“I am not paid by any company to promote their products”

“Some manufacturers fund my research”

“I will try to be evidence-based rather than anecdotal”
A practice-based assessment of patients' knowledge of dental materials

F. J. T. Burke¹,² and R. J. Crisp¹,²

**Aims**

It is the aim of this study to determine, by means of a questionnaire completed by patients attending ten UK dental practices, patients' level of knowledge on dental materials and techniques. **Materials and methods**

Members of The PREP (Product Research and Evaluation by Practitioners) Panel were asked to recruit patients to participate in a questionnaire-based assessment of their knowledge of dental materials. **Results**

Two hundred and forty-nine patients took part in the questionnaire. Sixty-three percent ($n = 157$) of the respondents were female and 92% ($n = 229$) of the respondents stated they were regular attenders at the dental practice. The respondents were asked how important the quality of dental materials used in their mouth was, and on a Visual Analogue Scale (VAS) where 1 = not important and 10 = very important, the result was 9.6. The same score was recorded when they were asked how important it was that the materials used in their mouth were supported with relevant clinical research evidence and long term data of the success of the material. They were also questioned on the subjects of price, manufacturer, source or material and type of filling material. A significant amount of respondents demonstrated that they had concerns over the use of amalgam. **Conclusions**

Respondents expressed strong views that the materials used on their teeth should have a robust evidence base and they care about the materials that are used in their mouths.

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**In Brief**

- Suggests that dental practice should be the prime location for clinical dental research.
- Discusses patients concerns regarding which dental materials are used.
- Demonstrates that patients care strongly that the materials are of a high quality and have been thoroughly researched.

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Patients care more about dental materials than I suspected!

Justifying the lecture!!!
CONCLUSIONS:

- Patients feel that materials should have a robust evidence base, produced by manufacturers with experience in the field
- Patients care about the materials that we use
- Almost half did not wish “own label” materials to be used in their mouths
- One third expressed anxieties regarding the use of amalgam in their teeth
BONDS

What do we want from a dentine bonding agent?
First, bonding to enamel

Bonding to dentine is therefore more difficult. It is a vital substrate.
Why do dentists need adhesion?

- Cervical restorations
- Build up of fractured or worn anterior and posterior teeth
- Short clinical crown for full or partial coverage restorations
- Resin retained bridges
Seals dentinal tubules to reduce post operative sensitivity

Seals restoration margins to reduce the risk of marginal staining and recurrent caries.
briefly, on the subject of class V restorations
Maximising class V effectiveness

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

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

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-caries 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 78.6%
- Amalgam 75%
- 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”
How to bond to sclerotic dentine


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

Conclusions

Which material and clinical technique performs best? From this review, it may be concluded that:

- RMGI performs optimally and is therefore recommended in clinical situations in which aesthetics is not an overriding factor;
- The surface of a NCCL should be roughened prior to placement of the restoration, be it GI-based or resin-based;
- There is no need to bevel the coronal aspect of the cavity margin; and
- 2-step self-etch bonding agents, Clearfil SE being an example, appear to perform optimally, 3-step etch and rinse bonding agents also being well ranked in a number of studies, but with the bond reducing with time.
As a rule of thumb – with 20 MPa of bond strength you are usually on the safe side.

E. Swift, ADA 2002, New Orleans
Smear Layer

- Thickness: 0.5 - 5.0 microns
- Will not wash off
- Weak bond to tooth – 2 – 3 MPa
- Very soluble in weak acid
Previous strategies to treat the smear layer

- Etch & Rinse/
  Total etch, 4 steps

- Self etch/
  No Rinse, 1 step
The quality of the hybridised dentine is more important than the bond strength

N. Nakabayashi, 2003
How wet is wet?

Wet
Moist
Dry

Important!

Noosa Beach, Queensland, Australia
The classification, *until recently*, of dentine bonding systems

1. Etch and rinse  
   *(etch & bond, total etch)*

2. Self etch  ➔  One bottle  
               ➔  Two bottles
...a landmark paper
Clearfil SE used as bonding agent, pH 2.3

100 class V restorations followed for 5 years

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

Marleen Peumans\textsuperscript{a}/Jan De Munck\textsuperscript{b}/Kirsten Van Landuyt\textsuperscript{c}/Paul Lambrechts\textsuperscript{a}/
Bart Van Meerbeek\textsuperscript{a}

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.
... the new approach is therefore.... selective enamel etching
Selective enamel etching

Kuraray etchant
....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)
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

- Flip cap for opening and closing
- New nozzle design for improved dispensing and cleanliness
Scotchbond Universal Adhesive: Composition

- BisGMA
- MDP
- Vitrebond Copolymer
- HEMA
- Ethanol
- Water
- Filler
- Silane
- Initiators
For Scotchbond Universal, the concept of selective enamel etching should be employed.
Product Research and Evaluation by Practitioners

2013:
A handling evaluation by the PREP Panel
Handling evaluation of 3M ESPE Scotchbond Universal by the PREP Panel

12 evaluators

Variety of bonding agents used pre-study

875 restorations placed (Class I: 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:

- Too thin: 1 to 5 (Too viscous: 3.1)
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

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
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.”
... I often treat tooth wear patients
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, albeit better than 15 years ago, was still not as good as dentists might wish.

The margins of the restorations may require occasional polishing.

Occasionally, chipping of the restorations may occur.
I switched to Scotchbond Universal Adhesive in September 2011.

Much better adhesive performance in wear cases than previously!
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.
In one round of experiments, 3 out of 4 “own label” specimens didn’t even make it to the Instron machine!!
Me too:
Are own label brands a threat to the development of new materials?
There is no evidence base for “own label” Glass Ionomer materials
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 ‘Composites’ and ‘Adhesives’ 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.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Number of Mentions in Research Abstracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearfil SE Bond Kuresay</td>
<td>40</td>
</tr>
<tr>
<td>Scotchbond Multipurpose (3M ESPE)</td>
<td>29</td>
</tr>
<tr>
<td>Adper Easy Bond (3M ESPE)</td>
<td>17</td>
</tr>
<tr>
<td>Optibond Solo (Kerr)</td>
<td>10</td>
</tr>
<tr>
<td>Prompt L Pop (3M ESPE)</td>
<td>10</td>
</tr>
<tr>
<td>Optibond FL (Kerr)</td>
<td>10</td>
</tr>
<tr>
<td>Optibond all-in-one (Kerr)</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 2. Most frequently mentioned adhesive agents in the ‘adhesive’ research abstracts.

Results: A total of 189 abstracts from the IADR classification ‘dentine adhesives’ were identified, showing 31 of these did not mention specific bonding agents and two were on light-curing units. The results indicated that 84 different types of bonding agent (note some of these may be discounted as some manufacturers may name the same bonding agent differently for different markets) had been subjected to research in the remaining 156 abstracts. A total of 333 bonding agents were tested in these abstracts. The most frequently mentioned bonding agents are presented in Table 1. Four materials did not specify their manufacturer, so these materials were investigated further in an internet search and their manufacturers identified. No OL brands were identified during the search.

