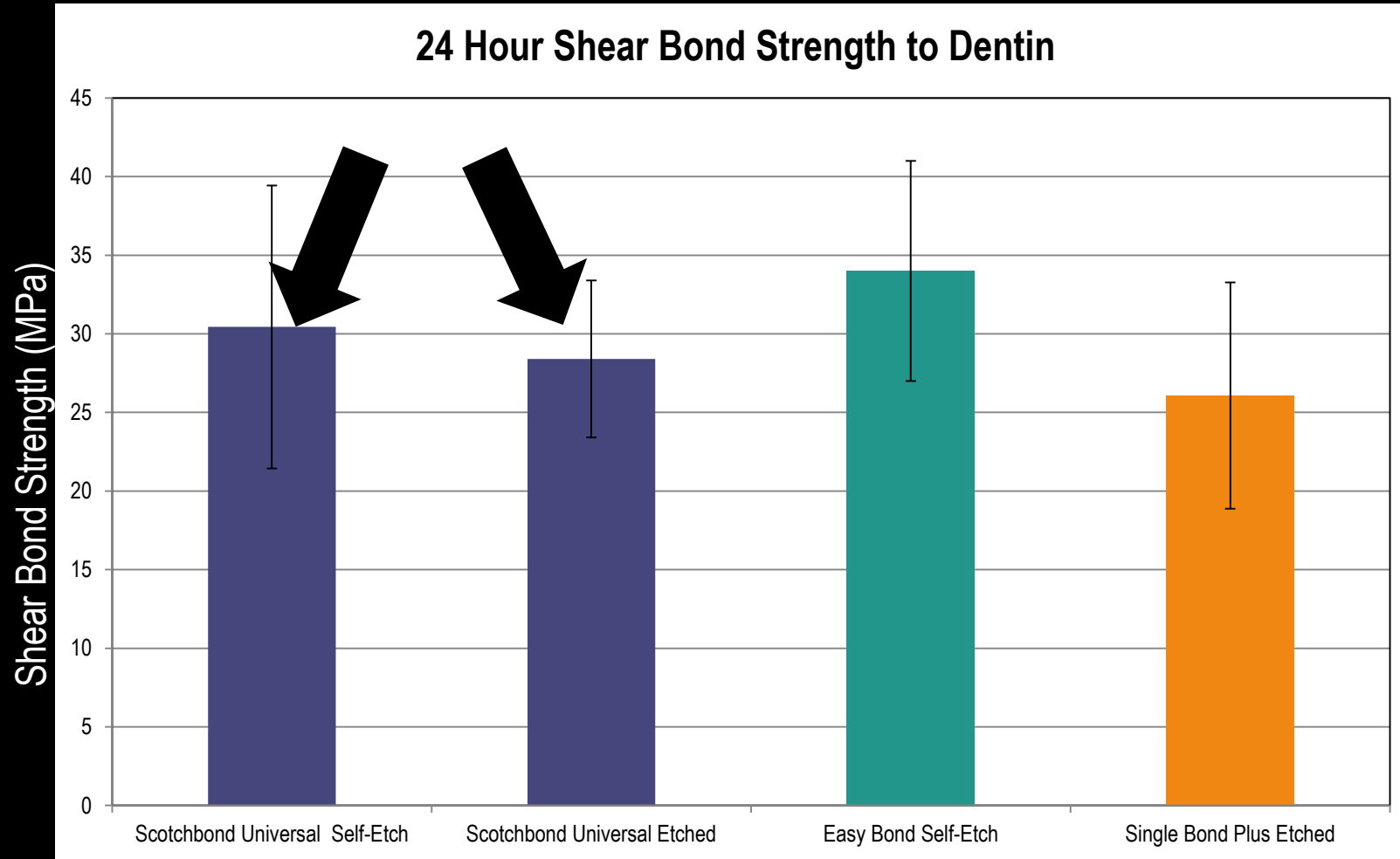
- 📖 Works with both Total- and Self-Etch technique, therefore high flexibility in clinical procedures
- 📖 Provides procedural simplicity
- 📖 Total-etch or Selective-enamel etch for highest enamel bond strength, e.g. incisal edges
- 📖 Self-etch for low post-op sensitivity
- 📖 Fast technique where isolation is difficult, or with non-co-operating patients

# Scotchbond Universal Adhesive: Composition

- BisGMA
- MDP
- Vitrebond Copolymer
- HEMA
- Ethanol
- Water
- Filler
- Silane
- Initiators



