

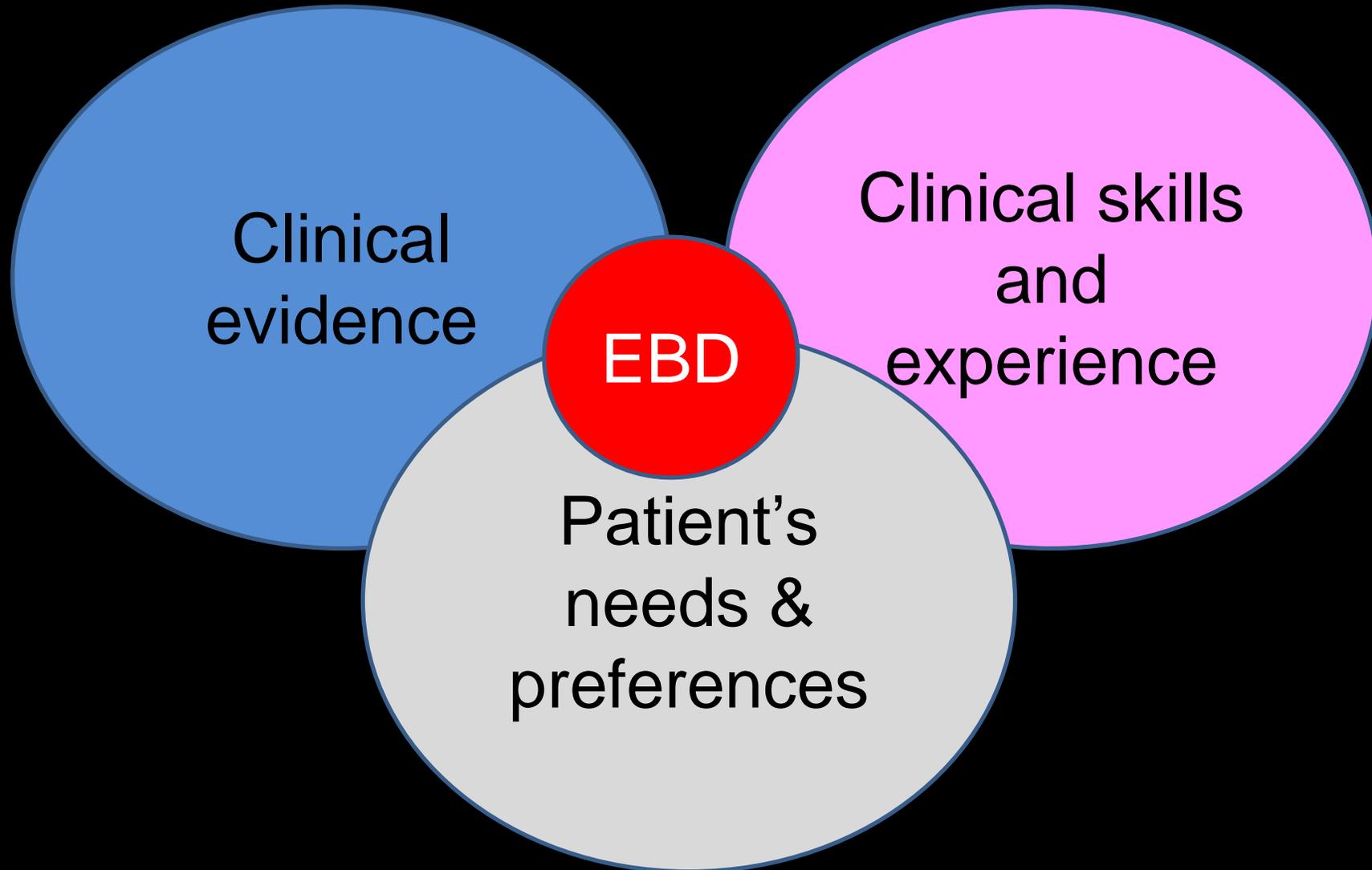


***End of the road  
for dental  
amalgam?***

AKA

*Is there a like-for-like replacement?*

# Put simply: What EBD really means



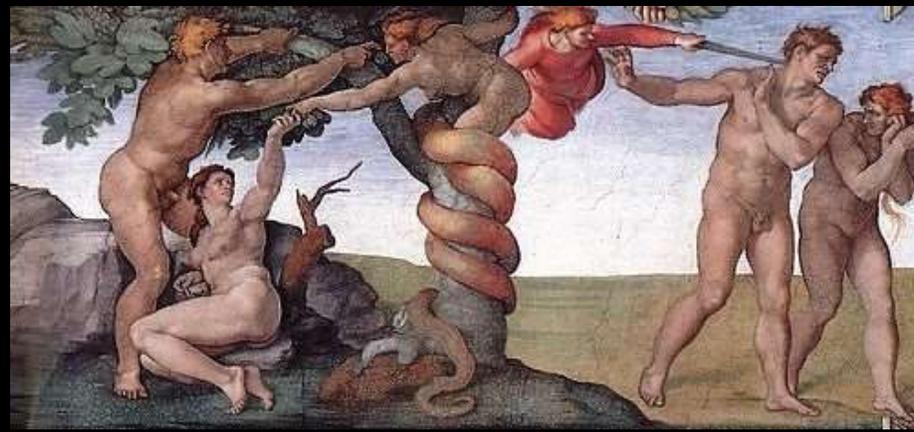
# Learning objectives

On completion of the presentation, listeners should:

- Be aware of why dental amalgam's days are numbered.
- Know the most recent developments in resin composite materials for loadbearing situations in posterior teeth, their cost comparison with dental amalgam and how to avoid post-operative problems.
- Be able to outline how glass ionomer (GIC) materials have developed over fifty years, and be aware of the clinical performance of most recent GIC materials in loadbearing situations in posterior teeth

# What I plan to talk about (not necessarily in this order!)

- Amalgam, briefly
- Resin composites – a true alternative?
- Latest on self-adhesive composite materials
- Current status of GICs and Glass Hybrids for restoration of posterior teeth
- How to place these
- Are these good enough to change our philosophy today?
- Final thoughts



In the beginning

**We had amalgam!**

Dental amalgam has had a turbulent history – amalgam wars etc



# Having all my 19 fillings removed changed my life

## Wife blames 40 years' depression on the mercury in her teeth

By Sinead McIntyre

FOR almost 40 years, Mary Stephenson suffered crippling depression.

She saw dozens of counsellors and tried every anti-depressant on the market, but nothing would stem her suicidal feelings.

Finally, when she was at the end of her tether, a friend suggested the cause might be mercury in her fillings.

So the 59-year-old grandmother took the painful step of having all 19 amalgam fillings replaced with plastic ones.

The result has been an extraordi-

**'Now I can't wait to jump out of bed'**

nary recovery. 'Having my fillings out has completely changed my life,' she said yesterday. 'I feel like a new person.'

Mrs Stephenson, who lives with her husband John, 67, in Lymington, Hampshire, found a dentist in Poole, Dorset, who would do the procedure.

The surgery was carried out by John Aherne of Moonfleet Dental Practice. Mrs Stephenson also underwent a mercury detox programme to flush the poison from her system.



Happy at last: Mary Stephenson today and, above, on her wedding day with her husband John. She suffered crippling depression for 38 years

Business Reserve Account

Do your

A Health Information Book  
To Answer Questions You May Have  
On Countering The Effects of  
Dental Mercury Exposure

# DENTAL MERCURY DETOX

BY

**Sam Ziff**  
**Michael F. Ziff, D.D.**  
**Mats Hanson, Ph.D.**

REVISED & EXPANDED  
1995 EDITION

## FTFD SYMPTOM ANALYSIS OF 1569 PATIENTS

% of Total	SYMPTOM	Total No.	No. Improved or Cured	% of Cure or Improvement
14%	ALLERGY	221	196	89%
5%	ANXIETY	86	80	93%
5%	BAD TEMPER	81	68	89%
6%	BLOATING	88	70	88%
6%	BLOOD PRESSURE PROBLEMS	99	53	54%
5%	CHEST PAINS	79	69	87%
22%	DEPRESSION	347	315	91%
22%	DIZZINESS	343	301	88%
45%	FATIGUE	705	603	86%
15%	GASTROINTESTINAL PROBLEMS	231	192	83%
8%	GUM PROBLEMS	129	121	94%
34%	HEADACHES	531	460	87%
3%	MIGRAINE HEADACHES	45	39	87%
12%	INSOMNIA	187	146	78%
10%	IRREGULAR HEARTBEAT	159	139	87%
8%	IRRITABILITY	132	119	90%
17%	LACK OF CONCENTRATION	270	216	80%
6%	LACK OF ENERGY	91	88	97%
17%	MEMORY LOSS	265	193	73%
17%	METALLIC TASTE	260	247	95%
7%	MULTIPLE SCLEROSIS	113	86	76%
8%	MUSCLE TREMOR	126	104	83%
10%	NERVOUSNESS	158	131	83%
8%	NUMBNESS ANYWHERE	118	97	82%
20%	SKIN DISTURBANCES	310	251	81%
9%	SORE THROAT	149	128	86%
6%	TACHYCARDIA	97	68	70%
4%	THYROID PROBLEMS	56	44	79%
12%	ULCERS & SORES (ORAL CAVITY)	189	162	86%
7%	URINARY TRACT PROBLEMS	115	87	76%
29%	VISION PROBLEMS	462	289	63%

MERCURY/AMALGAM DENTAL FILLINGS



# THE TOXIC TIME BOMB

IS THE  
MERCURY IN YOUR  
DENTAL FILLINGS  
AFFECTING YOUR  
HEALTH?

**Sam Ziff**

Foreword by J G Levenson

Member of the British Dental Society for Clinical Nutrition

None of these  
publications has  
ever been backed  
by scientific fact

## Amalgam—Resurrection and redemption. Part 2: The medical mythology of anti-amalgam

Michael J. Wahl, DDS<sup>1</sup>

Mercury-containing amalgam restorative material has come under attack for its alleged harmful effects on systemic health. A literature search revealed that amalgam restorations release small quantities of mercury but apparently not enough to cause systemic health problems. Mercury from dental amalgam restorations cannot be linked to kidney damage, Alzheimer's disease, multiple sclerosis, other central nervous system diseases, "amalgam disease," mental disorders, damage to the immune system, increases in antibiotic resistance, or harmful reproductive effects. Dentists occupationally exposed to mercury have not been shown to suffer harmful reproductive or other systemic health effects, provided proper mercury hygiene is used. There are legitimate health concerns about alternative restorative materials, including resin composite. According to the latest scientific information available, dental amalgam remains a safe and effective restorative material. (*Quintessence Int* 2001;32;696–710)

**Key words:** amalgam, biocompatibility, mercury, resin composite, safety, toxicity

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The scientific evidence (170 references):  
Does not support the myth that mercury from dental amalgam causes kidney damage  
Does not support the myth that dental amalgam is associated with MS, Alzheimer's Disease, mental disease or "amalgam illness"  
Does not support the myth that mercury from dental amalgam damages the immune system or causes harmful reproductive effects

# Contemporary UK dental practice 2015

Burke FJT, Brunton PR, Wilson NHF, Creanor S.

- 👉 Questionnaire to 500 UK dentists, 2015/16, useable returns 388 (77.6%)
- 👉 60% male, 51% principals, 25% single-handed
- 👉 Mean of 4.2 dentists per practice
- 👉 50% of patients NHS, 39% private
- 👉 55.4% of respondents had an intra-oral camera, 80.4% used nickel-titanium files, 47.4% used zirconia-based bridgework, and 24.9% used tricalcium silicate



# 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 phased down or out

RESEARCH

Contemporary dental practice in the UK, Part 1: demography and practising arrangements in 2015

T.J.T. Bates,<sup>1</sup> N.H. F. White,<sup>2</sup> F.A. Burton<sup>3</sup> and S. Coates<sup>4</sup>

Key points		
Response to 111 general practitioners, 1,641 dental practices and 10,000 dentists in the UK in 2015. 10% of dentists do not use amalgam and 10% do not use amalgam for Class II restorations.	Response for general dentistry has been previously reported. 86% of practitioners agreed with the statement that amalgam should continue to be used freely for Class II restorations.	Highlights that, regarding Class II restorations, 86% of practitioners agreed with the statement that amalgam should continue to be used freely for Class II restorations.

**Objectives:** To determine, by means of an anonymous, self-reported questionnaire, the demographic profile and practicing details of general dental practitioners in the UK in 2015. **Methods:** A previously piloted and validated 121-question questionnaire was distributed during 2015 to 500 dentists at UK dental meetings with a request that they complete the questionnaire and return it by post to the study principal investigator for the corresponding author. **Results:** Those included and eligible eligible practitioners were 10,000, giving a response rate of 77.0%. Of the respondents, 86.2% were male and 13.8% female. Their mean age was 44.6 (range 18-74 years), but over half of the respondents (50.0%) reported that they were retired or semi-retired. 36.4% were

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# A must read paper, Dent. Update Sept 2021

Enhanced CPD DO C Restorative Dentistry

**Leah Mackenzie**

## Dental Amalgam: A Practical Guide

**Abstract:** Historically, dental amalgam is the world's most commonly used restorative material. Its use is declining due to patient and professional demand for tooth-coloured restorations that are adhesive and promote minimally invasive tooth preparation techniques. Significant legislation has also resulted from environmental concerns relating to dental amalgam – 50% mercury content. This paper provides a comprehensive review of the status of dental amalgam including its advantages and disadvantages, amalgam safety, regulations and legislation and a comparison with alternative restorative materials. As the undergraduate teaching of amalgam procedures has progressively declined, this paper also provides an illustrated step-by-step revision guide to the material, equipment and clinical techniques that will optimize the restoration of challenging, complex cavities, where amalgam is still considered by many to be the material of choice.