Conclusion: Within the limitations of this study, which nevertheless involved the reading of 444 IADR abstracts as a source of evidence, there was no evidence of any OL product being subjected to testing in a research study. Further work is now indicated to provide evidence for the effectiveness of these materials, by laboratory and, ideally, clinical evaluation of their ‘own label’ resin-bonding restorative dental products.

Disclosures: The author is a member of the 3M ESPE Scientific Advisory Board but has no financial interest in any of the products mentioned.

References:

All articles published in Dental Update are subject to new retraction or removal in the event of uncorrectable errors.
Recent evidence against own label brands

However, greater batch to batch variation in several mechanical & physical properties of the own-label materials was noted.
Universal bonding agents: new additions are on the way!
All contain the resin 10-MDP
Universal bonding agents tested in Cuxhaven by VOCO.

No advantage in etching the dentine. Therefore, don’t do it!

SE = self etch, no dentine etch
TE = total etch, dentine etched

Fig. 1: Tensile bond strength values on enamel and dentine. The graph displays the self-etch mode and the total-etch mode of Futurabond U and Scotchbond Universal.
10-MDP is important for the status of the bond reaction with HAP.
How so-called self etch (and Universal bonding agents) work!

Without phosphoric acid etching, acidic monomers of self-etch adhesives do not remove the smear layer. Rather, the smear layer is partially demineralized and incorporated into the hybrid layer.
...other tips for optimal bonding..
Effects of moisture degree and rubbing action on the immediate resin-dentin bond strength

**Conclusion:**
High bond strength to dentine can be obtained under dry conditions when ethanol/H$_2$O and acetone based systems are vigorously rubbed on the dentine surface. On wet surfaces, light rubbing may suffice.
Does active application of universal adhesives to enamel in self-etch mode improve their performance?

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Article info

Article history:
Received 21 November 2014
Received in revised form 2 April 2015
Accepted 7 April 2015

Keywords:
Microshear bond strength
Degree of conversion
Enamel
Etch and rinse
Self etch
Universal adhesive systems

Abstract

Objectives: To evaluate the effect of adhesion strategy on the enamel microshear bond strengths (μSBS), etching pattern, and in situ degree of conversion (DC) of seven universal adhesives.

Methods: 84 extracted third molars were sectioned in four parts (buccal, lingual, proximal) and divided into 21 groups, according to the combination of the main factors adhesive (AdheSE Universal [ATU], All Bond Universal [ABU], Clearfil Universal [CFU], Scotchbond Universal [SBU], G-Bond Plus [GBP], Prime&Bond Elect [PBE], and Scotchbond Universal Adhesive [SBU]), and adhesion strategy (etch-and-rinse, active self-etch, and passive self-etch). Specimens were stored in water (37°C/24 h) and tested at 1.0 mm/min (μSBS). Enamel–resin interfaces were evaluated for DC using micro-Raman spectroscopy. The enamel-etching pattern was evaluated under a field-emission scanning electron microscope (direct and replica techniques). Data were analyzed with two-way ANOVA and Tukey’s test (α = 0.05).

Results: Active self-etch application increased μSBS and DC for five out of the seven universal adhesives when compared to passive application (p < 0.001). A deeper enamel-etching pattern was observed for all universal adhesives in the etch-and-rinse strategy. A slight improvement in etching ability was observed in active self-etch application compared to that of passive self-etch application. Replicas of GBP and PBE applied in active self-etch mode displayed morphological features compatible with water droplets. The DC of GBP and PBE were not affected by the application strategy.

Conclusions: In light of the improved performance of universal adhesives when applied actively in SE mode, selective enamel etching with phosphoric acid may not be crucial for their adhesion to enamel.
October 2015: The first clinical trial on Scotchbond Universal

Two-year clinical trial of a universal adhesive in total-etch and self-etch mode in non-curious cervical lesions

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3UAB Center for Clinical and Translational Science, 401P Medical tower, 1117 11th Ave S, Birmingham, AL 35204, USA
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.

Marginal discolouration greater in self etch group.
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?
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 (e.g. metal)
Conclusion from this publication:

New Universal bonding agents are an advance in bonding.
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
What is this?

This is a matrix metalloproteinase!
Inhibition of hybrid layer degradation by cavity pretreatment: Meta- and trial sequential analysis

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ARTICLE INFO

Article history:
Received 3 January 2016
Received in revised form 14 April 2016
Accepted 18 April 2016

Keywords:
Chlorhexidine
Dentin bonding
Ethanol-wet bonding
Matrix metallo-proteinase
MPb
Resin restorations

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 source: 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 DSF/SF 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 (995 cavities) and used chlorhexidine (seven trials), ethanol-wet bonding (two trials) and matrix metallo-proteinase inhibitors (seven trials) for pretreatment.

Conclusions: The most frequently used treatment was chlorhexidine alone or in combination with ethanol-wet bonding, while matrix metallo-proteinase inhibitors were used less frequently. This systematic review provided evidence that matrix metallo-proteinase inhibitors can inhibit hybrid layer degradation when used in conjunction with chlorhexidine.
Regarding MMPs

The way to obviate problems is to protect the collagen by thorough resin infiltration.
Take home message: Avoiding adhesive failures

Use a material from a manufacturer with experience in the field and follow the instructions!!

One bottle bonding (reduced risk of error) – new Universal materials are a significant advance

Effective light curing (check your light regularly!)

Think seriously about selective enamel etching
In brief

- Anterior crown fractures are commonplace in children and adolescents and may affect up to 25% of this patient population.
- If an intact tooth fragment is present after trauma, the incisal edge reattachment procedure presents a conservative, simple and aesthetic treatment.
- Clinical trials and long-term follow-up have revealed that reattachment using modern dentine bonding agents or adhesive luting systems may achieve functional and aesthetic success for up to 7 years.
- Reattachment failures may occur with new trauma, parafunction, or horizontal traction. Athletic soft mouthguards and patient education may enhance clinical treatment.
reteachment of the coronal fragment is a realistic alternative.

- 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.
It’s not perfect, it’s pragmatic aesthetics!

The literature states that patient appreciation is high


What's new in polishing?

I think that the Soflex Diamond Spiral is terrific!
Take home messages

Dentine bonding is now reliable and effective

Self etch adhesives do not produce bond strengths as high as etch & rinse systems

Selective etching of enamel is a good idea

Universal bonding materials with MDP are now the business
Take home message

Bonding restorations is more minimally invasive, and, potentially therefore less likely to have a bad medicolegal outcome.
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 get sued!)
- We now have materials to make this work

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

- SN7024, available from UKDataService.ac.uk contains anonymized longitudinal data on patients attending the General Dental Services in England and Wales (UK)
- Over three million different patients
- Over 25 million courses of treatment, between 1990 & 2006
- Modified version of Kaplan-Meier methodology used to plot survival curves for different sub-groups
“it is unrealistic to expect controlled longitudinal studies to last more than ten years”

Mjor et al, 1990
Therefore, large scale administrative databases are of value. The big numbers game. But some things are lost.
I can give you lots of tables & figures!