# Dentine Shear Bond Strength – Etched and Unetched

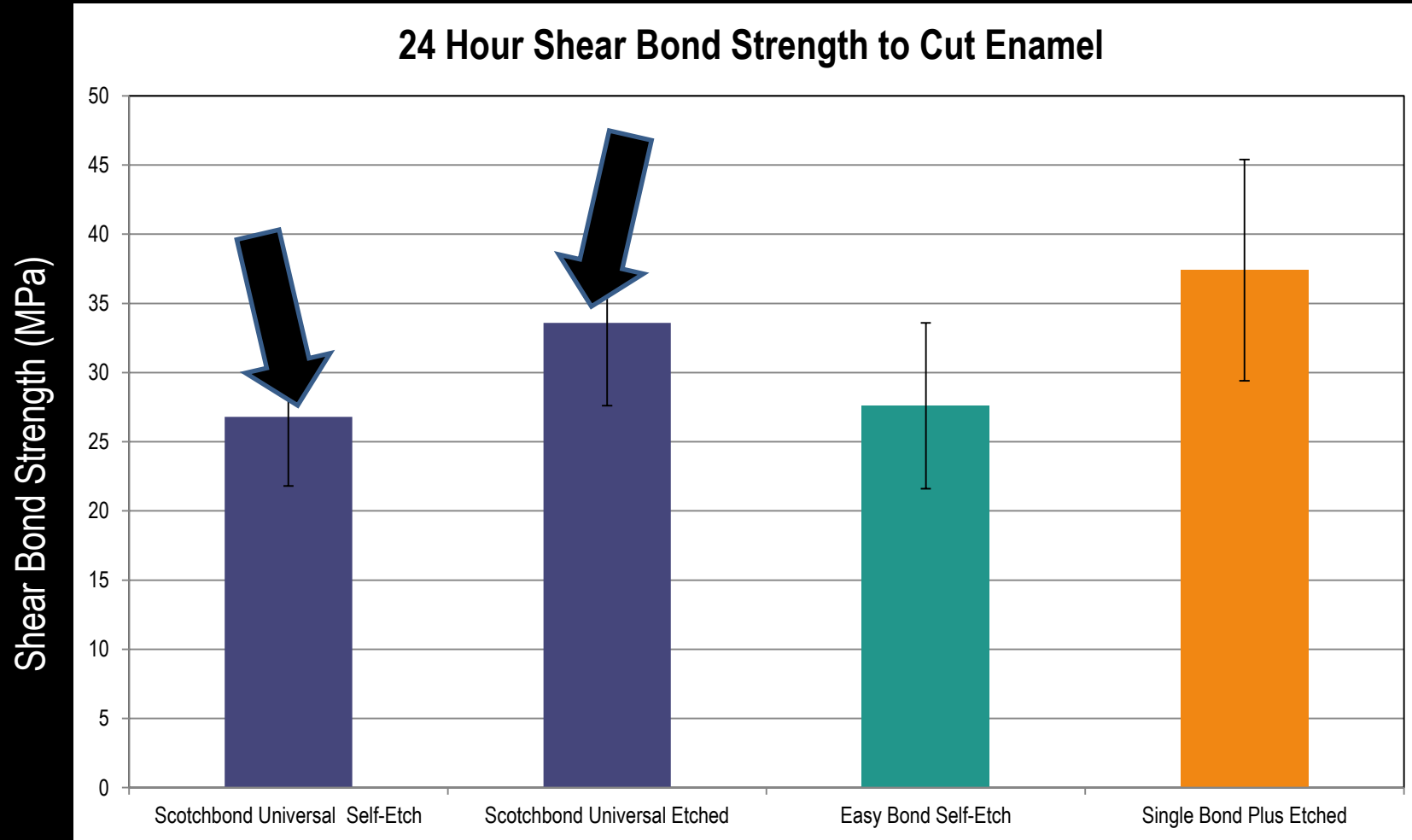


\*Study will also examine 11 month aged adhesion

Burgess J. et al, University of Alabama



# Cut Enamel Shear Bond Strength – Etched and Unetched



\*Study will also examine 11 month aged adhesion

Burgess J. et al, University of Alabama

# SUGGESTION

For Scotchbond Universal,  
the

concept of  
selective enamel etching  
should be employed

# Handling evaluation of 3M ESPE Scotchbond Universal by the PREP Panel

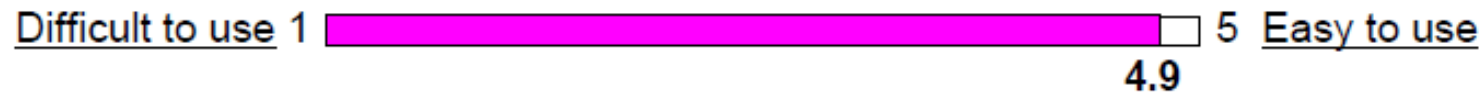
- 👉 12 evaluators
- 👉 Variety of bonding agents used pre-study
- 👉 875 restorations placed (Class 1:172, Class II:189, Class III:134, Class IV:178, Class V:182, Other:20)  
Also used for dentinal hypersensitivity, repair of fractured porcelain, bonding of posts.
- 👉 Rated material on visual analogue scales
- 👉 75% of evaluators would be prepared to pay extra for the convenience of single-unit doses
- 👉 All stated that the resin liquid easily wet the tooth surface, that the bond was easily visible. Some commented that it was “too yellow”

# Handling evaluation of 3M ESPE Scotchbond Universal by the PREP Panel

## Ease of use of previous bonding agent

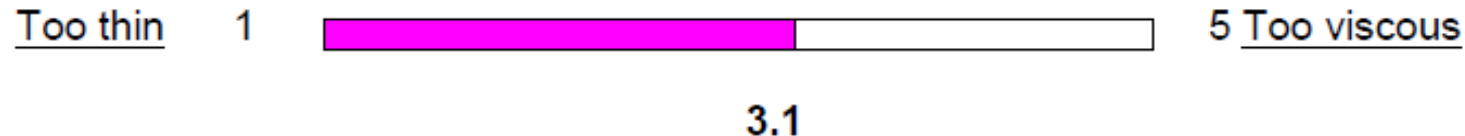


## Ease of use of Scotchbond Universal



## Viscosity of Scotchbond Universal

The viscosity of the bonding liquid was rated by the evaluators as follows:



# Handling evaluation of Scotchbond Universal by the **PREP** Panel: Comments

📖 All the evaluators stated that they would purchase if available at average price.

📖 “Extremely useful to have a material that bonds both to indirect restorations as well as the tooth structure. No need for multiple kits of materials. So far has worked well.”