**CPD/Clinical Relevance:** Amalgam remains an excellent restorative material for long-lasting restorations in larger/complex cavities and where moisture control presents challenges.  
Dent Update 2021; 56: 608-618

Dental amalgam has been used for demonstrable restorations over more than 100 years. It has been the subject of an unparalleled level of clinical and laboratory research, and its advantages and disadvantages are widely documented along with the evidence base for its successful use.<sup>1</sup>

Although amalgam is a safe, durable and cost-effective restorative material with excellent mechanical properties, its use is declining for a range of reasons (Table 1).<sup>2</sup>

As dental amalgam contains approximately 50% mercury it has often been the subject of controversy. If processed as a new material today, it would not be licensed for patient use.<sup>3</sup>

**Advantages and disadvantages of amalgam**

Although the use of dental amalgam is decreasing worldwide, it is still used in the majority of practices and its many advantages continue to make it the preferred restorative material in many countries (Table 2).<sup>1,4-7</sup>

Dental amalgam is still widely considered as the material of choice for specific procedures, such as the replacement of existing amalgam restorations in complex cavities (including one or more cusps) (Figure 1), and in deep cavities where moisture control is challenging.

Having demonstrated unparalleled long-term clinical success, amalgam's most commonly cited disadvantages relate to its aesthetic properties, the need for more invasive cavity preparations and environmental concerns relating to its mercury content (Table 3).

**Amalgam safety**

Dental amalgam is a combination of metallic particles predominantly silver and tin and liquid elemental mercury. The restorative multi-phase alloy contains approximately 80% mercury and forms a solid at room temperature.<sup>8</sup>

Although environmental authorities recognize that dental amalgam is an effective restorative material for the

general population, with low risk of adverse health effects,<sup>9</sup>

The main health concern regarding dental amalgam relates to the risk of release into the environment where aquatic macro-organisms can convert elemental mercury to organic compounds. These may then enter the human food chain, for example by eating fish and other marine species contaminated with organic methylmercury, which is the most toxic and bio-accumulative form of mercury.<sup>10</sup>

In this way, dental amalgam can indirectly contribute to a human health risk from mercury. Globally, it is estimated that approximately two thirds of the mercury content in dental amalgam is eventually released into the atmosphere, soil, surface and groundwater.<sup>11</sup> Amalgam can therefore contribute to environmental pollution via the following routes:<sup>12</sup>

- Dental amalgam manufacture (including mercury mining, trade and supply)
- Amalgam placement and removal
- Amalgam disposal (eg via landfill/waste water)
- Following granulation or burial of individuals with amalgam restorations.

Since children, infants and developing fetuses have increased susceptibility to

September 2021

- Amalgam exhibits less thermal expansion and contraction than tooth-coloured restorative materials<sup>2,3</sup>
- Corrosion over time enhances the marginal seal
- Heavy metal ionic breakdown products are antibacterial, resulting in slower progression of secondary caries compared to composite, which has been demonstrated to attract higher levels of more cariogenic bacteria<sup>2</sup>
- Does not significantly affect subgingival biofilms<sup>1</sup>
- Suitable for use in posterior teeth, where aesthetic demands are low
- Useful in deep cavities where the adhesive bond of composites has been shown to be diminished<sup>8</sup>
- Historically, amalgams were reported to result in a reduced incidence of endodontic problems compared to composite restorations<sup>2,8</sup>
- Colour contrast promotes easy removal (negligible risk of increasing cavity size compared to tooth-coloured restorations)<sup>1,8</sup>
- Colour contrast also simplifies amalgam carving/marginal finishing and indirect preparation of teeth with amalgam cores<sup>2</sup>
- Comparatively inexpensive/cost-effective material<sup>8</sup> (reduced surgery time more than offsets the high price of silver)

**Table 2. Advantages of amalgam.**

limiting the trade and supply of mercury-containing products.<sup>7</sup> The Minamata treaty was signed by 128 countries and came into force in August 2017. Table 5 lists the legally binding restrictions introduced in the UK in 2018–2019.<sup>4-6</sup>

The new legislation includes the slightly confusing exception that amalgam may be used in the prohibited patient groups 'where it is deemed strictly necessary by the dental practitioner based on the specific medical needs of the patient'. Supplemental guidance statements have been published to assist clinical decision making and are summarized as follows:

- Medical needs should be interpreted to include specific dental needs of the patient, ie where there are medical or

**Figure 1. (a)** MOD amalgam in a previously repaired mandibular first permanent molar, with a fractured mesio-buccal cusp. **(b)** Cavity preparation with resistance form augmented with pits for 'amalgapins'. **(c)** MODLB Bonded amalgam (immediate post-op). **(d)** Restoration at 6 years. **(e)** Restoration at 12 years.

608 **DentalUpdate** September 2021

Perhaps the last paper (perhaps the best?) ever written on amalgam?

# The Minamata Convention

Final agreement, 10th & 11th October  
2013, 147 countries signed up



July 2018: Amalgam banned in children 15 years and younger, and in pregnant/nursing women

Aesthetics:  
No contest!



## Patient Acceptance of Posterior Composite Restorations

F.J.T. Burke

*Patients no longer simply require the restoration of their teeth but may also want their restorations to be as aesthetically pleasing as possible. Composite materials have been developed for use in posterior teeth, but how do patients assess these restorations? A questionnaire was designed to obtain patients' opinions, and the results are given here.*

COMPOSITE FILLING materials were introduced to the dental profession by Bowen<sup>1</sup> in 1963. First reports of the use of such materials for restorations in load-bearing situations in posterior teeth were favourable,<sup>2</sup> but later reports<sup>3-5</sup> indicated that excessive wear was occurring, not only occlusally, but also at contact areas, leading Leinfelder to state, in 1975, that these materials should be eliminated as a material for use in Class I and Class II restorations.<sup>6</sup>

Changes in the formulation of composite materials for anterior use have led to microfilled materials, with a filler particle size of 0.4 µm giving a highly polishable surface but having an increased risk of incisal fracture,<sup>7</sup> and 'hybrid' materials (with particles from 1 to 5 µm mixed with 0.04 µm) which offer good polishability and strengths sufficient to withstand incisal stresses. Fine-particle composites are also available with 1-8 µm particles which allow a filler content similar to or greater than the hybrids together with reasonable finishing properties. Materials suitable for use in posterior load-bearing situations have also been developed by increasing the filler/resin ratio, altering the resin formulation, improving the bonding of

filler particles to the resin matrix, and the use of light-activation.

### POSTERIOR COMPOSITES

Problems associated with early composites in Class I and Class II situations have now largely been overcome. The excessive wear of early materials has led to the development of stringent criteria for materials for use in posterior teeth. To fulfil the ADA Provisional Acceptance criteria, wear no greater than 150 µm must occur in a three year period.<sup>8</sup> Four materials have, so far, gained provisional acceptance and two materials, Occlusin (ICI Dental, Macclesfield, Cheshire, UK) and Fulfil (L.D. Caulk Company, Milford, Delaware, USA) have met the criteria for full ADA acceptance after five years.

Studies are available which show satisfactory behaviour of these materials in clinical use.<sup>9-11</sup> From further studies, it can be seen that Occlusin restorations performed their intended purpose satisfactorily for periods of at least five years.<sup>12</sup>

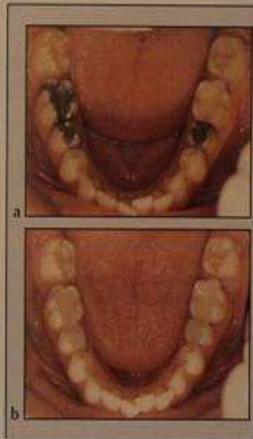
Technique problems have also largely been overcome by the development of new instruments, accessories such as burnishable matrices and transparent matrices used in conjunction with light-conducting wedges,<sup>13</sup> alongside the realization that incremental curing is necessary to prevent cuspal movement,<sup>14-16</sup> and that meticulous moisture isolation and dentine insulation is important. And so, as the clinical technique has evolved, patients have become interested in aesthetic posterior restorations.<sup>17</sup> However, as with any new procedure, it is necessary to inform them of the advantages — and possible disadvantages — of the new technique. Indeed, such is the media interest in new ideas in Medicine and Dentistry, that such new techniques may be given press coverage before clinical trials have been completed, with the result that patients may request new techniques

before they are readily available and before the dentist has undergone the necessary re-education.<sup>17</sup>

### PATIENT AWARENESS OF DENTAL AESTHETICS

Patient concern about appearance may be more important than health concerns,<sup>18</sup> and attractive persons may be considered more qualified and reliable than their unattractive peers.<sup>19,20</sup> Moreover, the appearance of a patient's teeth has been shown not only to have an effect on that patient's self-esteem,<sup>21</sup> but also to change that person's social attractiveness when judged by their peers and others.<sup>22-24</sup> In this respect, the advent of a tooth-coloured restorative for posterior teeth may offer

Figure 1. (a) Lower arch where several amalgams require replacement. (b) Amalgams in Figure 1a replaced with posterior composite.



Patients seem to like tooth-coloured restorations in their back teeth!

Dent. Update. 1989:  
16:114-116.

F.J.T. Burke, BDS, MDS, FDS, MCD, RCS (Ed), Part-Time Lecturer, Department of Conservative Dentistry, University of Manchester Dental School and General Practitioner, Manchester.

## Trevor's View

Once a patient has received one tooth-coloured restoration in a back tooth, he/she is unlikely to return to amalgam.

# A less well known fact....

## ORIGINAL ARTICLE

### Health and neuropsychological functioning of dentists exposed to mercury

K A Ritchie, W H Gilmour, E B Macdonald, F J T Burke, D A McGowan, I M Dale, R Hammersley, R M Hamilton, V Binnie, D Collington

Occup Environ Med 2002;59:287-293

**Objectives:** A cross sectional survey of dentists in the west of Scotland and unmatched controls was conducted to find the effect of chronic exposure to mercury on health and cognitive functioning.

**Methods:** 180 dentists were asked to complete a questionnaire that included items on handling of amalgam, symptoms experienced, possible influences on psychomotor function, and the 12 item general health questionnaire. Dentists were asked to complete a dental chart of their own mouths and to give samples of urine, hair, and nails for mercury analysis. Environmental measurements of mercury in dentists' surgeries were made and participants undertook a package of computerised psychomotor tests. 180 control subjects underwent a similar procedure, completing a questionnaire, having their amalgam surfaces counted, giving urine, hair, and nail samples and undergoing the psychomotor test package.

**Results:** Dentists had, on average, urinary mercury concentrations over four times that of control subjects, but all but one dentist had urinary mercury below the Health and Safety Executive health guidance value. Dentists were significantly more likely than control subjects to have had disorders of the kidney and memory disturbance. These symptoms were not significantly associated with urinary mercury concentration. Differences were found between the psychomotor performance of dentists and controls after adjusting for age and sex, but there was no significant association between changes in psychomotor response and mercury concentrations in urine, hair, or nails.

See end of article for authors' affiliations

Correspondence to: Dr K A Ritchie, MRC Institute of Hearing Research (Scottish Section), Queen Elizabeth Building, Glasgow Royal Infirmary.

180 dentists and 180 controls:  
Urine mercury, hair & nail,  
psychomotor performance analysed,  
general health questionnaire given.

GOOGLE CATEGORIES TV RADIO COMMUNICATE WHERE I LIVE INDEX SEARCH  Go

BBC NEWS

You are in: Health  
Tuesday, 30 April, 2002, 07:13 GMT 08:13 UK

### Teeth fillings 'make dentists ill'

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Dentists use mercury in tooth fillings

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Dentists may be at risk of developing kidney and memory problems because of their exposure to mercury, a study suggests.

Mercury is used safely in teeth fillings but long-term exposure can cause serious health problems.

A study by researchers at the University of Glasgow suggests that dentists may be at particular risk.

Dr Ewan Macdonald and colleagues found that dentists had higher levels of mercury in their bodies, compared with a sample group of academics.

They also found that dentists were significantly more likely to report kidney disorders and memory disturbances than the academic staff.

#### Possible link

The authors stopped short of making a direct link. But writing in the journal Occupational and Environmental Medicine, they said: "As mercury exposure at higher levels is known to

As mercury exposure at higher levels is known to cause similar health effects an association cannot be ruled out

Dr Ewan Macdonald, University of Glasgow

#### WATCH/LISTEN ON THIS STORY

Dr Ewan Macdonald  
"We have recommended that dentists should measure mercury in the air so that levels are not higher than they need to be"

#### See also:

25 Apr 02 | Scotland  
'Golden hellios' to fill dentist gap  
25 Apr 02 | Health  
Plans to retain women dentists  
06 Sep 01 | Health  
Huge swings in dental prices

#### Internet links:

British Dental Association  
Occupational and Environmental Medicine  
University of Glasgow

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Scientists probe breast drug danger  
Heart-share twins: The risks  
Absentee patients 'could be fined'

Links to more Health stories are at the foot of the page.

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Correspondence to: Dr K A Ritchie, MRC

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Ritchie KA, Gilmour WH, Macdonald EB, Burke FJT et al. Health and neuropsychological functioning of dentists exposed to mercury. *Occup.Environ.Med.*2002;59:287-293

The situation  
today....

#### Author's Information

*Dental Update* invites submission of articles pertinent to general dental practice. Articles should be well-written, authoritative and fully illustrated. Manuscripts should be prepared following the Guidelines for Authors published in the December 2023 issue (additional copies are available from the Editor on request). Authors are advised to submit a synopsis before writing an article. The opinions expressed in this publication are those of the authors and are not necessarily those of the editorial staff or the members of the Editorial Board. The journal is listed in *Index to Dental Literature*, *Current Opinion in Dentistry* and other databases.



Ewen McColl



FJ Trevor Burke

## End of the road for dental amalgam?

Readers will be aware of the Minamata Agreement, signed in 2013, in which 147 countries around the world agreed to minimize mercury use in a wide variety of fields, such as, lighting, fertilizers, and, of course, dental amalgam. This resulted in a ban, from 1<sup>st</sup> July 2018, on the use of amalgam in pregnant women and children under the age of 15 years. Some dental schools had, by then, on the surface, stopped teaching the concepts of resistance and retention form, and, as a result, a proportion of new graduates had no notion of how to retain an amalgam restoration in a tooth!<sup>1</sup> This lack of preparedness is a particular concern in the UK as amalgam is still in widespread use among dental practitioners<sup>2</sup>.