<table>
<thead>
<tr>
<th>Type of Treatment</th>
<th>1 year</th>
<th>5 years</th>
<th>10 years</th>
<th>15 years</th>
<th>n</th>
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</thead>
<tbody>
<tr>
<td>Amalgam</td>
<td>91</td>
<td>66</td>
<td>51</td>
<td>41</td>
<td>7,292,564</td>
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<td>59</td>
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<td>53</td>
<td>37</td>
<td>28</td>
<td>1,592,566</td>
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<td>63</td>
<td>53</td>
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<td>69</td>
<td>52</td>
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</tr>
<tr>
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<td>59</td>
<td>41</td>
<td>30</td>
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<tr>
<td>All Restorations</td>
<td>89</td>
<td>64</td>
<td>48</td>
<td>39</td>
<td>13,896,048</td>
</tr>
</tbody>
</table>

a total of 13,896,048 tooth restorations
First, a brief lesson in Kaplan Meier

The goal is to estimate a population survival curve from a sample. If every patient is followed until death, the curve may be estimated simply by computing the fraction surviving at each time. However, in most studies patients tend to drop out, become lost to follow up, move away, etc. A Kaplan-Meier analysis allows estimation of survival over time, even when patients drop out or are studied for different periods of time.
First, a brief lesson in Kaplan Meier

For restorations, the observation time starts at time 0 in the graph. Restorations that fail result in a drop in the graph. Restorations that have not failed by the end of the study are called *censored* observations and these are included for only as long as they are observed. Since information of both failed and non-failed restorations is used, the Kaplan Meier method is considered the gold standard in longevity assessment.
Kaplan Meier

Vertical axis represents estimated probability of survival for a hypothetical cohort, not actual % surviving.
Figure 5 Survival of porcelain veneers by patient annual gross fees spent on treatment

Proportion of teeth without re-intervention

Mean Annual Fees under £30
£30 to £79.99
£80 or more
In Stephen Hancocks’ October 26, 2018 editorial, he compares Kaplan Meier to a line of ants!

‘We can apply what we have observed of actual behaviour from the past to our decision making in the future...’
Looking at what has happened will give us a handle on how well restorations (and restored teeth) might survive.

This is important when advising patients on how well their treatment might perform, because patients are suing dentists more each year.
Experts in the field consider Kaplan Meier to be the method of choice for assessing restoration survival.
The effect of cavity design on amalgam restoration survival

The ultimate guide to restoration longevity in England and Wales. Part 2: Amalgam restorations – time to next intervention and to extraction of the restored tooth

F. J. T. Burke*1 and P. S. K. Lucarotti1

Key points
Circa 7.3 million amalgam restorations were included, of which 2.5 million had a re-intervention at 15 years. Kaplan Meier Analysis revealed that, overall, 41% of amalgam restorations had not required a re-intervention at 15 years.
Larger restorations survived less well to re-intervention than small restorations, with similar findings for time to extraction of the restored tooth. The placement of a dentine pin in restorations resulted in poorer performance of restorations.
Amalgam restorations in younger patients performed better than those in older patients, both in terms of time to re-intervention and time to extraction of the restored tooth.

Aim  It is the aim of this paper to present data on the survival of amalgam restorations by analysis of the time to re-intervention on the restorations and time to extraction of the restored tooth, and to discuss the factors which may influence this.
Methods  A data set was established, consisting of General Dental Services' patients, this being obtained from all records for adults (aged 18 or over at date of acceptance) in the GDS of England and Wales between 1990 and 2006. The data consist of items obtained from the payment claims submitted by GDS dentists to the Dental Practice Board (DPB) in Eastbourne, Sussex, UK. This study examined the recorded intervals between placing an amalgam restoration and re-intervention on the tooth.
Direct placement restorations: amalgam

7,425,049 amalgam cases included, of which 2,537,331, of which had a re-intervention
Amalgam Restoration Survival by Type of Cavity

Seven years’ difference in median survival time between MOD restorations and class I restorations

Proportion Surviving

Time in years from Treatment to re-intervention
Take home message

Keeping restorations as small as possible is therefore important.

We can only do this with adhesive dentistry.

Which brings us to resin composite for posterior teeth!
BULK!
These need a topping because their wear resistance isn’t good enough.
The Minamata Convention
Final agreement, 10th & 11th October 2013, 147 countries signed up

From 1st July 2018, amalgam banned in children under 15 and pregnant/nursing women

“Worldwide reduction and ultimate ban on mercury containing products”
And, don’t forget that patients seem to like tooth-coloured restorations in their back teeth!
Another reason

Mercury vapour levels in dental practices and body mercury levels of dentists and controls

K. A. Ritchie,1 F. J. T. Burke,2 W. H. Gilmour,3 E. B. Macdonald,4 I. M. Dale,5 R. M. Hamilton,6 D. A. McGowan,7 V. Binnie,8 D. Collington9 and R. Hammersley10

Aim A study of 180 dentists in the West of Scotland was conducted to determine their exposure to mercury during the course of their work and the effects on their health and cognitive function.

Design Data were obtained from questionnaires distributed to dentists and by visiting their surgeries to take measurements of environmental mercury.

Methods Dentists were asked to complete a questionnaire including items on handling of amalgam, symptoms experienced, diet and possible influences on psychomotor function such as levels of stress significantly associated with their level of mercury exposure as measured in urine. One hundred and twenty two (67.8%) of the 180 surgeries visited had environmental mercury measurements in one or more areas above the Occupational Exposure Standard (OES) set by the Health and Safety Executive. In the majority of these surgeries the high levels of mercury were found at the skirting and around the base of the dental chair. In 45 surgeries (25%) the personal dosimetry measurement (ie in the breathing zone of dental staff) was above the OES.
CONCLUSIONS

- Dentists short-term memory worse than controls
- Periodic health surveillance of DHCWs indicated
- Kidney disorders not correlated with surgery Hg vapour levels
- Safer handling of amalgam needed
- Further studies indicated on all members of the dental team
1991, Directorate to reduce amalgam use
2003, National clinical guidelines - encouragement to reduce amalgam use. Amalgam no longer the material of choice for posterior teeth, informed consent needed from the patient if amalgam used
2007, Restrictions on mercury vapour emissions from crematoria
2008, Partial ban on amalgam use
2011, Complete ban, although dentists can apply for exemptions

Environmental concerns……..YES
Toxicity issues........................ NO

No toxicity issues for patients: ?? for dentists??