# Handling evaluation of Scotchbond Universal by the **PREP** Panel: Comments

📖 “Disconcertingly yellow – but  
OK when thinned or light cured”

📖 “Spreads well when air applied”

📖 “Supposedly the lid can be  
opened one-handed but it is  
sometimes a problem”

📖 “First material that compares  
with G-Bond”

# Conclusions re SBU colour

- 🕒 Uncured Scotchbond Universal *is* more yellow than some other adhesives
  - 🕒 *Higher camphorquinone content gives high degree of conversion*
  - 🕒 *Better visibility on tooth in uncured state for safe application*
  - 🕒 *Lower solvent content for increased working time and uniform film thickness*
- 🕒 Yellow colour is barely visible after air drying step and bleaches upon light curing

**BEWARE!**

Any remaining yellow colour after the light curing step indicates incomplete cure and can be bleached by repeating the light cure or extending the curing time



...in my treatment  
of tooth wear

# Patient Information Leaflet

## Information sheet for patients receiving resin composite restorations for treatment of tooth wear

Your anterior teeth will receive adhesive resin composite restorations to cover the exposed dentine and prevent it from wearing further: this is the principal reason for treatment

An improvement in appearance of your teeth will be effected if possible

You will not be able to chew on your back teeth for a period of 3 to 6 months, and you should therefore cut your food into small pieces to avoid intestinal symptoms

Your back teeth will eventually erupt so that you will be able to chew on them again after 3 to 6 months

The change in shape of your upper anterior teeth might cause lisping for a few days

Your front teeth may be a little tender to bite upon for a few days

Your “bite” will feel very unusual for several days and you may find difficulty in chewing for this period, as you will be unsure exactly where to place your jaw to get tooth to tooth contact: however, you should become accustomed to your new “bite” after a few days

The procedure will normally be carried out without the need for local anaesthesia as there will be no, or minimal, need for tooth reduction.

If you have crowns, bridges or a denture in the posterior part of your mouth, it is likely that these will require replacement.

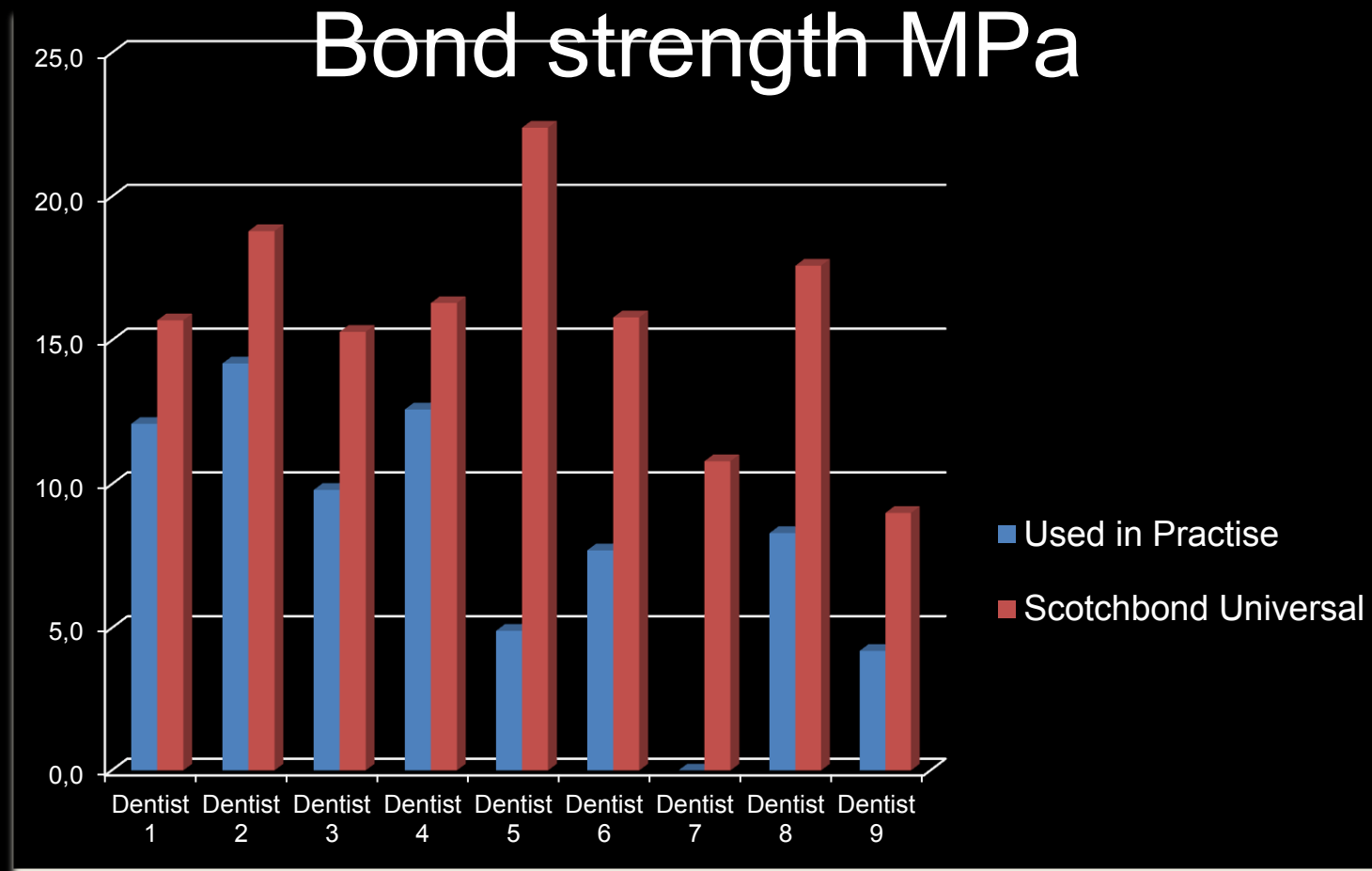
Regarding the longevity of the restorations:

The reliability of the restorations should be good, but that there was a small potential for restorations to de-bond, since bonding

The ma

Occasid

**A small % of restorations debond**



This is not exact science, but it is similar to what dentists do in their surgeries, and suggests that ease of use might contribute to an improved bond strength

Own label  
brands:  
Research  
evidence

An example...