There is some clarity now, in the form of a European Union draft document to phase out all amalgam use by 1<sup>st</sup> January 2025. These recent EU proposals<sup>3</sup> suggest:

*The revised Mercury Regulation targets the last intentional remaining uses of mercury in a variety of products in the EU in line with commitments set out in the EU's Zero Pollution Ambition. It sets rules that put the EU firmly on the track to becoming the first mercury-free economy by:*

Introducing a total phase-out of the use of dental amalgam from 1 January 2025 in light of viable mercury-free alternatives, thereby reducing human exposure and environmental burden;

Prohibiting to manufacture and export of dental amalgam from the EU from 1 January 2025.

If this EU directive is ratified, supply chains will be disrupted and the cost of amalgam will, in all likelihood, rise significantly. This situation will occur against a backdrop of a crisis in access to NHS dentistry, with patients presenting with advanced cavitation of molar teeth where amalgam may be the restoration of choice. This is particularly the case where isolation is particularly challenging, and rubber dam isolation for restoration placement becomes increasingly difficult. The situation may be compounded in Northern Ireland under the Windsor protocol where the EU directive may disproportionately affect colleagues where fees for posterior teeth are generally based on placement of amalgam restorations.

Let's look briefly at the implications of this from an educational point of view and discuss the alternatives.

Amalgam tends to be favoured in posterior teeth where isolation can be an issue, for example where margins are subgingival or the tooth is very heavily restored. While moisture control is still very important, amalgam is more forgiving and compatible with more traditional matrix systems with which most clinicians, across the years, are familiar. Amalgam restorations are not adhesive, so rely on resistance and retention form with

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MARK ALLEN DENTISTRY MEDIA (LTD)  
Floor 6, Quadrant House, Sutton SM2 5AS

Telephone: 01483 304944  
Email: [fiona.creagh@markallengroup.com](mailto:fiona.creagh@markallengroup.com)  
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Ewen McColl



FJ Trevor Burke

## A Dental Knell or Wake-up Call?

As the January *Dental Update* Comment went to press,<sup>1</sup> the European Union swiftly ratified the banning of dental amalgam from use and export, with an implementation date of January 2025, except when the use of dental amalgam is deemed strictly necessary by the dental practitioner to address specific medical needs of the patient (a previously used, rather ambiguous term). This led to an outcry from across the profession in the UK, with the British Dental Association highlighting the impact on an already struggling NHS dental service. Indeed, the impact of the amalgam ban in the EU may disproportionately affect the patients who present with late caries, as is frequently seen across the UK, accepting that many patients never have the opportunity to get as far as a dentist.<sup>2</sup> The British Dental Association highlighted that since the Minamata Agreement in 2013, we have known this was coming, but not quite now, stating:<sup>3</sup>

*'We have long supported a phase-down in dental amalgam. But this rapid phase-out is neither feasible nor justifiable.'*

*'We have stressed there are currently no alternative restorative materials that compete with amalgam on speed of placement or longevity.'*

*'When alternative materials can't compete, this will add new costs and new uncertainties to practices already on the brink.'*

*'Without decisive action this could be the straw that breaks the back of NHS dentistry.'*

The European Union clearly differ on whether the new ban is justifiable or not, citing environmental concerns overriding the use of dental amalgam. Of course, nobody can have failed to notice we are no longer in the European Union, but import costs of amalgam, its availability and the Windsor protocol mean that if Europe sneezes, the UK catches a cold. In this case, NHS patients in most need will suffer, because it is in that group where amalgam use is likely to be highest, and the increased cost will impact most, one way or another.

There are other reasons (perhaps the main reason), for the withdrawal of support for amalgam much earlier than the date initially planned, 2030. The European Network for Environmental Medicine published a document a year ago,<sup>4</sup> outlining reasons why the availability of amalgam will become increasingly limited, citing the new Medical Devices Regulation (MDR 2017/745) that came into force in May 2021, bringing much increased legal safety requirements for dental amalgam capsules, and, as a result, why six European manufacturers/distributors (including two in the UK) have left the amalgam business, with two major US players also leaving the market and others facing the end of their certification. As a result, therefore, the 'writing was on the wall' for amalgam in the EU, and, as stated above, there will be a knock-on effect in the UK. Anecdotally, on talking with dentists from around Europe, resin composite is much more widely used there for posterior teeth than in the UK, where results of the most recent survey of 500 UK dentists (response rate 78%) in 2016, indicated that 66% of respondents used resin composite for Class II restorations in premolars, with amalgam being used 7% more for Class II restorations in molars than composite (55% vs 48%).<sup>5</sup> Unfortunately, this research did not investigate whether there were differences in material use in NHS and private practice. Nevertheless, it is apparent from the above data that only half of UK dentists would have to change their materials' prescribing habits if it became

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DU ISSN 0305-5000



## Was amalgam an ideal material?

- ❖ No toxicity issues to patients: To dentists?? To the environment? **XX**
- ❖ Physical properties good ✓
- ❖ Relatively easy placement, said to be “forgiving”, but, can it be placed under saliva and blood contamination? ✓
- ❖ Comparatively cost effective (reduced surgery time) ✓
- ❖ High thermal conductivity **X**
- ❖ Did not need an intermediate bonding agent ✓
- ❖ But, required retentive cavity features = tooth destruction **XX**
- ❖ Plenty of research “evidence” on longevity ✓
- ❖ Aesthetics poor (although colour contrast facilitates removal) **X**
- ❖ Waste is highly regulated **X**

5/7

# What I plan to talk about (not necessarily in this order!)

- Amalgam, briefly
- Resin composites – a true alternative?
- Latest on self-adhesive composite materials
- Current status of GICs and Glass Hybrids for restoration of posterior teeth
- How to place these
- Are these good enough to change our philosophy today?
- Final thoughts

A problem with resin  
composite materials:  
they don't bond to  
the tooth!

# Problems in bonding to dentine

## COMPOSITION OF DENTINE

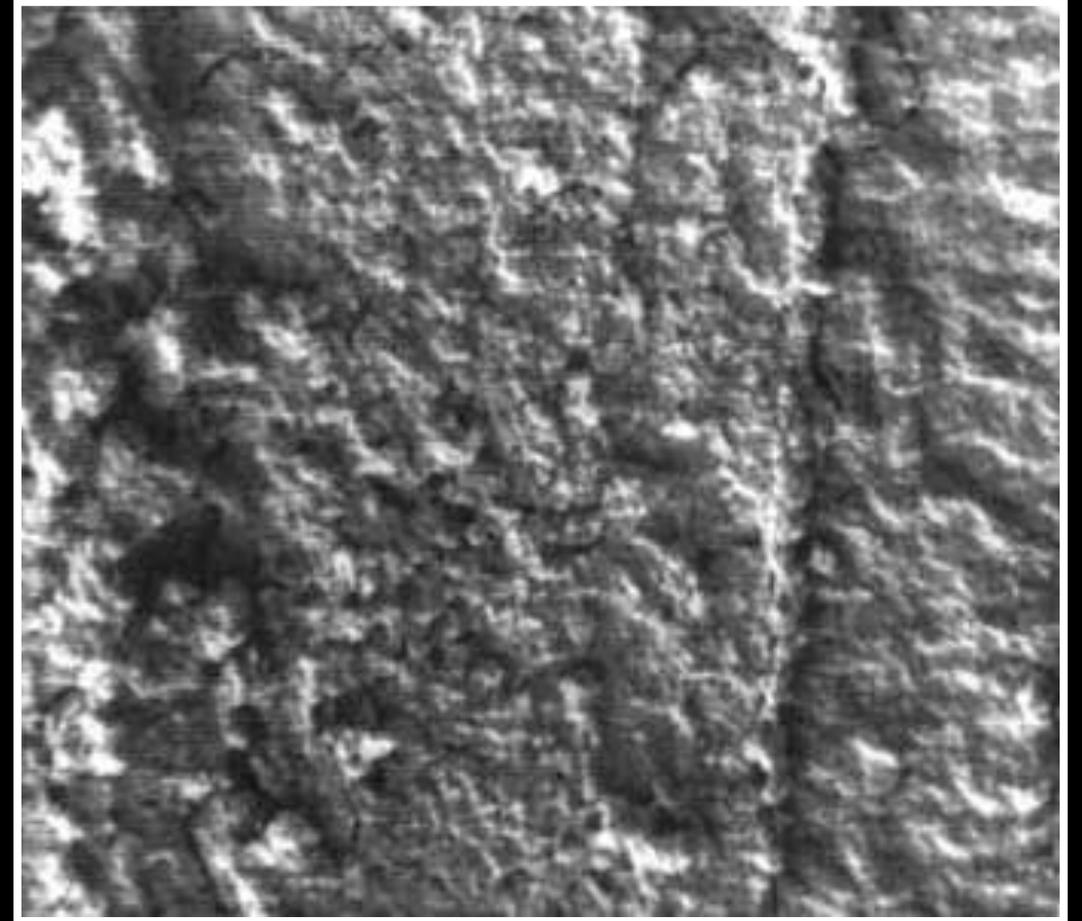
70% Inorganic

Bonding to dentine is  
therefore more difficult

It is a vital substrate

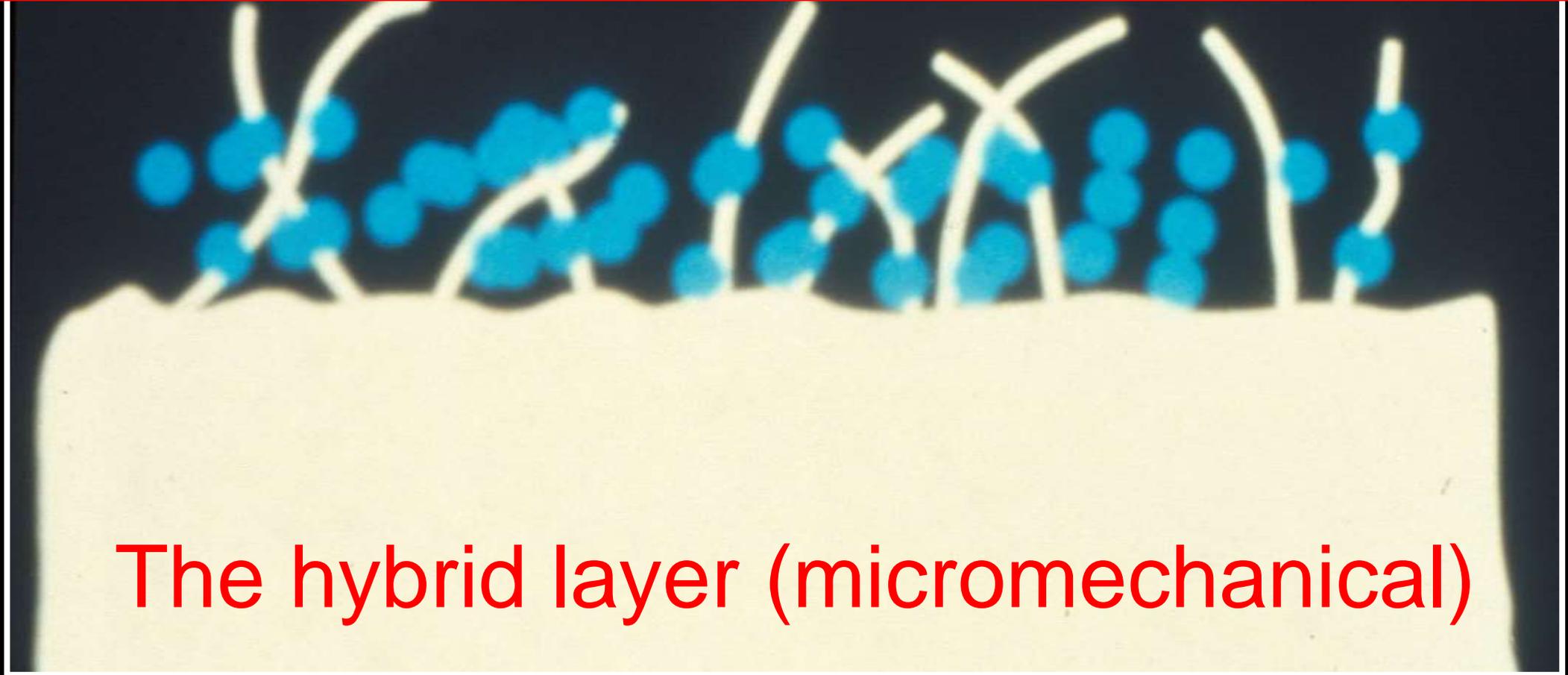
# Another problem: The smear Layer

- Thickness:  
0.5 - 5.0 microns
- Will not wash off
- Weak bond to tooth,  
2 – 3 MPa
- Very soluble in  
weak acid



B. Van Meerbeek in: Summitt Fund. Oper. Dent. 2001,  
Enamel and Dentin Adhesives, Col Kraig S. Vandewalle, USAF Dental  
Investigation Service,

# Overdrying causes the collagen to collapse



Nakabayashi N, Kojilma K, Masuhara E. The promotion of adhesion by the infiltration of monomers into tooth substrates. *J Biomed Mater Res* 1982; 16: 265–273.