Slide made in 1996
The verdict on amalgam?
Contemporary UK dental practice
2015/16: Comparison with previous results:

Premolars
Amalgam for Class II, 2002....86%
Amalgam for Class II, 2008....59%
Amalgam for Class II, 2015....40%

25% of respondents stated that amalgam should continue to be used freely,
41% considered that it should be

Burke FJT, Wilson NHF, Brunton PA, Creanor S. BDJ 2019
Reinforced Glass Ionomer Materials

- Smaller particle size leads to faster reaction
- Higher loading brings improved physical properties
- Exhibits plastic features – can be condensed and packed
- Still a need for improved wear resistance
- Typical glass ionomer features
Clinical performance of reinforced GIC materials in loadbearing situations

Abstract: Glass ionomer materials have been available for 40 years, but have not been indicated for loadbearing restorations, other than when used in the ART concept. However, there is anecdotal evidence that dentists are using the reinforced versions of this material in posterior teeth, possibly as a result of demands from patients to provide them with tooth-coloured restorations in posterior teeth at a lower cost than resin composite. This paper reviews the existing literature on reinforced glass ionomer restorations in posterior teeth, concluding that, under certain circumstances (which are not fully elucidated) these materials may provide reasonable service. However, the patient receiving such restorations should be made aware of the minimal amount of evidence for the success of these restorations and the potential need for the restorations to be re-surfaced in due course.

8 papers on GI in posterior teeth included
Conclusions

In clinical situations where there are no adverse situations at work (such as high occlusal loading or an acidogenic plaque), certain restorations in reinforced GI materials (such as Fuji IX) may provide reasonable longevity. However, the conditions for longevity are not readily identified. Two of the studies (Scholtanus and Huysmans, 2007: Basso, 2013) demonstrate higher than desirable failure rates for GI restorations in posterior teeth, especially in the longer term.
Trevor’s view

Until more high quality evidence becomes available, for practitioners using reinforced GI materials in loadbearing situations in posterior teeth, it is prudent to advise patients of the relative paucity of good quality evidence for the success of the restorations that they are placing.
GIs in posterior teeth – a medicolegal perspective

- Tell the patient that it is a glass ionomer that the evidence base is variable and limited
- Definitive restoration or long term provisional?
- The restorations may need re-surfacing with composite
- Alternatives are more expensive
- May not do harm

Possibly OK in class I cavities?
And, reinforced glass ionomers are a Godsend to special care dentists.
The “F” word

Glass-ionomer Restoratives: A Systematic Review of a Secondary Caries Treatment Effect
R.C. Randall* and N.H.E. Wilson
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*corresponding author

Abstract. It is generally accepted that glass-ionomers inhibit secondary caries in vivo, and data from in vitro studies support the effect. The aim of this review was a systematic assessment, from the literature, of clinical evidence for the ability of glass-ionomer restoratives to inhibit secondary caries at the restoration margin. Inclusion and exclusion criteria for selection of the review papers were established prior to commencement of the literature search. Papers which conformed to these criteria, and reported on secondary caries as an outcome, were selected (N = 52). Primary and secondary lists of systematic criteria for use in

Introduction
There is increasing interest in evidence-based dentistry (Antczak-Bouckoms et al., 1996; Lawrence, 1995), echoing similar discussions. The intention of this approach is to base treatment for patients on a combined use of current best individual clinical expertise (Sackett et al, 1994), application of treatments for which valid evidence is judged to have been established

28 papers included
No conclusive evidence for or against inhibition of secondary caries by glass ionomer restoratives

The F-word
Fluoride IS released by glass ionomers but its effect is small.
Fluoride released by F-containing composites is negligible

Fraud
Fiction
Fudge
False
Fools
Fairies
Equia Forte seems to hold promise
Differences from Fuji IX

- New ultrafine highly reactive glass particles added
- Higher molecular weight polyacrylic acid
- 20% improved flexural strength, 21% improvement in acid resistance, 40% wear resistance
- Improved fluoride release
The conclusion gleaned from the above cohort studies is that resin composite restorations have acceptable survival rates when placed in loadbearing situations in posterior teeth, with AFRs generally within the range 2% to 3%, which the authors consider to

Survival Rates of Resin Composite Restorations in Loadbearing Situations in Posterior Teeth

Abstract: The use of resin composite for routine restoration of cavities in posterior teeth is now commonplace, and will increase further following the Minamata Agreement and patient requests for tooth-coloured restorations in their posterior teeth. It is therefore relevant to evaluate the published survival rates of such restorations. A Medline search identified 144 possible studies, this being reduced to 24 when inclusion criteria were introduced. Of these, ten directly compared amalgam and composite, eight were cohort studies, and six were systematic reviews. It was concluded that posterior composites may provide restorations of satisfactory longevity and with survival rates generally similar to those published on amalgam restorations. However, the ability of the operator in placing the restoration may have a profound effect.

CPD/Clinical Relevance: With the increasing use of composite for restorations in posterior teeth, it is relevant to note that these may provide good rates for survival.

Dent Update 2019; 46: 523–535

Resin composite has been an alternative material to dental amalgam since the first use of resin composite materials in posterior teeth (hitherto termed 'posterior composites') need for high-quality evidence from primary dental care. It has also been noted that RCTs

144 studies identified, 24 included
Shrinkage stress is the problem. Stress is a function of materials factors such as:

- Polymerisation shrinkage
- Modulus of elasticity/filler load
- Degree of conversion
Five ways:
1. Increase the filler loading
2. Reduce resin shrinkage
3. Reduce % resin conversion
4. Bulk fill low stress material
5. Use a high molecular wt. resin
The Filtek™ Silorane System

The first composite to achieve 1% shrinkage

Silorane: good results at 5 years

The lack of post-operative sensitivity when using a low shrinkage stress material, in conjunction with its self-etch adhesive, is considered to be a significant benefit by the present authors, with their advice to clinicians to determine the shrinkage stress of materials that they are considering using in posterior teeth.

Five Year Clinical Evaluation of Restorations Placed in a Low Shrinkage Stress Composite in UK General Dental Practices

ABSTRACT

This paper evaluates the five year clinical evaluation of restorations placed in a low shrinkage stress resin composite material. Over 5 years, the authors found that the material had excellent durability and was highly acceptable to the patients.

INTRODUCTION

The low shrinkage stress of the material ensures minimal post-operative sensitivity, which is highly desirable in posterior restorations.

CONCLUSION

Restorations formed in a low shrinkage stress resin composite restorative system and placed under general dental practice conditions in the UK, were found to provide good clinical service at five years, albeit with a high incidence of marginal staining at some sites around the restorations.
Take home message

Indications at 5 years are that a low shrink composite, Filtek Silorane, is a viable alternative for restoration of posterior teeth.