# There is no evidence base for “own label” Glass Ionomer materials

DentalMaterials



Steffen Mickenautsch

## How Well are GIC Product Labels Related to Current Systematic Review Evidence?

**Abstract:** Systematic reviews have been recommended as providing the best source of evidence to guide clinical decisions in dentistry. They appraise evidence from trials focused on investigating clinical effects of dental material categories, such as conventional glass-ionomer cements (GIC) or resin-modified GIC. In contrast, the general dental practitioner is introduced to these categories of materials in the form of branded or private product labels that are marketed during dental conventions or through advertisements. Difficulties may arise in recognizing material categories that have been subjected to systematic reviews, because of the multitude of product labels on the current market. Thus, the value and relevance of published systematic review evidence concerning the material categories represented by these labels may remain obscure. Based on a systematic literature search, this article identifies glass-ionomer cement product labels used during clinical trials which, in turn, were subsequently reviewed in systematic review articles (published between 15 April 2009 and 14 April 2011). This article further clarifies how these product labels relate to the systematic review conclusions. The results show that the conventional and resin-modified glass-ionomer cements that were used in most trials were marketed by GC and 3M ESPE, respectively. The conventional GICs used in most of the reviewed trials were Fuji III and Fuji IX, while Vitremer was the most commonly used resin-modified GIC. Evidence from the reviewed trials suggests that GIC provides beneficial effects for preventive and restorative dentistry. However, more trials of higher internal validity are needed in order to confirm (or disprove) these findings. Only GIC products of branded labels and none of private labels were identified, suggesting that private label GIC products have little or no research back-up.

**Clinical Relevance:** Dental products, such as glass-ionomers cements (GIC), can only be judged as effective when they are based on sufficient research back-up. Systematic reviews of clinical trials provide such back-up at the highest level. Thus clinicians must be able to identify GIC products for which reliable evidence from systematic reviews of clinical studies is available and know about what such evidence contains.

**Dent Update 2011; 38: 634–644**



FJ Trevor Burke

## Me Too 3

Welcome to another year of *Dental Update*, a special 40th Anniversary year which will see the publication of a 40th Anniversary issue which will reflect upon the contents of the first issue from May 1973. I hope that you will enjoy it all.

I have previously written on the subject of own label adhesives,<sup>1,2</sup> questioning the wisdom of purchasing cheaper materials which may not have been researched in the way that materials should be. A paper which I presented at a recent research meeting concludes my 'evidence' on this subject.

### References

1. Burke FJT. Me too. *Dent Update* 2010; 37: 137.
2. Burke FJT. Me too 2. *Dent Update* 2011; 38: 586-592.

## The evidence base for 'own label' resin-based dental restoratives

**Abstract:** There is anecdotal evidence that sales of 'own-label' (OL) or 'private label' dental products is increasing, as dentists become more cost conscious in times of economic downturn. However, the purchase of such (less expensive) products could be a false economy if their performance falls below accepted standards. So, while the examination of a resin-based product under research conditions alone may not guarantee success, it could be considered that a material which has been subjected to testing under research conditions will demonstrate its effectiveness under laboratory conditions or reveal its shortcomings; either of these being better than the material not being examined in any way. It was therefore considered appropriate to determine the materials on which research was carried out, with particular reference to OL brands.

**Objective:** To determine whether there is a research base behind OL resin-based restorative dental materials.

### Methods

The abstract memory stick for the IADR meeting in March 2011 in San Diego was examined. All abstracts included in the 'Dentine adhesives' and

'Composite' sections were read in full and examined in order to identify the names of products mentioned in the abstracts. These were recorded and tabulated. Any product which did not state the manufacturer was further investigated by an internet search.

Product Name	Number of Mentions in Research Abstracts
Clearfil SE Bond (Kuraray)	40
Scotchbond Multipurpose (3M ESPE)	29
Adper Easy Bond (3M ESPE)	17
Optibond Solo (Kerr)	17
Prompt L Pop (3M ESPE)	10
Optibond FL (Kerr)	10
Optibond all-in-one (Kerr)	10

**Table 1.** Most frequently mentioned dentine-bonding agents in the 'Bonding agent' research abstracts.

# ZERO evidence base for "own label" resin-based materials

## 'Own-Label' Versus Branded

Some own label materials performed as well in testing as those from manufacturers in the field

Keywords

Filler

Degree of Conversion

## Property Comparisons

However, greater batch to batch variation in several mechanical & physical properties of the own-label materials was noted