*.....NOW*

The Universal Adhesives

# *Definition of a Universal Adhesive*

- ☺ capable of being used in whichever etching mode that the operator considers appropriate (total etch, self-etch or selective enamel etch):
- ☺ may be used for direct and indirect dentistry, the latter generally in conjunction with a resin-based luting system from the same manufacturer as the bonding agent, with the luting system incorporating a material-specific initiator (Burke et al)
- ☺ the addition of the monomer 10-MDP to provide chemical bonding to hard tissue & metals (Matos et al),
- ☺ a single-bottle, no-mix adhesive system that performs equally well with any adhesion strategy and bonds to tooth structure & to different direct/indirect restorative materials (Nagarkar and colleagues).
- ☺ suitable for clinical applications, e.g. direct/indirect restorations, core build-ups, zirconia primers and dentine desensitising (Perdigao et al)

# 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)

Etch&Rinse and Self Etch were type specific

# Universal bonding agents:



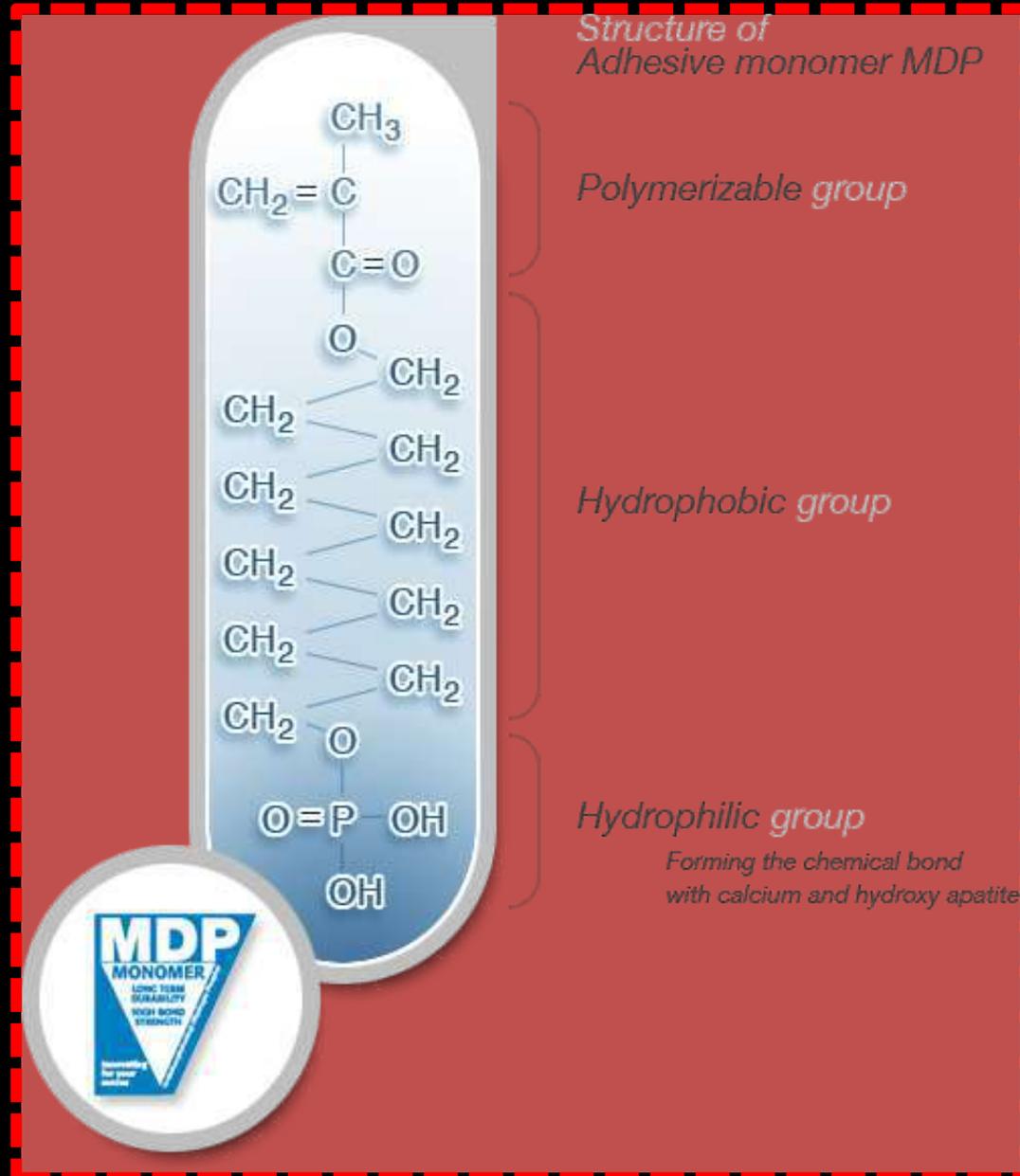
The first Universal  
Adhesive:  
Scotchbond  
Universal (3M)

Universal bonding agents:

Many new additions have  
arrived!

Most contain the resin 10-MDP

Why has 10-MDP become so popular?



10-MDP is important for the bond reaction with HAP

# 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)

# A recent addition



# Scotchbond Universal Plus: What's different?

It bonds to caries affected dentine

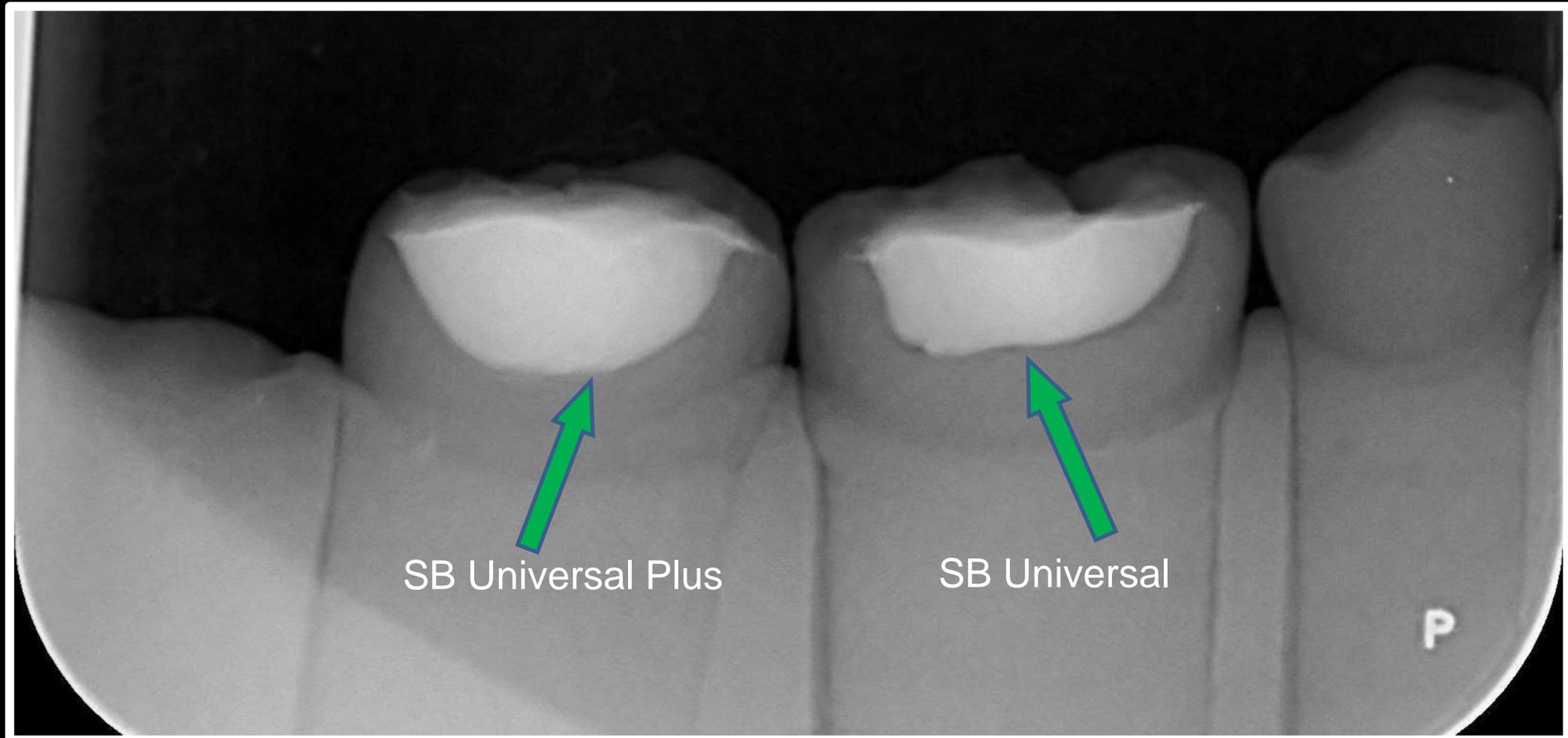
Does everything that SBU did,  
but better bond (manufacturer's data)

Improved silane

The gamechanger

A longstanding  
question

Is it a layer of bond?  
Or is it caries?



Filtek Universal Pink Opaque

## User tip!

If the adhesive layer looks dull, there isn't sufficient, therefore add another layer

Follow the drying instructions rigidly

Anyone prefer a 2-bottle  
(plus etch) system to a  
one-bottle bonding  
system?

A new 2-bottle bonding system

Some slides from 

# From Buonocore's Pioneering Acid-Etch Technique to Self-Adhering Restoratives. A Status Perspective of Rapidly Advancing Dental Adhesive Technology

Bart Van Meerbeek<sup>a</sup> / Kumiko Yoshihara<sup>b</sup> / Kirsten Van Landuyt<sup>c</sup> / Yasuhiro Yoshida<sup>d</sup> / Marleen Peumans<sup>e</sup>

**Summary:** This literature-based OPINION PAPER reflects in an introductory historical perspective on the rapid advancement of dental adhesive technology. Past and current techniques to bond to tooth tissue, in particular to dentin as the most challenging bonding substrate, are critically appraised. Including the historical perspective in (1), this paper focuses on fourteen items thought to be of primary importance with regard to the current status of dental adhesive technology. In (2) the primary mechanisms involved in adhesion to enamel and especially dentin are dealt with having (3) also revisited the previously introduced adhesion-decalcification concept (AD concept) as basis of biomaterial-hard tissue interaction; the worldwide accepted classification of today's adhesives into etch&rinse (E&R) and self-etch (SE) adhesives are presented in (4), along with presentation of their respective PLUS-MINUS balances in (5) and (6); nomination of the GOLD-STANDARD E&R (7) and SE (8) adhesives is based on evidence of successful laboratory and long-term clinical performance, resulting in a recommended 3-step full E&R bonding route in (9) and the preferred 3-step combined selective enamel E&R with 2-SE bonding route in (10); (11) description of the main bond-degradation pathways and eight strategies to preserve bond stability; (12) coverage of the PROS and CONS of the newest generation of UNIVERSAL adhesives. Looking into the future, some expected future developments in dental adhesive technology have been suggested in (13), along with (14) a first status determination of the latest research-and-development towards self-adhesive restorative materials that no longer require any pre-treatment.

**Keywords:** review, bonding, dentin, adhesion, self-adhesive.

*J Adhes Dent* 2020; 22: 7-34.  
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## perspective of the MILESTONES in technology

technology continues to evolve at a rapid pace. We have already learned to bond effectively to enamel 65 years ago with Buonocore's "ACID-ETCH TECHNIQUE".<sup>22</sup> Predating Buonocore's attempts to bond acrylic resin to tooth structure contributed to the Swiss chemist Hagger in

1951.<sup>63,110,111</sup> He used the functional monomer glycerophosphate dimethacrylate (GPDM), which today is still contained as primary functional monomer in some popular dental adhesive products, such as the Optibond FL/XTR/Universal (Kerr) product family. Historical research identified Kramer and McLean, who showed in 1952 that GPDM improved adhesion to dentin by "penetrating the surface and forming an intermediate layer".<sup>90</sup> Much later, this inter-

Van Meerbeek et al



Fig 10 Evidence justifying the nomination of Optibond FL (Kerr) as gold-standard E&R adhesive, based on meta-analytical laboratory<sup>149</sup> and clinical data,<sup>148</sup> as well as on its superior clinical performance in a thirteen-year randomized clinical trial.<sup>150</sup>



Fig 11 Evidence justifying the nomination of Clearfil SE Bond (Kuraray Noritake) as gold-standard SE adhesive, based on meta-analytical laboratory<sup>149</sup> and clinical data,<sup>148</sup> as well as on its superior clinical performance in a thirteen-year randomized clinical trial,<sup>150</sup> though clinically recommended to be employed in a 3-step combined selective enamel E&R with 2-SE bonding mode.

class-V restorations,<sup>148</sup> the clinical model regarded as most suitable (most objective) to assess clinical effectiveness of adhesives.<sup>222</sup>

Based on two meta-analytic proofs of laboratory and clinical effectiveness along with one independent RCT, Optibond FL (Kerr) deserves to be recognized as gold-standard E&R adhesive (Fig 10).

## (8) GOLD-STANDARD SE ADHESIVE (Fig 11)

GS1: Being on the market for more than 20 years, the 2-step SE adhesive Clearfil SE Bond (Kuraray Noritake) cur-

retention rate reported in independent long-term RCTs of non-retentive class-V restorations.<sup>149</sup>

GS3: A very low AFR of 2.2 ( $\pm 1.7$ )%, as based on 12 RCTs, was recorded for Clearfil SE Bond (Kuraray Noritake) in a meta-analysis of clinical effectiveness of adhesives in non-retentive class-V restorations.<sup>148</sup>

Based on two meta-analytic proofs of laboratory and clinical effectiveness along with one independent RCT, Clearfil SE Bond (Kuraray Noritake) deserves to be recognized as gold-standard SE adhesive (Fig 11).