What we learnt was that low shrinkage stress is important in reducing post-operative sensitivity.
Filtek Bulk Fill Posterior Restorative: Advantages over Silorane

- One-step placement
- 5 mm depth of cure
- Can use dentine bonding agent of choice
- Therefore, faster than Silorane Bond
- Easier polishing due to nanofiller
- Potentially better aesthetics

**BUT**
- Still excellent stress relief
- Still excellent handling and sculptability
New Methacrylate Monomers for Lower Shrinkage and Stress Relief

**AUDMA**: Aromatic urethane dimethacrylate

- Higher molecular weight with less number of reactive groups
- Moderates volumetric shrinkage
- Contributes to stress reduction

**AFM**: Addition-fragmentation (AF) monomer
Filtek™ One Bulk Fill Restorative

**Filler** (total inorganic filler loading = ~76.5 wt%, 58.5 vol%)

- Silica filler, 20nm, non-agglomerated
- Zirconia filler, 4-11nm, non-agglomerated
- Zirconia/silica cluster
- Ytterbium trifluoride, 100nm

Nanofiller technology enables …

- Excellent polish retention
- Management of opacity and translucency
- High strength
- Low potential for voids
- Excellent wear resistance
My new classification for **BULK FILL** materials:

**BULK FILL BASE MATERIALS** (which need a capping because their wear resistance isn’t good enough)

**BULK FILL RESTORATIVE MATERIALS** (satisfactory wear resistance)
These need a topping because their wear resistance wasn’t good enough.

So, the original bulk fill base materials are now history!

Bulk fill started with the bulk-fill flowable base materials.
NOW!

New bulk fills that don’t need a topping!
My new classification for **BULK FILL** materials:

**BULK FILL RESTORATIVE MATERIALS**
(satisfactory wear resistance)
Advantages of Bulk Fill Restorative materials

- Time saving, no need for complex layering technique
- Easier handling
- Fewer increments, fewer voids
- Simpler shade selection, due to fewer shades
The study that I wished I had done!

Are new bulk fill composites quicker to place?

196 restorations in 43 patients

Filtek Z350 vs Filtek Bulk Fill, both placed with SB Universal

“Less time consuming”

**Title:** 1407 - Clinical-time and Postoperative-sensitivity When Using Bulk-Fill Composites With Universal Adhesives

**Authors:**
- Chane Terdem Pereira (Presenter)
- Fluminense Federal University
- Elisa Albuquerque, Federal Fluminense University
- Stefane Barbosa, Fluminense Federal University
- Leticia Lopes, Fluminense Federal University
- Fernanda Calazans, Fluminense Federal University
- Stella Marins, Fluminense Federal University
- Luiz Augusto Poubel, Fluminense Federal University
- Roberta Barcelos, Fluminense Federal University
- Marcos Barcelotto, Fluminense Federal University

**Abstract:** The first objective of this double-blind randomized clinical trial was to compare the different clinical-time using Scotchbond Universal adhesive (3M ESPE), in self-etch or selective enamel-etching strategy, associated with incremental or bulk-fill composite in posterior restorations. The second objective was to compare the postoperative sensitivity, 24h and 48h after the restorations.

**Methods:** A total of 196 restorations were placed in 43 patients according to the following groups: SETB- Self-etch/bulk fill; SETI- Self-etch/incremental; SEEB- Selective enamel-etching/bulk-fill and; SEEI- Selective enamel-etching/incremental. Filtek Z350XT composite (3M ESPE) was incrementally placed and Filtek Bulk Fill (3M ESPE) was placed using Bulk-fill technique. The adhesive system was used according to manufacturer’s instructions. Postoperative-sensitivity was evaluated using two scales (NRS and VAS).

**Conclusions:** The simultaneous use of the tested Universal adhesive using the self-etching strategy with the tested Bulk-fill composite is less time consuming and does not increase the postoperative risk or intensity when compared with traditional incremental technique.
A Practice-Based Clinical Evaluation of a Bulk Fill Restorative Material

ABSTRACT

Objective: To evaluate the handling, by a group of practice-based researchers, of a recently introduced bulk fill resin-based composite restorative material, Filtek Bulk Fill Restorative C1M (3MESPE). Methods: Twelve select evaluators were sent explanatory letters, a pack of the material under investigation to use for 8 weeks, and a questionnaire. Results: The evaluators cast the excess of the bulk fill restorative same as the previously used posterior composite material. The provision of one hour only for evaluation may have compromised the score for an aesthetic quality. No post-operative sensitivity was reported. Conclusion: The bulk fill material was well received as indicated by the high number of evaluators who would both purchase the material and recommend it to colleagues. Clinical relevance: A recently introduced bulk fill restorative material achieved a rating for handling which was similar to the evaluators’ previously used resin composite, although there were some concerns regarding the translucency of the material.

INTRODUCTION

PRACTICE BASED RESEARCH

The value of practice-based research has been previously discussed, with the arena of general dental practice having been considered the ideal environment in which to carry out evaluations of the handling of dental materials and their clinical effectiveness. In this regard, a wide variety of research projects may be considered to be appropriate to general dental practice, including assessment of materials, devices and techniques, clinical trials of materials, assessment of treatment trends and, patient satisfaction with treatment.

A UK-based group of practice-based researchers is the PREP (Product Re
The PREP Panel evaluation

FBFR assessment
Conclusions
75% of evaluators would purchase
92% (n=11) would recommend to colleagues

The new Filtek™ One Bulk Fill Restorative handles similarly
How do manufacturers do it?

SUMMARY
More potent/efficient initiator systems
Increasing the translucency of the filler
For some, improved resin systems
Avoiding post-op sensitivity with posterior composites

- Use a so-called self etch or Universal Material, AND do not etch the dentine
- Use a low shrinkage stress composite
- Ensure good adaptation at the gingival margin
- Ensure adequate light luring
- Use a reliable manufacturer’s material
An amalgam substitute should:

Be self adhesive
Have 5mm depth of cure
Have low shrinkage stress
Have good physical properties and good wear resistance
Be quick & easy to place
Be non toxic

In addition, today, adequate aesthetics for back teeth
Evaluation of a novel flexible lip retraction system by UK practitioners.

R J Crisp and F J T Burke. (University of Birmingham, UK)

Program number 608

INTRODUCTION

1993 saw the establishment of a group of practicing dental practitioners, the PREP (Product Research and Evaluation by Practitioners) Panel, who were prepared to complete evaluations of new materials and techniques in the practice environment. To date, over 40 evaluations, including handling evaluations and clinical trials, have been completed. The PREP panel presently has 28 members (61% holding post-graduate qualifications) with an average time since graduation of 21 years. The Panel has a UK-wide distribution and a wide range of dental interests facilitating the assessment of a full range of products and techniques.