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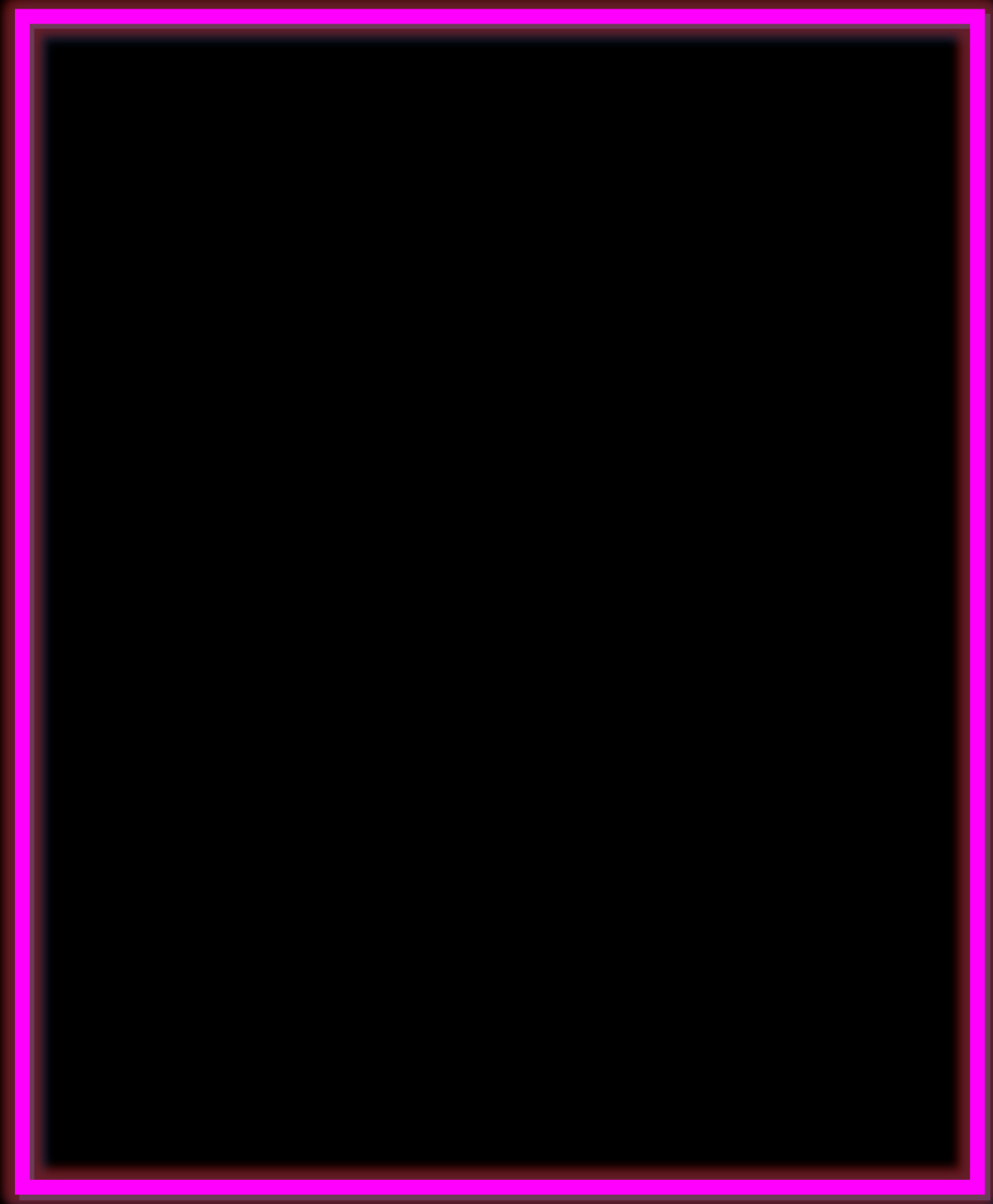
\* General Dental Practitioner, Harrogate, UK

Results indicated that own-label dental resin composites produced similar results to materials from established companies in terms of flexural strength characteristics and degree of conversion. However, a greater batch-to-batch variation in several mechanical and physical properties of the own-label materials was noted.

## INTRODUCTION

The dental materials market is competitive and the product cycle of "new" dental resin-based composites replacing older types may be rapid. Resin composite materials, which are becoming increasingly used by dentists worldwide,<sup>1</sup> are the subject of a large volume of research which aims to improve reliability, durability and clinical longevity and their associated properties such as polymerisation shrinkage stress,<sup>2,3</sup> polymer conver-

Own label  
brands:  
Research  
evidence





# What's in Clearfil Universal?

10-MDP

What a surprise!!

Bis-GMA

2-HEMA

Hydrophilic aliphatic dimethacrylate

Colloidal silica

Silane coupling agent

Di-Camphorquinone

Ethanol

Water

# Futurabond U

Liquid 1:

BisGMA, HDDMA, UDMA, HEMA,  
fumed silica, CQ, 10 MDP

Liquid 2:

Ethanol, water, catalyst

pH.....2.3

## All-Bond Universal

- 10-MDP
- Phosphate monomer
- HEMA
- BisGMA
- Ethanol

pH 3.1

# Adhese Universal (Ivoclar-Vivadent)

Monomer Name	Type	Purpose
<b>MDP</b> Methacryloyloxydecyl dihydrogen phosphate	Phosphoric acid methacrylate	Forms strong bond to hydroxyapatite surfaces. Promotes adhesion to tooth surface by formation of non-soluble $\text{Ca}^{2+}$ salts.
<b>MCAP</b>	Methacrylated carboxylic acid polymer	Carboxylic acid functional polymer reacts with and bonds to hydroxyapatite. The presence of many carboxylic acid groups along a polymeric backbone/chain allows multiple bonds to the tooth surface.
<b>HEMA</b> Hydroxyethyl methacrylate	Hydrophilic mono- functional methacrylate	Promotes wetting of polar / inorganic and moist surfaces. Assists penetration of liquid filled dentinal tubuli.
<b>Bis-GMA</b> Bisphenol A glycidyl methacrylate	Hydrophilic / hydrophobic crosslinking dimethacrylate	Facilitates compatibility of hydrophilic HEMA and hydrophobic D3MA in the presence of water, thereby preventing phase separation of adhesive. Imparts high mechanical strength and resilience to adhesive layer.
<b>D3MA</b> Decandiol dimethacrylate	Hydrophobic crosslinking dimethacrylate	Enables the reaction of the adhesive with the less polar monomers of the filling or luting composite.

# What's in GC Premio Bond?

4-META

10-MDP

10-Methacroyldecyl  
dihydrogen thiophosphate

Methacrylate ester

Acetone

Distilled water

Photoinitiators

Silica fine powder

# What's in Coltene One Coat 7 Universal?

10-MDP

Methacrylated polyacid

2-HEMA

Urethane dimethacrylate

Photoinitiators

Ethanol

Water

No silane: does that matter?