# Bart van Meerbeek's "wish list": What is the ideal modern bonding approach with multi-step adhesive?

## The ideal adhesive system should contain:

### 1. A separate primer

- Acting as the adhesion promoter; **allows use of selective enamel etching**
- with **chemical bond** ability based on **10-MDP**
- **containing also photo-initiators**, to make sure all areas, even in the deeper parts of the hybridization, will be covered by photo-initiators



### 2. A separate bonding agent that can be light-cured immediately

- **Solvent-poor/free adhesive resin, hydrophobic** to reduce the water uptake
- applied in a **sufficient thick layer**, with stress-absorbing potential like flowable composite & presenting high mechanical properties
- that provides a **good seal of the interface**

**G-2 Bond Universal** contains all these features



**FJ Trevor Burke**

**Peter Sands and Russell J Crisp**

# A Practice-based Clinical Evaluation of a Novel Two-bottle Dentine Adhesive system

**Abstract:** This study evaluated the handling of a recently introduced two bottle dentine adhesive system by a group of practice-based researchers. Twelve evaluators from the practice-based research group, the PREP Panel, were sent explanatory letters, a pack of the material under investigation, G2-Bond Universal, with a request to use it, where indicated, for 10 weeks and then to complete a questionnaire designed to elicit the evaluators' views on the handling of the materials. In total, 568 restorations were placed. The results from the questionnaire indicated good acceptance of the material, despite the fact that it required more clinical steps than the material previously used by the evaluators.

**CPD/Clinical Relevance:** Results from this evaluation indicate that there is a place in a majority of evaluators' practices for a two-bottle adhesive system.

**Dent.Update.2022:49:112-118**

# Some recent PREP Panel evaluations

# The PREP Panel evaluation of G-Premio Bond

## 2 evaluators, 719 restorations placed

When the evaluators were asked to rate the ease of use of the bonding system which they currently used, the result was as follows:



When the evaluators were asked to rate the ease of use of the G-Premio Bond, the result was as follows:





F J Trevor Burke

Russell J Crisp and Peter Sands

## A 'Handling' Evaluation of the Dentsply Sirona Class II Solution System by the PREP Panel

Dent Update 2018; 45: 1032-1040

### Practice-based research

The value of practice-based research has been previously discussed,<sup>1</sup> 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.<sup>1</sup> A UK-based group of practice-based researchers is the PREP (Product

Research and Evaluation by Practitioners) Panel. This group was established in 1993 with six general dental practitioners (GDPs), and has grown to contain 31 dental practitioners located across the UK, with one in mainland Europe.<sup>1</sup> The group has completed over 70 projects – 'handling' evaluations of materials and techniques, and, more recently, clinical evaluations (n = 8) of restorations placed under general dental practice conditions, with the restorations being followed for up to five years.<sup>1</sup>

### Resin composite systems

As patients increasingly move away from amalgam restorations in their posterior teeth,<sup>2</sup> with the added impetus of the Minamata Agreement by which the use of amalgam has been banned, from 1st July 2018, in children 15 years and younger and in pregnant and nursing women, dental practitioners have had to use an alternative material, the most appropriate of which is resin composite. In this regard, practice-based clinical evaluations of this material have indicated positive results.<sup>3-7</sup> However, in order to obtain such results, along with the resin composite material, a variety of materials and devices must be employed, for example, a dentine-bonding agent, a suitable matrix system

have been marketed as a single system, the Dentsply Sirona Class II Solution system. It is therefore the aim of this study to evaluate the opinions of a group of practice-based researchers, the PREP Panel, of the components of this system, and the system as a whole.

The Dentsply Sirona products under evaluation therefore are: the dentine bonding system Prime & Bond Active™, the Palodent V3 Sectional Matrix System, SDR® Flow+ composite, Ceram.x Universal composite and the Enhance® Finishing and Polishing System (all manufactured by Dentsply Sirona, Building 3, The Heights, Brooklands, Weybridge, Surrey, KT13 0NY at [www.dentsplysirona.com/en-gb](http://www.dentsplysirona.com/en-gb)).

### Methods

#### Selection of participants

All 31 members of the practice-based research group, the PREP Panel, were sent an email communication asking if they would be prepared to be involved in the 'handling' evaluation of a recently-introduced Class II resin composite system. Of those who agreed to participate, 12 were selected at random.

A questionnaire was designed jointly by the PREP Panel co-ordinators

**FJ Trevor Burke**, DDS, MSc, MDS, MGDS, FDS (RCS Edin), FDS RCS(Engl), FFGDP(UK), FADM, Primary Dental Care Research Group, University of Birmingham School of Dentistry, The PREP Panel Ltd, Knutsford, Cheshire, **Russell J Crisp**, BDS, DGD, The PREP Panel Ltd, Knutsford, Cheshire, **Peter Sands**, MSc, BDS, LDS RCS, MFGDP, General Dental Practitioner, Abingdon, PREP Panel member and part-time Lecturer, University of Birmingham.



Figure 1. Prime &amp; Bond Active™

When the evaluators were asked to rate the ease of use of the Prime & Bond Active™, the result was as follows:



Find out more

# The PREP Panel evaluation of Zipbond

A good result!

100% would purchase if available at “average” price

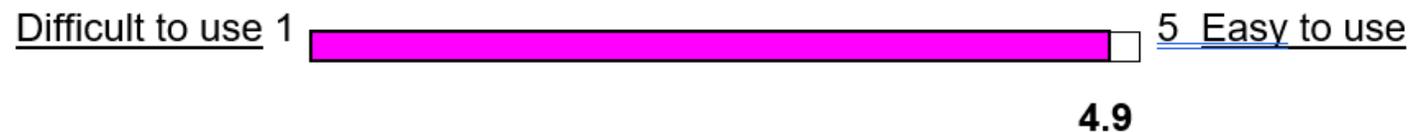
When they were asked if there were any changes the considered essential to the acceptability of the material the following comments were made:

“None”

“Make single dose compule easier to use- may have been just my inexperience using them”

“Packaging of single dose compules a little bulky”

When the evaluators were asked to rate the ease of use of SDI Zipbond, the result was as follows:



593  
restorations  
placed



## Trevor's view:

Universal bonding  
agents generally  
represent improved ease  
of use compared with  
previous bonding agents

this is good  
because....

# An easy to use material may allow us to produce better results

Special Report

## Ease of use versus clinical effectiveness of restorative materials

F. J. T. Burke, DDS, MSc, MDS<sup>1</sup>/ M. Liebler, DDS<sup>2</sup>/ G. Eliades, DDS, Dr Odont<sup>3</sup>/  
R. C. Randall, M Phil, BChD<sup>4</sup>

"Ease of use," as applied to dental materials and techniques, means different things to different people. Factors that may contribute to ease of use include a minimum number of application stages, easy application and shaping ability, quickness of use, lack of stick, and moisture sensitivity. Ease of use may also imply that a material or technique does not cause stress for the dentist and patient, is cost effective, is easy to learn, and should provide the operators with a sense of satisfaction with their work. Similarly, "clinical effectiveness" of the treatments prescribed for patients is not always capable of being accurately defined. Suggested factors that may contribute to clinical effectiveness include a lack of patient complaints with respect to longevity and/or cost, no secondary caries, and preservation of the remaining tooth structure during functional loading. Ease of use and clinical effectiveness are not necessarily related, but they must be combined for a technique to be successful. The achievement of this demands a partnership between clinicians, manufacturers, and patients. (*Quintessence Int* 2001;32:239-242)

# Recent clinical studies on Universal Adhesives



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>

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>4</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>5</sup> Green, Mackenzie and Banerjee<sup>6</sup> and others.<sup>1,6</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

**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, MFDC(RCS Edin), General Dental Practitioner, Nottingham, David JB Green, BDS(Hons), BSc, MFDS(RCS(Edin)), SrR 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.**

# Conclusion from this publication:

# New Universal bonding agents are an advance in bonding

Dent.Update.2017;44:328-340



FJ Trevor Burke  
Louis Mackenzie

# Bonding to Dentine: An Update on Universal Adhesives

**Abstract:** The ability to successfully bond restorations to dentine is central to minimally invasive restorative dentistry. While dentine bonding agents have gone through a variety of 'generations', it is the purpose of this article to describe the latest clinical and laboratory research on universal adhesives. Results from the latest laboratory and clinical research indicates that universal adhesives are a step forward in the quest for the ultimate bond to tooth substance and ease of use of the adhesive. The wide variety of studies that indicates the effectiveness of universal adhesives are discussed, along with research that indicates that selective enamel etching is a beneficial procedure when using these materials.

**CPD/Clinical Relevance:** Universal adhesives appear to hold promise in the quest for a reliable bond to dentine.  
*Dent Update 2021; 48: 620-631*

Dentine bonding agents play a central 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 restorations, which may be bonded to tooth substance, do not require the macro-mechanical retentive features such as locks and keys that are a feature of (non-adhesive) dental amalgam or gold cavity preparations.<sup>2</sup>

A dentine adhesive should perform the following functions:<sup>3</sup>

- Provide an immediate, strong and definitive 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 article to trace the history of dentine adhesives since that is relevant to the performance of the latest group of adhesives, the universal adhesives (UAs), and thereby to update readers on the progress of UAs since a previous *Dental Update* paper in 2017,<sup>4</sup> and to compliment other *Dental Update* publications on the subject, which readers may wish to read as background, such as those by Green and Banerjee,<sup>5</sup> and, Green et al.<sup>6</sup>

### A brief history of bonding to dentine

In the past, dentine bonding agents were

bonding agents generally fell into disarray because of confusion regarding which 'generation' each type of bonding agent fitted into. Until recently, the classification has therefore been to simply subdivide resin-based dentine bonding agents into etch and rinse materials (also known as total etch materials) and self-etch materials, with some workers classifying these according to the number of steps involved in their placement (one or two), or by their pH.<sup>1,7</sup>

The year 1955 heralded what we now realize to be a game-changing breakthrough in restorative dentistry, namely the genesis of adhesive (and, therefore, more minimally invasive) dentistry by enabling clinicians to bond to enamel, when this was first described by Buonocore.<sup>8</sup> This also has facilitated the development of resin composite materials, with these materials becoming increasingly used worldwide,<sup>1</sup> principally because of patient concerns regarding mercury in dental amalgam, the Minamata Agreement of 2013 that recommended reduction in the use of dental amalgam, and increasing

# Hot off the press!

## 10 laboratory studies included

Finally, recent laboratory studies include the work by Lago and co-workers<sup>39</sup> who compared the shear bond strength of six UAs to dentine, using Clearfil SE Bond (Kuraray) as control. The results indicated highest bond strength values for Scotchbond Universal (3M) (33.9MPa), but this was not significantly different to Clearfil Universal (Kuraray) and Tetric N-Bond (Ivoclar-Vivadent). All six UAs provided superior bond strength values to the Clearfil SE control.

In summary, therefore, laboratory studies appear to confirm that the bond strengths obtained by UAs are generally an improvement over those previously attained, with a selective enamel etch strategy being preferred.



FJ Trevor Burke  
Louis Mackenzie

# Bonding to Dentine: An Update on Universal Adhesives

**Abstract:** The ability to successfully bond restorations to dentine is central to minimally invasive restorative dentistry. While dentine bonding agents have gone through a variety of 'generations', it is the purpose of this article to describe the latest clinical and laboratory research on universal adhesives. Results from the latest laboratory and clinical research indicates that universal adhesives are a step forward in the quest for the ultimate bond to tooth substance and ease of use of the adhesive. The wide variety of studies that indicates the effectiveness of universal adhesives are discussed, along with research that indicates that selective enamel etching is a beneficial procedure when using these materials.

**CPD/Clinical Relevance:** Universal adhesives appear to hold promise in the quest for a reliable bond to dentine.  
*Dent Update 2021; 48: 620-631*

Dentine bonding agents play a central 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 restorations, which may be bonded to tooth substance, do not require the macro-mechanical retentive features such as locks and keys that are a feature of (non-adhesive) dental amalgam or gold cavity preparations.<sup>2</sup>

A dentine adhesive should perform the following functions:<sup>3</sup>

- Provide an immediate, strong and definitive 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;
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- Be easy to use.

It is the intention of this article to trace the history of dentine adhesives since that is relevant to the performance of the latest group of adhesives, the universal adhesives (UAs), and thereby to update readers on the progress of UAs since a previous *Dental Update* paper in 2017,<sup>4</sup> and to compliment other *Dental Update* publications on the subject, which readers may wish to read as background, such as those by Green and Banerjee,<sup>5</sup> and, Green et al.<sup>6</sup>

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**FJ Trevor Burke**, DDS, MSc, MDS, MGDS, FDS (RCS Edin), FDS RCS (Engl), FFGDP (UK), FADM, Emeritus Professor, University of Birmingham School of Dentistry, UK.  
**Louis Mackenzie**, BDS, FDS RCPS, Head Dental Officer, Denplan UK, Winchester and Clinical Lecturer, University of Birmingham School of Dentistry, UK.

# Hot off the press!

## 11 clinical studies included

In summary therefore, there is a strong body of evidence that indicates that recently developed UAs provide clinical effectiveness as good as, or better, than previous 'gold standard' adhesives, and that selective etching of the enamel is desirable, given that the results presented above indicate improved retention rates of class V restorations when the margins are etched, and reduced levels of discolouration around the margins of all restorations. The present authors therefore strongly recommend this procedure. Does that statement apply to all UAs? It is the authors' view that, in view of the similarities between many of the UAs (Table 1<sup>21,22</sup>), and the fact that their pH values tend to lie between 1.5 and 3, it is prudent to suggest that this is carried out if the clinician wishes to limit marginal staining over time.

# The current status of resin composite materials for posterior teeth



**F J Trevor Burke**

**Louis Mackenzie and Adrian CC Shorthall**

# 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 RCCTs

Do you want  
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more?

144 studies  
identified, 24  
included

Dent.Update.  
2019:46:  
523-535

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

The conclusion gleaned from the above systematic reviews 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%. Risk factors for premature failure include patients at high risk of caries and the presence of a liner or base beneath the resin composite restoration.

Do you want  
to read  
more?