The purpose of this study is to evaluate the handling properties of a new flexible lip retraction system (Optragate, Ivoclar Vivadent UK), which consists of 2 flexible plastic rings connected by a latex-free plastic material. (Fig. 1) It was tested in 2 sizes. Regular and Small but is also now available in a Junior sizing for young patients.

METHOD

> Twelve dental practitioners from the PREP Panel were chosen at random and sent twenty of the retractors along with a questionnaire designed to evaluate the presentation, handling and ease of use of the system. Most responses were given on a visual analogue scale (VAS). The evaluators were also asked the reasons for use of lip retraction systems, and to compare the currently used system with the new retractor.

BACKGROUND INFORMATION

Ten (83%) of the evaluators currently used a lip retraction system. All but one evaluator used the plain plastic photographic type of retractor. Nine (75%) used the retractors for photography and 4 (33%) for an aid to isolation. The evaluators rated the ease of use of the currently used lip retraction system on a VAS (where 1 = difficult to use & 5 = easy to use) as follows:

![Figure 1: Optragate](image)

<table>
<thead>
<tr>
<th>Size</th>
<th>Ease of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>3.9</td>
</tr>
<tr>
<td>Junior</td>
<td>4.2</td>
</tr>
</tbody>
</table>

RESULTS

Six (50%) of the evaluators stated that the sizes provided were adequate. The remaining 50% stated that the regular size was too large and a smaller size than ‘small’ was required. (See note in Introduction).

When asked if Optragate adequately protected the lips, 9 (75%) stated that it did. The remaining three evaluators (25%) all stated that the bottom lip slipped out.

98% (n=7) of the evaluators encountered difficulties initially with the use of Optragate. Comments made by these evaluators included: "Initially difficult but with practice – and Vaseline I could slip it on almost undetected!" and "Needs to be moist to fit!"

Patient comments reported included:
- "Easier to keep my mouth open", "More comfortable then rubber dam" and "Uncomfortable behind lower lip"
- Just one evaluator reported a symptom or side effect from the use of Optragate, and that was hypersalivation in 2 cases.
- Eight (67%) of the evaluators stated that they would purchase the Optragate system and 9 (72%) that they would recommend the system to colleagues.
- The evaluators rated the ease of use of the currently used lip retraction system on a VAS (where 1 = difficult to use & 5 = easy to use) as follows:

<table>
<thead>
<tr>
<th>Ease of Use</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior</td>
<td>3.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular</td>
<td></td>
<td></td>
<td></td>
<td>4.2</td>
<td></td>
</tr>
</tbody>
</table>

Final comments included:
- "I use them all the time for surgical procedures now, especially implant placements - it helps keep the patient’s mouth open, and is more gentle on the tissues than a conventional retractor.
- It also allows both me and my nurse an extra hand as we are not having to ‘retract’..." and "Innovative and effective – a joy!"

CONCLUSIONS

The Optragate lip retraction system has been subject to an extensive clinical evaluation in which it scored better for ease of use than the lip retraction system used previously. The majority of evaluators would both purchase the system and recommend it to colleagues. The sizes of Optragate provided for this evaluation did prove problematic, with 50% of the evaluators requiring a smaller size (now provided). This was a product that seemed to gain favour and find more applications the more it was used.

ACKNOWLEDGEMENT

The support of Ivoclar Vivadent UK is acknowledged. The authors also wish to thank the participating practitioners.

REFERENCES

Latest research on restoration survival

Burke’s tips!
Because of the size of the dataset, we can now look at the effect of the restoration on survival of the tooth.
These “rules” apply throughout the dataset
The effect of root filling on restoration survival...with apologies to my endodontist friends!

![Graph showing proportion surviving over time from treatment to re-intervention.]

- **Proportion Surviving**
  - Y-axis: 0.2 to 1.0
- **Time in years**
  - X-axis: 0 to 15
- **Legend**
  - Pink line: root filled
  - Yellow line: root not filled

---

No root filling

Tooth root filled
The effect of root filling on survival of the restored tooth is even more dramatic.

The message therefore is... prevention, and educating patients that restoring a tooth before the pulp is involved is a good idea! Or, sealing in caries in a vital, asymptomatic tooth.
Infected Dentine Revisited

Abstract: Dentine becomes infected as a result of caries lesion formation on root surfaces and when lesions progress following cavitation of enamel lesions. However, this infection is unimportant because the driving force for lesion formation and progression is the overlying biofilm. This explains why root surface caries can be controlled by mechanical plaque control and fluoride, and restorations are not needed to arrest these lesions. Similarly, the infected dentine in cavitated coronal lesions does not have to be removed to arrest the lesion. If the lesion is either accessible or opened for cleaning by the patient or parent, the lesion can be arrested. Sealing of infected dentine within the tooth, either by a full crown in the primary dentition or by partial caries removal prior to placing a well-sealed filling, will also arrest the lesion. When restoring deep lesions in symptomless, vital teeth, vigorous excavation of infected dentine is likely to expose the pulp and make root canal treatment necessary. Thus ‘complete excavation’ is not needed and should be avoided.

CPD/Clinical Relevance: Root surface caries can be arrested by cleaning and fluoride application. Restorations are not essential. Vigorous excavation of softened dentine in deep cavities of symptomless, vital teeth is contra-indicated. It is not needed and increases the risk of...
When restoring deep caries lesions in vital, asymptomatic teeth, vigorous excavation is likely to expose the pulp. This complete excavation is not needed and should be avoided. Always produce a sound cavity margin for bonding.
Systematic review:
28 studies

Conclusions:
Removal of all softened biomass until only hard dentine remains was clinically inefficacious. No studies indicated that complete excavation had any advantages to removing only soft dentine. Not attempting to remove all softened dentine could reduce the risk of complications.
CONCLUSION

The seal’s the deal!
**HOT** under the collar?

**CONCLUSION:**
The evidence base for this is building
Another way of managing deep caries in a vital tooth
The calcium silicate has the ability to interact with water leading to the setting of the cement. This is a hydration of the tricalcium silicate which produces a hydrated calcium silicate gel (CSH gel) and monosodium silicate (Na2SiO3).

\[
2(3\text{CaO}.\text{SiO}_2) + 6\text{H}_2\text{O} \rightarrow 3\text{CaO}.\text{SiO}_2.\text{H}_2\text{O} + 2\text{Na}_2\text{SiO}_3
\]

This dissolution process occurs for each grain of calcium silicate. The hydrated calcium silicate gel forms a matrix where calcium hydroxide tend to precipitate at the surface of the grains of the powder, due to saturation of the medium. This setting process is reinforced in systems with low water content.