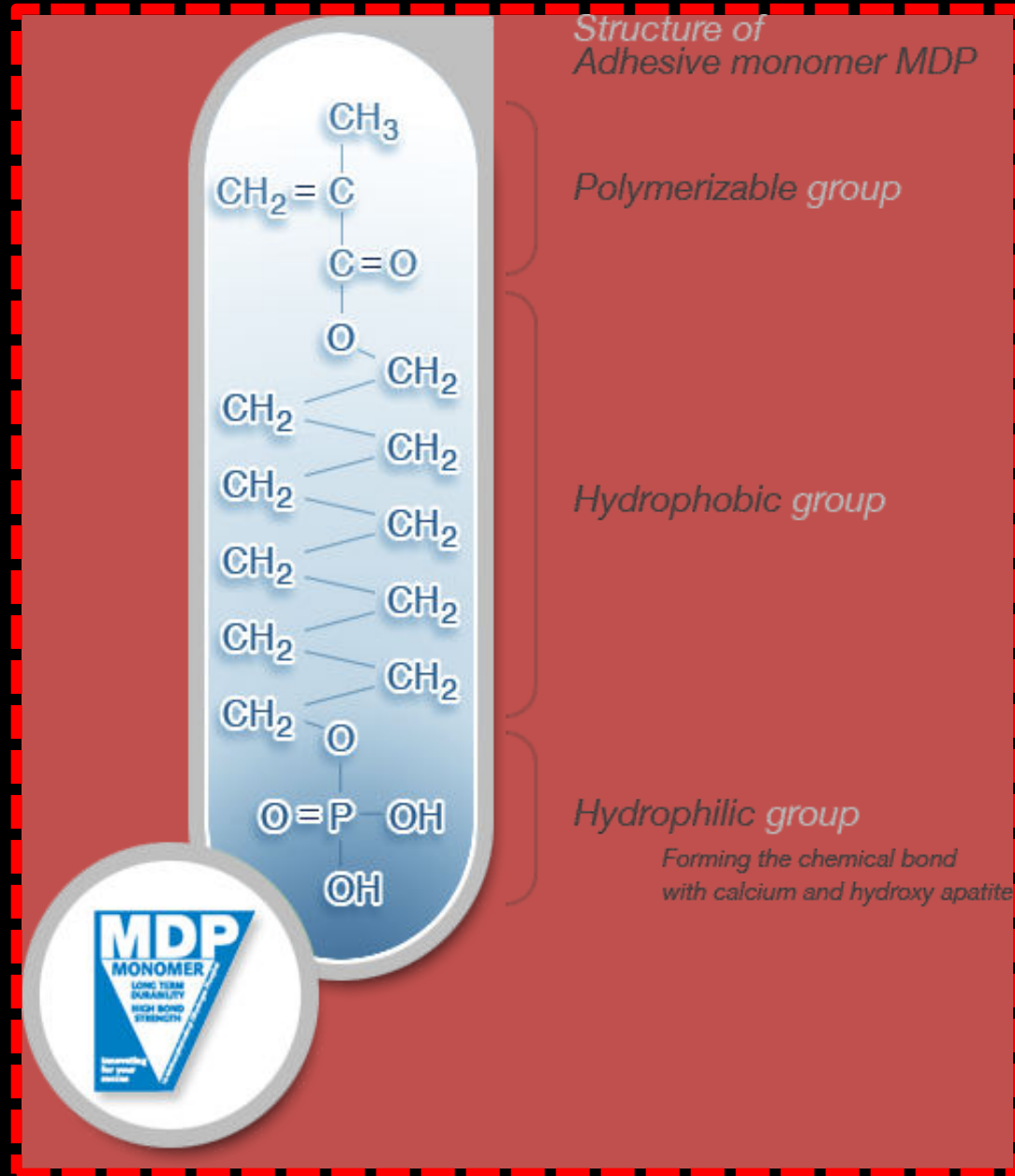
# A new Universal from Dentsply

What's in it?

10-MDP  
PENTA  
Initiator  
Isopropanol  
Water

pH=2.5

Why has 10-MDP become so popular?



10-MDP is important for the bond reaction with HAP





FJ Trevor Burke

Anna Lawson, David JB Green and Louis Mackenzie

## What's New in Dentine Bonding?: Universal Adhesives

**Abstract:** The ability to bond restorations to dentine successfully is central to minimally invasive restorative dentistry. While dentine-bonding agents have gone through a variety of 'generations', it is the purpose of this paper to describe the latest dentine-bonding agents, the Universal Bonding Agents. These materials may be considered 'Universal' insofar as they may be considered to be capable of being used for direct *and* indirect dentistry, as well as being suitable for use in whichever etching modality the clinician considers appropriate, namely self-etch, etch and rinse or selective enamel etch. Laboratory investigations and initial clinical studies hold the promise that Universal Bonding Agents are a forward step in the quest for the ultimate bond to tooth substance.

**CPD/Clinical Relevance:** New Universal Bonding Agents appear to present a promising advance in bonding to dentine.  
**Dent Update 2017; 44: ??? ??**

Dentine-bonding agents play a strategic role in the sealing and retention (where necessary) of resin composite restorations, which are increasingly placed by dentists worldwide.<sup>1</sup> Bonding to dentine is also central to the practice of minimally invasive dentistry, given that bonded restorations do not require macro-mechanical retentive features such as locks and keys, which are a feature of non-adhesive (amalgam) cavity preparations.<sup>2</sup>

**FJ Trevor Burke**, DDS, MSc, MDS, MGDS, FDS(RCS Edin), FDS RCS(Eng), FFGDP (UK), FADM, Primary Dental Care Research Group, University of Birmingham School of Dentistry, **Anna Lawson**, BDS, MSc, MPDC(RCS Edin), General Dental Practitioner, Nottingham, **David JB Green**, BDS(Hons), BSc, MFDS RCS(Edin), StR Restorative Dentistry, Birmingham Dental Hospital and **Louis Mackenzie**, BDS, General Dental Practitioner, Birmingham and University of Birmingham School of Dentistry, 5 Mill Pool Way, Pebble Mill, Birmingham B5 7EG, UK.