144 studies  
identified, 24  
included

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2019:46:  
523-535

The ultimate evidence  
- Systematic reviews

N.J.M. Opdam<sup>1\*</sup>, F.H. van de Sande<sup>2</sup>,  
E. Bronkhorst<sup>1</sup>, M.S. Cenci<sup>2</sup>,  
P. Bottenberg<sup>3</sup>, U. Pallesen<sup>4</sup>,  
P. Gaengler<sup>5</sup>, A. Lindberg<sup>6</sup>,  
M.C.D.N.J.M. Huysmans<sup>1</sup>,  
and J.W. van Dijken<sup>6</sup>

*J Dent Res* 93(10):943-949, 2014

<sup>1</sup>Radboud University Nijmegen Medical Centre, College of Dental Sciences, Preventive and Restorative Dentistry, Ph van Leydenlaan 25, PO Box 9101 6500HB Nijmegen, The Netherlands; <sup>2</sup>Federal University of Pelotas, Graduate Program in Dentistry, Gonçalves Chaves, 457, 5th floor, Pelotas, RS, 96015560, Brazil; <sup>3</sup>Vrije Universiteit Brussels, Dept. of Oral Health Sciences, Laarbeeklaan 103, BE 1090 Brussels, Belgium; <sup>4</sup>Faculty of Health and Medical Sciences, University of Copenhagen, Institute of Odontology, Nørre Allé 49, DK-2200, Copenhagen, Denmark; <sup>5</sup>Universitätsklinikum Bonn, Abteilung für Zahnerhaltung und Zahnmedizin, Alfred-Herrhausen-Str. 44, D-53117 Bonn, Germany; and <sup>6</sup>Umeå University, Department of Odontology, SE-901 85 Umeå, Sweden; \*corresponding author; .opdam@radboudumc.nl

## **Longevity of Posterior Composite Restorations: A Systematic Review and Meta-analysis**

1,551 papers identified  
25 met inclusion criteria  
12 authors provided raw data  
2,816 restorations included,  
of which 569 had failed

The conclusion of the present meta-analysis of 12 clinical studies based on raw data is that caries risk and number of restored surfaces play a significant role in restoration survival, and that, on average, posterior resin composite restorations show a good survival, with annual failure rates of 1.8% at 5 years and 2.4% after 10 years of service.

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## Longevity of posterior composite restorations: Not only a matter of materials

Flávio F. Demarco<sup>a,\*</sup>, Marcos B. Corrêa<sup>a</sup>, Maximiliano S. Cenci<sup>a</sup>,  
Rafael R. Moraes<sup>a</sup>, Niek J.M. Opdam<sup>b</sup>

<sup>a</sup> Graduate Program in Dentistry, School of Dentistry, Federal University of Pelotas, RS, Brazil

<sup>b</sup> Department of Restorative and Preventive Dentistry, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands

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### ABSTRACT

Resin composites have become the first choice for direct posterior restorations and are increasingly popular among clinicians and patients. Meanwhile, a number of clinical reports in the literature have discussed the durability of these restorations over long periods. In this review, we have searched the dental literature looking for clinical trials investigating posterior composite restorations over periods of at least 5 years of follow-up published between 1996 and 2011. The search resulted in 34 selected studies. 90% of the clinical studies indicated that annual failure rates between 1% and 3% can be achieved with Class I and II posterior composite restorations depending on several factors such as tooth type and location, operator, and socioeconomic, demographic, and behavioral elements. The material properties showed a minor effect on longevity. The main reasons for failure in the long term are secondary caries, related to the individual caries risk, and fracture, related to the presence of a lining or the strength of the material used as well as patient factors such as bruxism. Repair is a viable alternative to replacement, and it can increase significantly the lifetime of restorations. As observed in the literature reviewed, a long survival rate for posterior composite restorations can be expected provided that patient, operator and materials factors are taken into account when the restorations are performed.

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34 papers, each with evaluation periods of >5 years.

## RESULTS:

Poorer survival rates in molar teeth than in premolars

Multiple surface fillings more likely to fail than class I

CONCLUSION: “Composite restorations have been found to perform favourably in posterior teeth, with annual failure rates of 1-3%”.

“due to their aesthetic properties and good clinical service, composites have become the preferred standard for direct posterior restorations”.

## Trevor's view:

Posterior composites perform as well as amalgams, but cannot be cost effective because they take longer to place *at present*. Perhaps bulk fills are the answer.

Authors' Information

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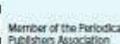
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FJ Trevor Burke

## Light curing may not be as simple as it seems!

Some readers may recall a time when resin composite materials were presented in two pots, with equal amounts of the material from each pot being mixed to produce the restorative material, which then had a working time of less than three minutes. These were the early composite materials which were chemically cured. The introduction, in the early 1980s, of so-called 'command set' materials which polymerised when exposed to a light of wavelength circa 460nm (in the blue part of the spectrum) was a welcome change, as the clinician had much longer working time. As a result, the ease of use of composite materials improved dramatically and, indeed, the only problem was that some materials slowly polymerised in the ambient light of the surgery. Light curing materials, whose chemistry was derived as a by-product from the paint industry, are now an accepted, indeed fundamental, part of restorative dentistry. However, light curing may not be as straightforward as it seems: a number of factors are involved.

First, while light-activated resin composite materials cannot be over-cured, it is essential that they receive sufficient light energy to initiate and satisfy the curing process. Failure to do this may result in a less than optimally cured restoration whose physical properties, and resultant longevity, will suffer as a direct result. This has been brought home to me recently when I was asked to light cure a restoration in an upper first molar in a phantom head, with the irradiance being measured in a specially designed apparatus called MAIRC (Managing Accurate Resin Curing: BlueLight Analytics Inc. Halifax Canada). My result was suboptimal because I had not held the light steady in one position and perpendicular to the restoration – a serious wake up call. I was not alone, however, as a large quantitative and qualitative variation was identified in the irradiance delivered to teeth by operators carrying out a similar experiment to that which I had done. In addition, the light energy delivered to a class V preparation was less than to the class I. Some dentists delivered as little as 20% of the energy achieved by others using the same light source and intra-oral location. However, there was no difference between dentists and fourth year dental students. This message is also worthy of transmission to our nurses, to whom many of us delegate our light curing and who may have other duties within the surgery to distract them while operating a curing light unit. The first ever study reporting on individual intra-oral variations in light curing ability also noted a wide spread difference in individual operator performance. Whilst dentists' performance was more consistent overall than second and third year undergraduates the most consistent individual was a student! If nothing else these studies should highlight the need for concentration to the task in hand. All individuals in these studies knew they were being tested! Results may have been even worse had this not been the case. Second, research studies have demonstrated considerable variability in the maintenance and quality of light curing units in dental practice. In this respect, correct maintenance of these units is essential and their irradiance should be checked regularly, although newer types may have their own built-in radiometer. The quality of the light curing unit, per se, is also relevant here – I recently spotted a new curing light on sale on E bay for £50 and felt that there must be questions asked about its fitness for purpose. It is interesting also to note, that while quality standards are in place for dental materials, my recent searching of the literature has indicated that no such standards exist for dental light curing units. Message: be careful what you buy!

Last, a recent paper<sup>1</sup> has drawn our attention to the potential difficulties in disinfecting light curing units. Bacterial contamination of 52 units was measured for a week, with the results indicating that, while few viable organisms were detected on the fan or handle areas, many were identified on the on/off button, including *Staphylococcus aureus*. It would therefore appear that this area is not disinfected as effectively as is necessary, presenting a theoretical infection-control risk and indicating that this area should be added to the cleaning regime.

Do we now take light curing too much for granted? It has revolutionised and enhanced restorative dentistry but also has the potential for being abused. As in life, there is a danger that familiarity may breed contempt!

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All articles published in Dental Update are subject to review by specialist referees in the appropriate dental disciplines.



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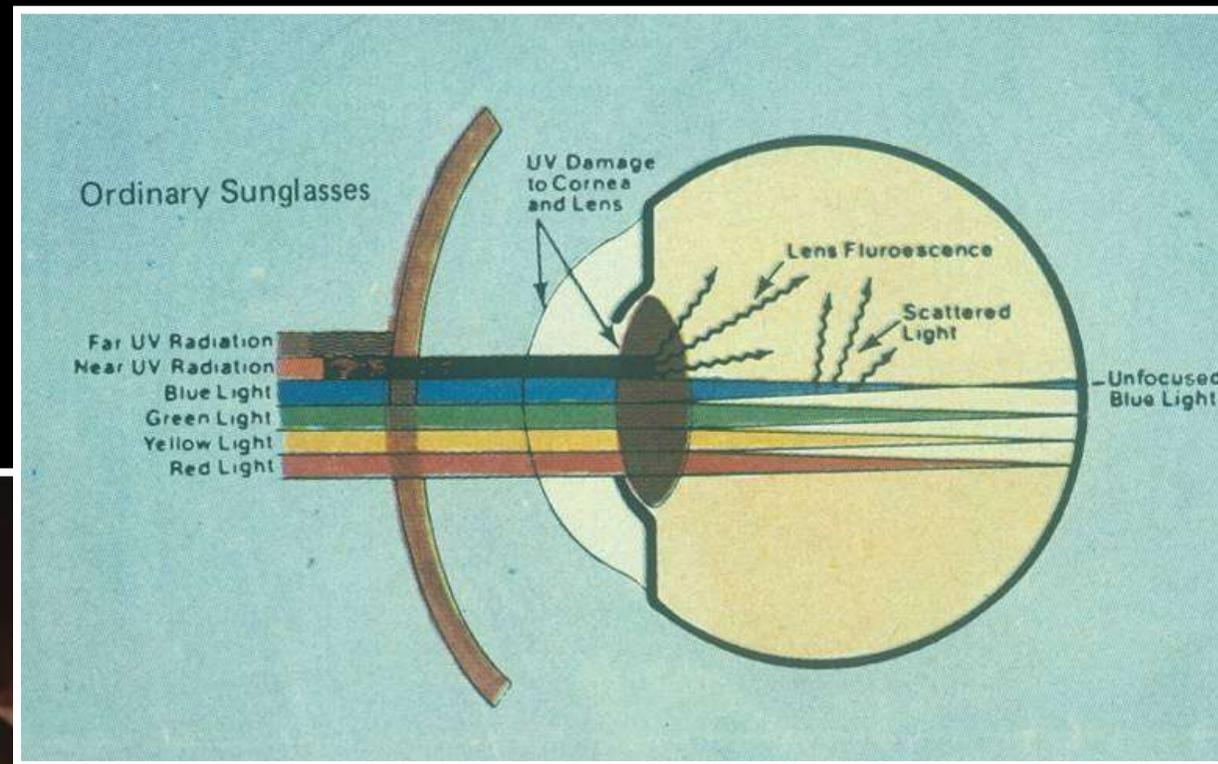
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# Revision time!

Degree of cure  
correlates to the  
product of the logarithm  
of light intensity  
and the logarithm  
of curing time

**DANGER!**



**Avoid retina burns**

## Trevor's view

Don't take light curing for granted! The light tip needs to be in the right place and the light needs to be working satisfactorily.

And, how often should we check our light curing units?

*ANSWER:*

Prof Will Palin (Univ of Birmingham) considers that  
“every 3 months should be sufficient”

# Matrices for posterior composites

Two main types



Circumferential



Sectional

The composite must be stiff enough to push out the matrix (i.e. flowables won't work)

...but, generally we will need to burnish the matrix at the contact

# Circumferential: Supermat (Kerr)



The handle is autoclavable to 10,000 cycles

So, yellow centre in a green holder  
is potentially the most versatile



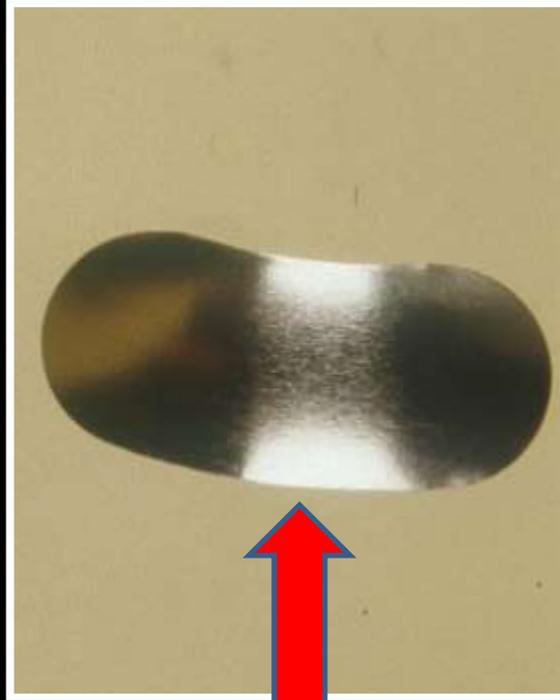
If your contact point is tight, you need these!