Setting mechanism same as Portland cement
Problems involving dentine
Can one material be used instead?
## Indications

<table>
<thead>
<tr>
<th>Crown</th>
<th>Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent dentine restorations</td>
<td>Root perforations</td>
</tr>
<tr>
<td>Deep cavities</td>
<td>Pulpal floor perforations</td>
</tr>
<tr>
<td>Pulp capping</td>
<td>Internal/External resorptions</td>
</tr>
<tr>
<td>Pulpotomy</td>
<td>Apexification</td>
</tr>
<tr>
<td>Temporary enamel restoration</td>
<td>Apical surgery</td>
</tr>
</tbody>
</table>

- **Pulp Exposure**
  - Biodentine™

- **Perforations**
  - Biodentine™

- **Internal/External Resopptions**
  - Biodentine™

- **Apical surgery**
  - Biodentine™

- **Dentine Caries**
  - Biodentine™

- **Pulpotomy**
  - Biodentine™

- **Apexification**
  - Biodentine™
The evidence base is building.
In Vitro Microleakage of Biodentine as a Dentin Substitute Compared to Fuji II LC in Cervical Lining Restorations

Anne Raskin¹ / Geoffroy Eschrich² / Jacques Dejou³ / Imad About⁴

Purpose: 1) To evaluate the marginal sealing efficacy of Biodentine at the cervical margins of approximal cavities placed in molars; 2) to evaluate and compare the use of Biodentine in combination with resin-based adhesives and a resin composite, compared with a resin-modified glass-ionomer cement (Fuji II LC).

Materials and Methods: Sixty approximal cavities were prepared on mesial and distal surfaces of 30 extracted human third molars. The teeth were randomly assigned into 6 groups of 10 cavities each: (G1) Biodentine, (G2) Fuji II LC as a filling material, (G3) Biodentine as a base + Optibond Solo Plus + silane + Filtek Z250, (G4) as in G3 without silane, (G5) Biodentine as a base + Septobond SE + Filtek Z250, (G6) Fuji II LC as a base + Optibond Solo Plus + Filtek Z250. The materials were applied according to the manufacturers’ instructions. Biodentine required no dentin or enamel surface conditioning treatment. The teeth were thermocycled 2500x (5°C to 55°C). The specimens were then sealed with a 0.1 mm window around the marginal interface. Samples were immersed in a 50% w/v silver nitrate solution and exposed to a photodeveloping solution. The teeth were embedded in resin (Sorya 33) and sectioned through the restorations. The silver penetration was directly measured using a light microscope. The results were expressed as ordinal scores from 0 to 3 at cervical, interfocal, and enamel margins. The data were analyzed with the nonparametric Kruskal-Wallis, Games Howell, and Wilcoxon signed rank tests (p < 0.05).

Results: No statistically significant differences were found between the 6 groups, neither for the dentin cervical margins nor for cervical lining (Biodentine or Fuji II LC)/resin composite interfaces. Statistically significant differences were observed between G5 (median score = 2.0) and the other groups (median score = 1.0) for the enamel margins. Statistically significant differences were found between enamel and dentin cervical margins in G2 (enamel median score = 1.0; dentin median score = 1.5) and G5 (enamel median score = 2.0; dentin median score = 1.0).

Conclusion: Within the limits of this in vitro study, Biodentine as dentin substitute in cervical lining restorations or as a restorative material in approximal cavities when the cervical extent is under the CEJ seems to perform well without any conditioning treatment. However, the operating time is longer than when a RMGIC (Fuji II LC) is used.

Keywords: Ca₃SiO₅-based dentin substitute, resin-modified glass-ionomer cement, microleakage.
Bioactivity of Biodentine

CONCLUSION:
“There is a clear need to improve the bioactivity of restorative dental materials and calcium silicate systems offer exciting possibilities in achieving this goal”
How does the pulpal response to Biodentine and ProRoot mineral trioxide aggregate compare in the laboratory and clinic?

R. Careddu¹ and H. F. Duncan*¹
material efficacy. Other physical characteristics diverge with Biodentine setting quicker and staining less than ProRoot-MTA, however, the radiopacity of Biodentine is below testing standards making identification difficult. **Conclusions** Biodentine does present an evidence-based biologically-based alternative VPT material to ProRoot-MTA. Future research should be directed at long-term clinical outcome studies and the interaction of Biodentine with the dentine matrix.

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**Fig. 1** Schematic theoretical representation of the process of reparative dentinogenesis after a VPT procedure using calcium silicate cement.
Biodentine™
Advantages & disadvantages

**Advantages**
- Maintains pulp vitality
- Biocompatibility
- Long working time
- Suitable for use with the “thumb” technique

**Disadvantages**
- Technique sensitive
- Long working time
- Idiosyncratic handling
- Mixing sensitive

But, I used Biodentine only a few weeks’ ago, and it handled much better!
Calcium hydroxide on steroids!

....not just me who is convinced!!

When in contact with water, the surface of Biodentine particles generates and releases Calcium Hydroxide and Calcium Silicate Hydrates, which results in a highly alkaline pH.
My conclusion...
How to make the sealed caries concept work in your practice

- Make sure that the patient understands the PIL (consent)
- Advise the patient that (s)he is having a therapeutic (healing) filling
- That (s)he will have to pay for that and again in 9-12 months to have it resurfaced
The PIL is published in Dental Update (March 2018) and on my web site as a Word document.

As a patient, what you need to know is:

- Dental decay (caries), one of the commonest diseases on earth, has caused a deep hole in your tooth. The decay is close to the nerve but the tooth is still alive and not causing pain. One way of treating deep decay is to drill or scrape out all the decay and risk exposing the nerve of the tooth. Your dentist will then need to carry out extensive treatment on the affected tooth; this may involve placement of a root filling and a crown or other restoration to protect the cusps of the root-filled tooth.
- The methods of treatment for deep decay in teeth which are alive and not causing symptoms have changed! With your permission, I propose to avoid scraping out all the decay because this could expose the nerve and then a root filling or extraction would be needed. Having removed part of the decay, I will fill the tooth and this will stop the progress of the decay. I will review the tooth in 6 to 12 months and take an X-ray then (or earlier should you have any discomfort). Provided the tooth remains alive, no further treatment should be needed. Please note that, on the follow-up X-ray, the decay that I left will show as a black area.
- You should be aware that this technique has gained credibility for vital teeth as the research base for this has expanded and become positive.

As a patient, what you also need to know is:

- If you change dentists and you have a subsequent X-ray on the tooth with deep decay, your new dentist could say that the previous dentist has left decay in a tooth when, in fact, I’ve done this based on good clinical research. That’s why you need to know what your dentist has been trying to achieve.
- Placing a well-sealed filling over the decay will ensure that the decay doesn’t come back. There is, however, always a small chance that your tooth will die and a root filling will be needed, but this is much less than if the nerve of the tooth is exposed by drilling away all the decay.
- You have had deep decay in your tooth. That therefore means that you have a problem with your diet and/or with your oral hygiene/toothbrushing. You will therefore need to address this – your dentist and/or his/her hygienist will give you advice on this.