A dentine-bonding agent should perform the following functions:<sup>3</sup>

- Provide a strong, immediate and permanent bond to dentine;
- Seal the cavity and minimize leakage;
- Resist microbial or enzymatic degradation;
- Provide adhesion *per se* of the restoration in cases where this is necessary;
- Prevent post-operative sensitivity;
- Reduce the risk of recurrent caries;
- Prevent marginal staining;
- Be easy to use.

It is the intention of this paper to update readers on the new group of Universal Dentine Bonding Agents, this being a follow-up to a paper published in 2004 giving details of the last major innovation in bonding to dentine, the introduction of the so-called self-adhesive dentine bonding agents<sup>3</sup> and to other *Dental Update* publications on the subject which readers may wish to read as background or a further update, such as those by Green and Banerjee,<sup>2</sup> Green, Mackenzie and Banerjee<sup>4</sup> and others.<sup>5,6</sup>

### A brief history of bonding to dentine

In the past, dentine-bonding agents were classified into generations.<sup>7</sup> However, this means of identifying different groups of bonding agents fell into disarray because of the failure of authorities in the subject to agree on the type of bonding agent which fitted a given 'generation'. Until recently, the classification has therefore been simply, glass ionomer materials, and resin-based dentine-bonding agents, the latter being further classified into *etch and rinse* materials and *self-etch* materials, with some workers classifying the self-etch materials according to their pH.<sup>8</sup>

There are two principal means by which a bond to dentine may be achieved:<sup>9</sup>

- First, glass ionomer materials (GIC – glass-ionomer cements) which were developed in the 1970s, initially being derived from the Fluoro-Alumino-Silicate glass used in the silicate cement materials which were used until the 1960s, but with the phosphoric acid used in silicate cements being substituted by a

# Do you want to read more?

# SUMMARY: Universal bonding agents:

Can be used in total etch, self etch, selective enamel etch modes

Are compatible with direct & indirect procedures

Can be used with self & dual cure luting materials (with separate activator)

Are suitable primers for silica & zirconia

Can bond to different substrates

# OptiBond XTR

- 📖 Self-etch 2-component, light cured, 15% filled, (fluoride releasing) bonding agent.
- 📖 Indicated for direct and indirect restorative procedures
- 📖 Separate hydrophilic self-etching primer with enhanced etching capabilities
- 📖 Separate hydrophobic adhesive to maximize material compatibility, increase strength and promote bond durability

# CONCLUSION

It is interesting that several top manufacturers have created materials that do (very much) the same thing, in different ways

# Universal adhesives



**Conclusions:** The enamel bond strength of universal adhesives is improved with prior phosphoric acid etching. However, this effect was not evident for dentin with the use of mild universal adhesives with the etch-and-rinse strategy.

**Clinical significance:** Selective enamel etching prior to the application of a mild universal adhesive is an advisable strategy for optimizing bonding.

## ARTICLE INFO

Article history:  
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14 March 2015  
Accepted 5 April 2015

## ABSTRACT

**Objectives:** A systematic review was conducted to evaluate the effect of self-etching mode on the bond strength of universal adhesives to dentin.

**Data:** This

So, why bother to etch dentine when using these adhesives?

**Results:** The analysis of dentin micro-tensile bond strength showed no statistically significant difference between the etch-and-rinse and self-etch strategies for mild universal adhesives ( $p \geq 0.05$ ). However, for the ultra-mild All-Bond Universal adhesive, the etch-and-rinse strategy was significantly different than the self-etch mode in terms of dentin micro-tensile bond strength, as well as in the global analysis of enamel micro-tensile and micro-shear bond strength ( $p \leq 0.05$ ).

# October 2015: The first clinical trial on Scotchbond Universal

37 adults, 126 teeth with NCCLs,  
42 in SBU total-etch group  
42 in SBU self etch group  
42 in SB Multipurpose group

Observed after 24 months

# October 2015: The first clinical trial on Scotchbond Universal

5 failed restorations in total  
SBU total etch group had most  
“perfect” ratings and no restorations  
lost to retention  
But, this group had higher “sensitivity  
to cold” scores

# October 2015: The first clinical trial on Scotchbond Universal

## CONCLUSIONS

Scotchbond Universal in total etch or self etch modes performed similar to or better than Scotchbond

Multipurpose

But, more post-op sensitivity in total etch group

So, why bother to etch dentine when using Scotchbond Universal?



...other tips for optimal  
bonding..



Effects of moisture degree  
and rubbing action on the  
immediate resin-dentin bond strength  
Dal-Bianco K, Pellizzaro A, et al.  
Dent.Mater.2006

**Conclusion:**

High bond strength to dentine can  
be obtained under dry conditions  
when ethanol/H<sub>2</sub>O and acetone based  
systems are vigorously rubbed on  
the dentine surface. On wet surfaces,  
light rubbing may suffice.

# Rules for bonding

**Do not overdry the surface**






**Etch according to manufacturers' instructions**

**With modern materials, try to avoid etching the dentine.**

**Do not overblow resin layer**

**Rub in the adhesive**

# Benefits of lab testing

-  Speed by which data are gathered
-  The relative ease of test methodology
-  Possibility to measure one specific parameter, while keeping others constant
-  Ability to test many experimental groups simultaneously
-  May use unsophisticated and inexpensive protocols and/or instruments