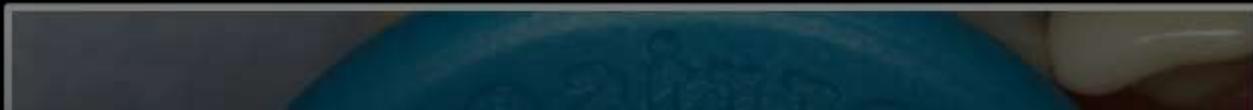


Standard artery forceps

The opposite - for  
smaller interproximal boxes:  
Sectional matrices

**The convex edge goes at the  
gingival margin**





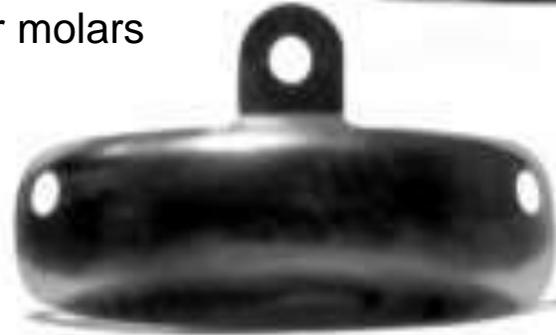
# Variations on sectional matrices

# Palodent Plus Matrix Bands

6.5 mm for deep and wide  
cavities



5.5 mm, most common size for molars



4.5 mm for most pre-molars



3.5 mm for pedodontics or small cavities



on pre-molars

All sizes are 30  $\mu$ m thick

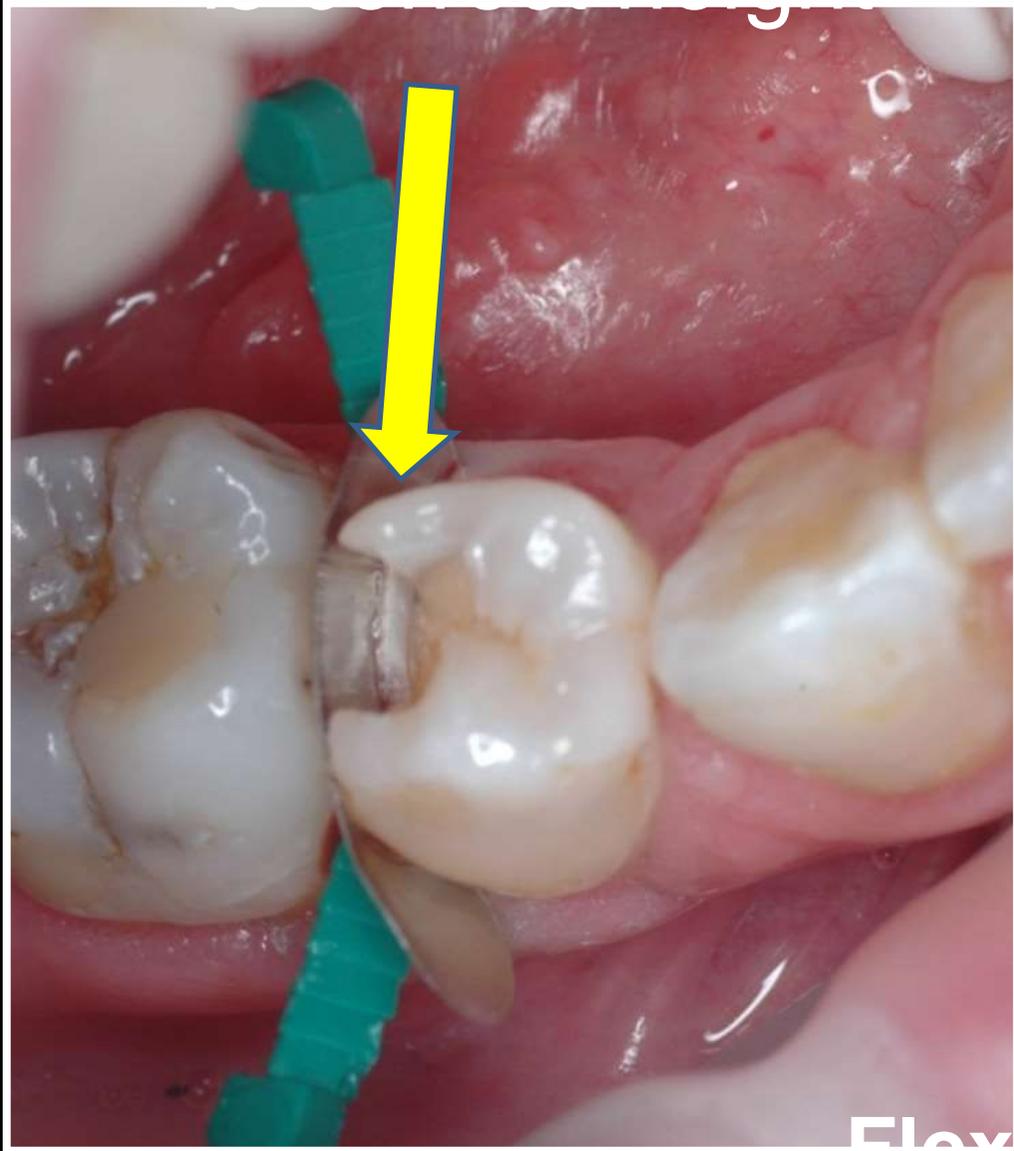
..for good proximal contacts:

- 👄 Use a thin metal matrix
- 👄 Push the matrix
- 👄 Wedge firmly
- 👄 Use a packable/stiff composite
- 👄 Use a non-stick composite
- 👄 Use a non-slumping composite

## Trevor's view

A sectional will be your “go-to” matrix for the average box, with Supermat (and Palodent 360) for cusp replacement restorations and wide boxes.

Size selected  
is correct height



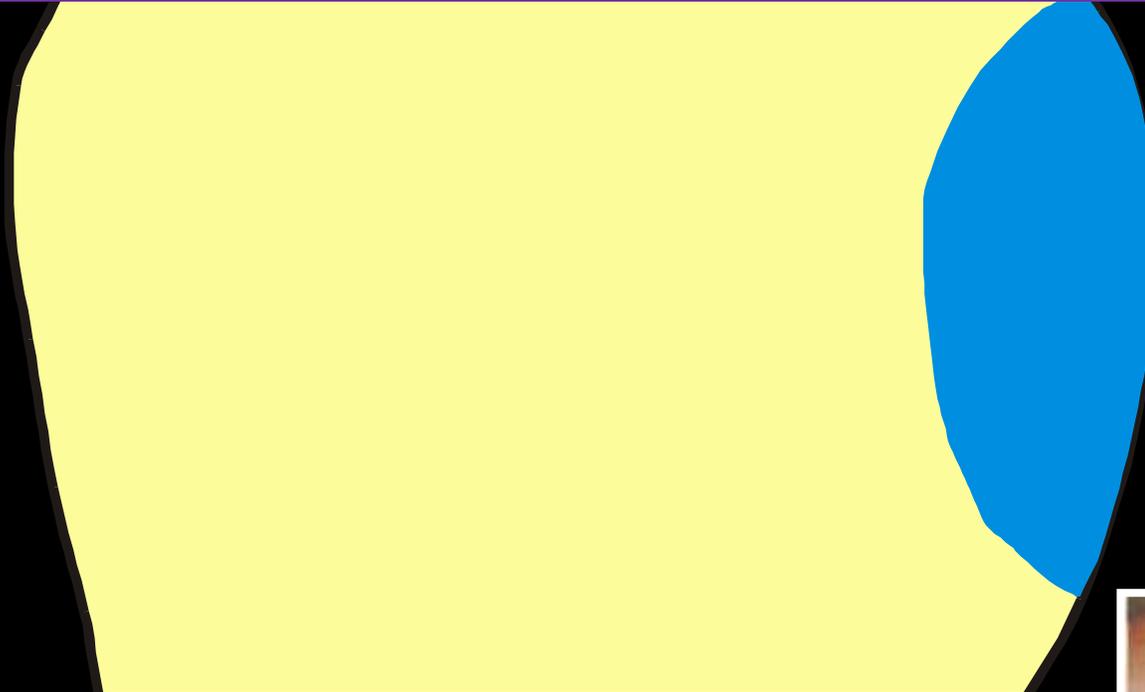
Matrix size is  
important



Size selected  
is too high

Flexiwedges

Is this non-retentive adhesive cavity design  
the cavity of choice?



Use a Universal  
bonding agent



## Trevor's view

Resin composites can be placed in minimal, non-retentive cavities.

And, don't forget the Preventive Resin Restoraton.

*Clinical* factors influencing

shrinkage stress:

Cavity geometry

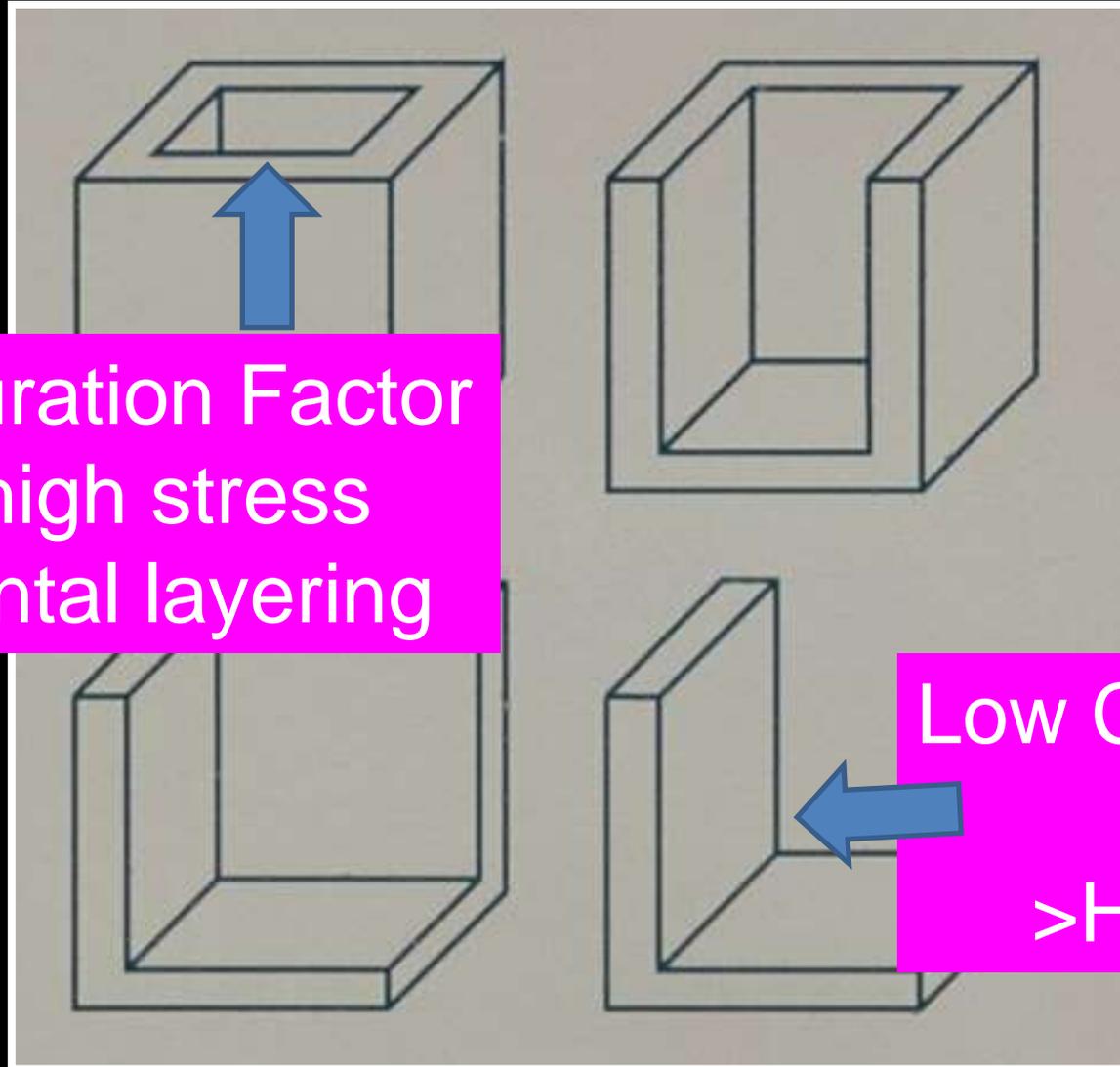
Application technique

Light intensity

# The Configuration Factor



High Configuration Factor  
= high stress  
> incremental layering



Low Configuration Factor  
= low stress  
> Horizontal layering

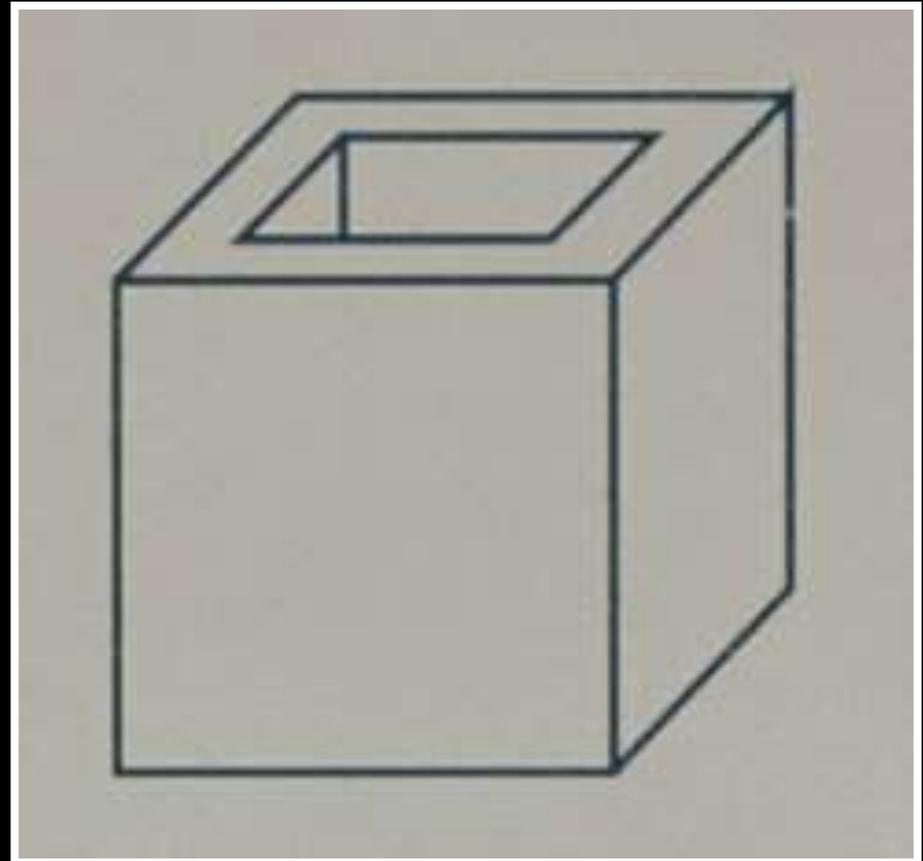
# The Configuration Factor

Occlusal cavities are the highest stress,  
especially large cavities

## C-Factor

$$C = \frac{\text{Total Bonded Area}}{\text{Total Unbonded Area}}$$

$C < 1$  required to survive polymerisation  
contraction stress (Feilzer et al., 1987)



# *Physical (materials) factors influencing* **shrinkage stress:**

-  Polymerisation shrinkage
-  Elastic modulus
-  (Development/flow capacity  
Degree of cure/conversion)

...a way of reducing  
shrinkage stress –  
a composite with a low  
shrinkage/ low shrinkage  
stress

Now history!