Table 1. Patient Information Leaflet for patients for whom deep decay has been sealed into a Vital Asymptomatic Tooth.

Technique Tips: Patient Information Leaflet
Information for Patients for whom Deep Caries has been Sealed into a Vital Asymptomatic Tooth

The concept of sealing deep caries into a vital asymptomatic tooth, rather than removing all caries and risking a pulpal exposure with all the inevitable sequelae (ranging from pulp-capping to root canal filling), has gained increasing acceptance from the time when Merz- Fahlbrant and colleagues published their ten-year randomized controlled trial in 1990. In this work, in a split-mouth research design study, all patients received an amalgam restoration (50% of which were sealed after restoration placement) and a resin composite.
Take home message

Sealing caries into a vital asymptomatic tooth is now considered good practice. The literature is increasingly showing that it works! Fewer teeth will require RCT.
Molar teeth

The effect of crowns
Crows: Conclusions

• While crowns provide a patient with a restoration which requires the least number of re-interventions, they perform poorly (indeed, as poorly as GI) when time to extraction is examined.

• Factors influencing crown survival are patient age and patient treatment need, with patients with high treatment need having crowns which perform suboptimally.
Crows: Conclusions

• Factors influencing crown survival also include dentist age, but, in comparison with direct restorations in which younger dentists out-perform older dentists, for crowns, dentists in the 30 to 60 age group provide crowns with optimum performance.

• Crowns placed on upper canine teeth perform worse than crowns placed on any other tooth: crowns perform best on first molar teeth.

• Placing a pinned core appears to enhance the longevity of the subsequent crown, whereas the placement of a root filling or a metal post does not.
It’s only in older patients that crowning a molar tooth is a good idea!
During 2012, about 54.5 million indirect tooth unit replacements—including single crowns, pontics and abutments—were placed in the United States. (Bennett Napier, chief staff executive, National Association of Dental Laboratories, oral communications July 15, 2013.) As of May 27, 2013, the United States had a total resident population of 315,000,065.1, approximately one-fourth of the U.S. population was younger than 20 years (25.7 percent) in 2009. Therefore, assuming that about 75 percent of the current U.S. population is older than 20 years, there are about 237 million adults in the United States. These statistics, taken together, lead to the conclusion that about one indirect tooth unit was placed per 2.3 adults during 2012. However, the number of crowns per patient actually is higher when one considers that many adults do not visit their dentist on an annual basis. In my opinion, the quantity of crowns placed probably is higher than needed or expected. I am not the only clinician uneasy about this; many participants in my continuing education courses also have expressed concern.

Gordon J. Christensen, DDS, MSD, PhD

What are the indications for crowns? Are these indications clearly identifiable to practitioners, or are they debatable? What are the reasons for the placement of so many crowns? Could some of the patients who received these crowns have been treated more conservatively? This column provides my observations on the subject as a board-certified prosthodontist who is active in international continuing education and who has had several decades of practice and research experience.

INDICATIONS FOR CROWNS
Some readers may not agree with the following points. However, when perusing the available meta-analyses reported in the dental literature on the subjects below, one can find evidence to support or refute any of these points. It is not my intention in this column to debate the indications for crowns. It is my purpose to express my own observations on the subject as an experienced clinician, educator and researcher. For the purpose of this discussion, my definition of "crown" includes indirect onlay restorations covering all tooth cusps, as well as conventional full-crown restorations.

Teeth with large, previously placed defective restorations or active carious lesions. Although controversial, the following are some guidelines regarding indications for a crown in specific situations. Posterior teeth that require removal of one-half or more of the lingual-cusp-tip-to-cusp-tip occlusal distance are best treated with crowns or onlays. If restored with intracoronal restorations instead of crowns, such posterior teeth have three nearly free-standing sections: the remaining facial tooth structure, the lingual tooth structure and the restorative material, which usually is resin-based composite or amalgam. This division of tooth strength often allows breakage of either the facial or lingual tooth structure from the intracoronal restoration during service.

For anterior teeth, my observations show that the need for crowns is related to teeth that are missing at least one-half of the coronal tooth structure because of caries or previously placed restorations. The location of the remaining tooth structure is not predictable and can be any corono-one-half of the clinical crown. Bonding the remaining tooth structure, usually dentin, with restorative material appears to reduce the breakage of tooth.
Take home message

In no age group does crowning an anterior tooth preserve the lifespan of an incisor tooth. This confirms the concept of keeping worn teeth going with direct restorations.
Premolar teeth
Take home message

Keeping MOD restorations off premolar teeth seems a good idea.
Canine teeth: 1,232,041 restorations

Regarding re-intervention, veneers and crowns outperform other restoration types, with 45% and 40% respectively surviving to re-intervention at 15 years and with glass ionomer restorations performing least well.

However, regarding to time to extraction of the restored canine tooth, veneers continue to perform optimally (around 93% cumulative survival at 15 years) but crowns represent the worst performing restoration at 15 years (66% cumulative survival),
Take home message

Crowning a canine tooth leads to a reduced lifespan of the crowned tooth. Root fillings perform worse in canines than in any other tooth. Patients must be told!
The new restoration survival parameter is survival of the tooth.

For time to extraction, incisors are worst, molars best.

In jaws, upper canines dominates bad performance.

1 in 5 crowned teeth receive a root filling in the same course of treatment (includes post crowns).
Glass ionomers do not perform as well as other materials.

Amalgams are cheap, but may provide value for £s.
Crowning a tooth leads to an earlier demise of the tooth than placing direct restoration/s.

For youngest age groups, crowns perform worst.

Avoid crowns in back teeth, except in the oldest age groups.

Try to avoid placing a post.
There may be some confounding factors like fewer crowns on canines. Patients who are exempt from payment receive treatments that fail sooner. The older the patient, in general, the greater the treatment need. But, overall, we are observing an existing historical population, with dentists making decisions in the best interests of the oral health of their patients.
Crowns in canine teeth perform worse than in any other tooth (time to extraction)

<table>
<thead>
<tr>
<th>Tooth type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisors</td>
<td>75%</td>
</tr>
<tr>
<td>Canines</td>
<td>66%</td>
</tr>
<tr>
<td>Premolars</td>
<td>78%</td>
</tr>
<tr>
<td>Molars</td>
<td>83%</td>
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</tbody>
</table>

WHY?
Perhaps crowned canines are not as strong as we thought! Is it time to re-examine the concept of canine guidance when crowning canine teeth?
45 years of evidence-based publishing!
“The patient’s need is the continued preservation of what remains of his chewing apparatus rather than the meticulous restoration of what is lost, since what is lost is irretrievably lost.”

deVan, 1952 Reprinted 2006

DeVan MM Basic principles of impression taking. J. Prosthet. Dent. 1952:2:26-75
If you want to read more... BDJ 2018
Dentistry is changing!

New bonds and bulk will help that to happen!
Thank you for listening