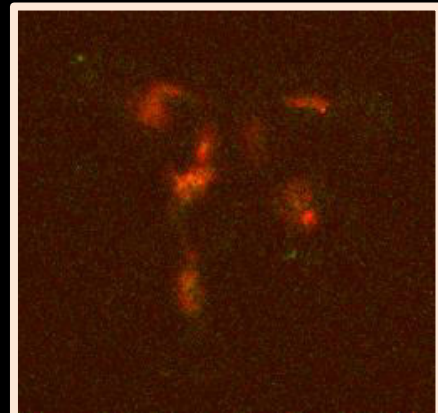
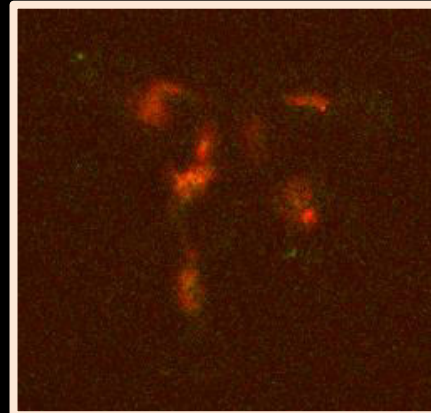
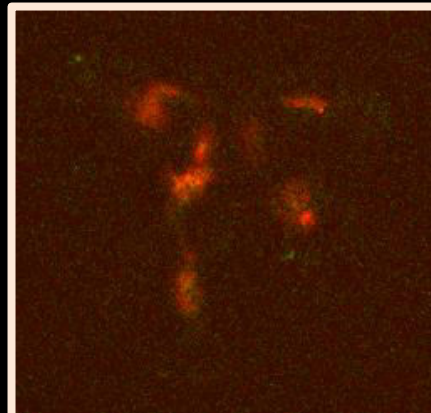
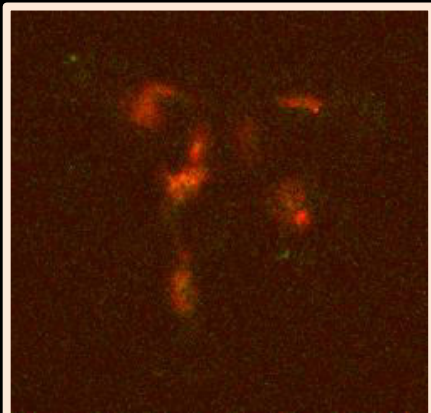
# Avoiding post-op sensitivity when using dentine bonding agents

Use a *so-called* self etch or Universal material

Do not etch the dentine when using these materials

# MMPs

- ➡ Demineralised dentine contains these
- ➡ Require calcium to maintain their structure
- ➡ Need zinc ions for their catalytic activity



# Latest *clinical* research on MMPs

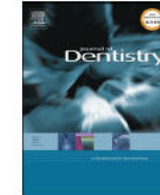
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Review article

## Inhibition of hybrid layer degradation by cavity pretreatment: *Meta-* and trial sequential analysis



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### ABSTRACT

**Objectives:** Inhibition of hybrid layer degradation, for example via inhibition of matrix-metalloproteinases (MMP) could reduce risk of retention loss and failure of adhesively placed restorations. This systematic review investigated such inhibitory pretreatment qualitatively and via *meta-* and trial-sequential-analysis.

**Data sources:** We included randomized clinical trials comparing degradation inhibitory cavity pretreatment versus no, placebo or alternative treatments prior adhesive placement of resin-based restorations. Trials reporting retention loss or failure (graded bravo-delta in USPHS or similar criteria) were included. Trial selection, data extraction, and risk of bias assessment were conducted independently by two reviewers. Fixed- or random-effects intention-to-treat, per-protocol, and scenario *meta*-analyses were performed, and trial-sequential-analysis used to control for risk of random errors. Electronic databases (PubMed, Embase, Cochrane CENTRAL) were systematically screened, and hand searches and cross-referencing performed.

**Study selection:** The ten included trials involved 208 patients (695 cavities) and used chlorhexidine (seven trials), ethanol-wet bonding (two trials), and quaternary ammonium compounds for degradation



# Latest *clinical* research on MMPs



Given the high risk of bias and the limited quantity of evidence, our findings were graded as being supported by very weak evidence only. Therefore, degradation inhibitory cavity pretreatment prior adhesively placing resin-based restorations can neither be recommended nor refuted.

Phew!

In conclusion, there is insufficient evidence to recommend or refute hybrid layer degradation inhibitory cavity pretreatment prior adhesively placing resin-based restorations. Based on this review and the included studies, dentists could pretreat cavities prior adhesively placing restorations (for example as part of re-wetting the cavity, or introduced to an adhesive), while evidence supporting this strategy is lacking. The impact of further effects (e.g. disinfection, pulp-irritation) of pretreatment remains unclear.

(e.g. disinfection, pulp-irritation) of pretreatment remains unclear



# Regarding MMPs

The way to obviate problems is to protect the collagen by thorough resin infiltration

# Take home messages

Dentine bonding is now reliable and effective

Selective etching of enamel is a good idea

Universal bonding materials with MDP are now the business

# Long term survival of fragment bonding in the treatment of fractured crowns

Andreasen FM, Noren JG, Andreasen JO,  
Englehardsen S. et al.,  
Quintessence Int.1995;26:669-681

...reattachment of the coronal fragment is a realistic alternative

Andreasen et al

- Good fragment retention, acceptable aesthetics
- Use of a dentine bonding agent with acid etching provides greater strength
- Fragment loss was usually due to a second blow
- Not a successful means of managing crown-root fractures

Approx 25% of 334 rebonded fragments were retained at 7 years after bonding

But, others are still adopting an invasive approach (and being sued!)

## Reasons to adopt minimal intervention

- 👄 Patients like it (if you advise them of your philosophy)
- 👄 Teeth like it (fewer die!)
- 👄 It's easier for dentists (fewer die: better for their blood pressure!)
- 👄 Lawyers hate it (fewer dentists sued!)
- 👄 We now have the materials to make this work

# Take home message

Bonding restorations  
is more minimally invasive,  
and,  
potentially therefore less  
likely to have a bad  
medicolegal outcome

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