Now history!

# The Filtek™ Silorane System



The first composite to achieve 1% shrinkage, plus better hydrolytic instability, improved ambient light sensitivity



Weinmann W, Thalacker C, Guggenberger R. Siloranes in dental composites. Dent.Mater. 2005;21:68-74

# Silorane: good results at 5 years

## Keywords

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Restorative Dentistry  
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Low Shrinkage Stress

## Authors

**E J Trevor Burke \***  
(DDS, MSc, MDS, MGDS, FDS (RCS Edin.),  
FDS RCS (Eng.), FFGDP (UK), FADM)

**Russell J Crisp †**  
(BDS, DGDGP)

**Ali James †**  
(MSc, BDS, MFGDP)

**Louis Mackenzie †**  
(BDS)

**Owen Thompson \***  
(BDS, FDS RCPS, MFGDP, MGDSRCPS)

**A Pal †**  
(BDS, MFGDP (UK), MGDS, FFGDP (UK))

**Peter Sands †**  
(MSc, BDS, LDS, MFGDP)

**William M Palin \***  
(BMedSc MPhil PhD, FADM)

## Address for Correspondence

**Russell John Crisp †**  
Email: [crisp.russell@gmail.com](mailto:crisp.russell@gmail.com)

\* Birmingham Dental School & Hospital,  
University of Birmingham, College of Medical  
and Dental Sciences, Institute of Clinical  
Sciences, 5 Mill Pool Way, Edgbaston,  
Birmingham, B5 7EG

† Clinical Lecturer, University of Birmingham  
School of Dentistry, College of Medical and  
Dental Sciences, Institute of Clinical Sciences,  
5 Mill Pool Way, Edgbaston, Birmingham, B5 7EG

## 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 formed in a low shrinkage stress resin composite material (3M ESPE Filtek Silorane, Seefeld, Germany) and placed in the general dental practices of five members of the PREP Panel, a group of UK practice-based researchers. Results indicated satisfactory performance of the material under evaluation, other than for marginal staining, which affected 60% of the restorations evaluated after five years, albeit with less than 10% of the circumference of the restorations being affected. CLINICAL RELEVANCE: The low shrinkage stress material, Filtek Silorane™, demonstrated good clinical performance in the majority of parameters which were assessed at five years.*

### INTRODUCTION

#### PRACTICE BASED RESEARCH

The value of practice-based research has been previously discussed,<sup>1</sup> 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. It is the "real world" in which the majority of dental care is provided, worldwide.

A UK-based group of practice-based researchers is the PREP (Product Research and Evaluation by Practitioners) Panel. This group, established in 1993, have completed over 70 projects - including eight clinical evaluations of restorations placed under general dental practice conditions.<sup>2</sup> It is apparent that the advantages of practice-based research are now being



# Trevor's View

What we learnt was that low shrinkage stress is important in reducing post-operative sensitivity.

...a more recent composite  
with a low shrinkage stress  
resin

# 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 **NANO!**
- Zirconia/silica cluster **NANO!**
- Ytterbium trifluoride, 100nm **NANO!**

Nanofiller technology enables ...

- Good polish retention
- Faster polishing
- Reduced potential for voids
- Good wear resistance



# Advantages of Bulk Fill *Restorative* materials

- Time saving, no need for complex layering technique
- Easy handling
- Fewer increments, fewer voids
- Simpler shade selection, due to fewer shades

**BULK FILL IS IN!**

# Bulk fill composites are quicker to place

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

**Authors:**

Chane Tardem Pereira (**Presenter**)  
Fluminense Federal University

Elisa Albuquerque, Federal Fluminense University  
Sthefane 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 Barceiro, Fluminense Federal University

**Abstract:**

**Objectives:** 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.

196 restorations  
in 43 patients

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

“Less time consuming”

# Trevor's view in 2021

Bulk fill restorative materials  
will be our amalgam alternative  
in the short to medium term

Is composite better or worse  
than amalgam?

# COMPOSITE

## Is composite an ideal material?

- ❖ No toxicity issues to patients: To dentists?? To the environment? ✓
- ❖ Physical properties good ✓
- ❖ Relatively easy placement, said to be “forgiving”, but, can it be placed under saliva and blood contamination? ✗
- ❖ Comparatively cost effective (reduced surgery time) ✗
- ❖ High thermal conductivity ✓
- ❖ Did not need an intermediate bonding agent ✗
- ❖ But, required retentive cavity features = tooth destruction ✓
- ❖ Plenty of research “evidence” on longevity ✓
- ❖ Aesthetics poor (although colour contrast facilitates removal) ✓
- ❖ Waste is highly regulated ✓

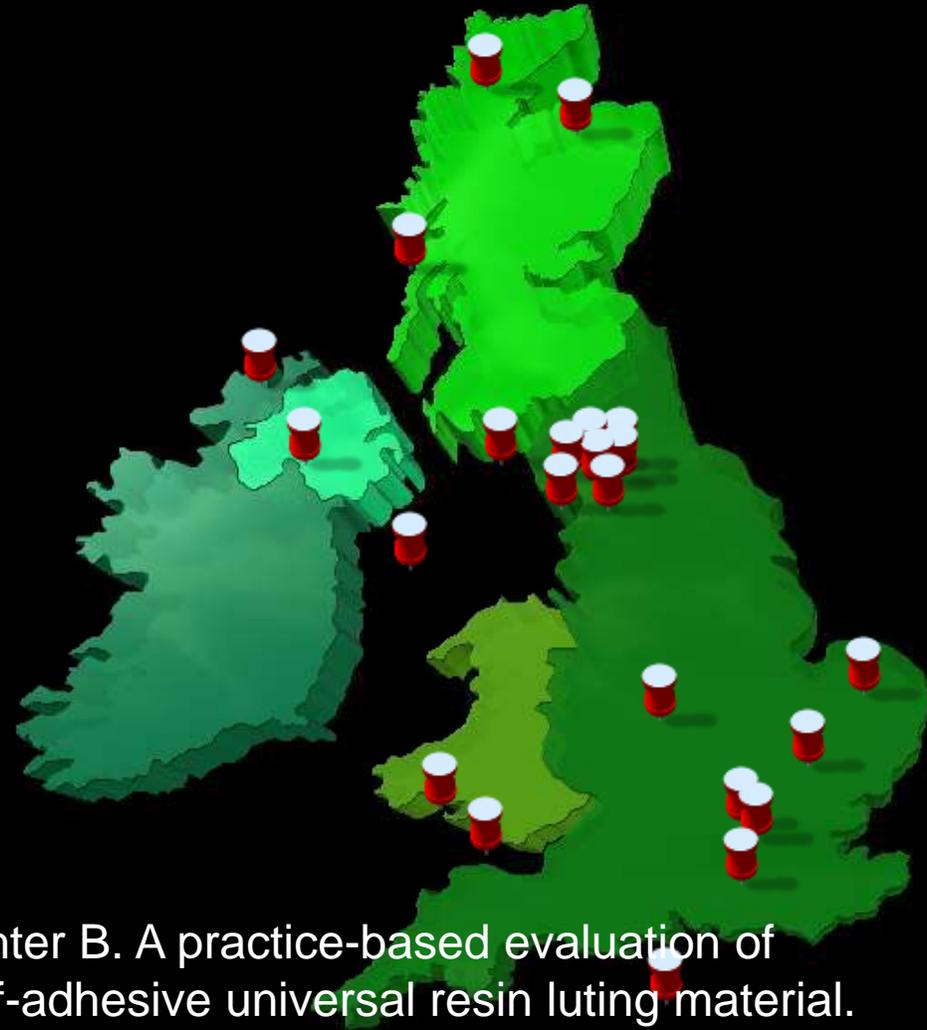
# What I plan to talk about (not necessarily in this order!)

- Amalgam, briefly
- Resin composites – a true alternative?
- Latest on self-adhesive composite materials
- Current status of GICs and Glass Hybrids for restoration of posterior teeth
- How to place these
- Are these good enough to change our philosophy today?
- Final thoughts



# Clinical evaluation by the **PREP** (Product Research & Evaluation by Practitioners) Panel

- 12 UK general dentists used Unicem for 6 weeks
- Variety of luting materials used pre-study
- 134 crowns cemented
- Rated material on analogue scales



Burke FJT, Crisp RJ, Richter B. A practice-based evaluation of the handling of a new self-adhesive universal resin luting material. *Int.Dent.J.*2006;56:142-146.

# First clinical evaluation of RelyX

## Unicem by the **PREP** Panel

Ease of use of previous resin luting system



Ease of use of conventional luting system used prior to evaluation



Overall ease of use of RelyX Unicem



No reported incidence of post-op sensitivity

# Evaluation of Unicem 2 by the PREP Panel, 2015

Flow of Unicem 2: Was flow satisfactory?



Ease of use of Unicem 2



## Review Article

# Self-adhesive resin cements – chemistry, properties and clinical considerations

J. L. FERRACANE\*, J. W. STANSBURY<sup>†</sup> & F. J. T. BURKE<sup>‡</sup>  
*\*Department of Restorative Dentistry, Division of Biomaterials and Biomechanics, Oregon Health & Science University, Portland, OR, <sup>†</sup>Department of Craniofacial Biology, School of Dental Medicine, University of Colorado Denver, Aurora, CO, USA and <sup>‡</sup>Primary Dental Care, University of Birmingham School of Dentistry, Birmingham, UK*

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**SUMMARY** Self-adhesive resin cements were introduced to dentistry within the past decade but have gained rapidly in popularity with more than a dozen commercial brands now available. This review article explores their chemical composition and its effect on the setting reaction and adhesion to various substrates, their physical and biological properties that may help to predict their ultimate performance and their clinical performance to date

and handling characteristics. The result of this review of self-adhesive resin cements would suggest that these materials may be expected to show similar clinical performance as other resin-based and non-resin based dental cements.

**KEYWORDS:** dental cement, self-adhesive, self-etch, properties, clinical performance

Accepted for publication 10 July 2010

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## Introduction

Self-adhesive resin cements, defined as cements based on filled polymers designed to adhere to tooth structure without the requirement of a separate adhesive or

glass-ionomer and resin composite. However, dentists may still experience confusion over the specific composition and indications for other types of 'hybrid' cements, such as resin-modified glass-ionomer and polyacid-modified resin (compomers). Because of their

Do  
you  
want  
to  
read  
more?

# The logical next step?



Their development into self-adhesive composites?

Which might also score highly for ease of use?

Materials which scored highly for ease of use



Recently  
introduced  
(self adhesive)  
composites for  
posterior teeth

# What's in Surefil one?



Dentsply-Sirona

Component	General function
Modified polyacid (MOPOS)	Etchant, adhesion promoter, crosslinker between covalent and ionic network
Bifunctional acrylate (BADEP)	Crosslinker in the covalent network
Acrylic acid	Reactive diluent, Primer, crosslinker between covalent and ionic network
Water	Solvent for polyacid and resins, etching aid
Reactive glass filler	Filler supporting wear resistance and mechanical strength
Non-reactive glass filler	Radiopacifier, rheology modifier
Initiator	Photo- and redox initiator system
Stabilizer	Stabilize monomers upon storage

This appears to be a hybrid ionomer/resin material

OPEN

## One-year clinical results of restorations using a novel self-adhesive resin-based bulk-fill restorative

Andreas Rathke<sup>1,2\*</sup>, Frank Pfefferkorn<sup>3</sup>, Michael K. McGuire<sup>4</sup>, Rick H. Heard<sup>5</sup> & Rainer Seemann<sup>1,4</sup>

This prospective study assessed the dual-curing self-adhesive bulk-fill restorative Surefil one. The restorations were placed and reviewed by dental practitioners who are members of a practice-based research network in the United States. Seven practitioners filled 60 cavities (20 class I, 19 class II and 21 class V) in 41 patients with Surefil one without adhesive, according to the manufacturer's instructions. The restorations were evaluated using modified USPHS criteria at baseline, 3 months, and 1 year. Patients were also contacted to report postoperative hypersensitivity one to four weeks after placement. The only patient that showed moderate hypersensitivity after 1 year had previously reported symptoms that were unlikely associated to the class I molar restoration. One class II restoration in a fractured maxillary molar was partially lost. The remaining restorations were found to be in clinically acceptable condition resulting in an annual failure rate of 2%. Color match showed the lowest number of acceptable scores (88%) revealing significant changes over time ( $P = 0.0002$ ). No significant differences were found for the other criteria ( $P > 0.05$ ). The novel self-adhesive bulk-fill restorative showed clinically acceptable results in stress-bearing class I and II as well as non-retentive class V cavities at 1-year recall.

Resin-based composites have become the standard filling material in dental practices for anterior and posterior restorations. Long-term clinical studies confirmed that the longevity of direct composite restorations in posterior teeth is comparable to that of amalgam restorations<sup>1–5</sup>. In addition, innovations in composite technology have simplified the application. Compared to conventional composite application in 2 mm thick layers, bulk-fill composites can be placed in 4–5 mm layer thickness due to their reduced polymerization shrinkage stress and high reactivity to light curing<sup>6</sup>. Clinical data of up to 10 years confirmed the safe applicability of these bulk-fill composites as alternative to conventional posterior composite restorations<sup>7–9</sup>. Further simplification involved the development of self-adhesive composites that eliminated the use of an adhesive, thus minimizing the time in which blood or saliva contamination could compromise the restoration. The most common approach was modifying the reactive diluents with acidic moieties to facilitate the bonding with enamel and dentin. This approach was commercialized as self-adhesive flowable composites, but many laboratory studies have questioned whether these materials are a valid alternative to composites where a separate adhesive is applied<sup>10–12</sup>. Particularly in load-bearing areas, the contradictory clinical performance of self-adhesive restorative materials has not led to a breakthrough<sup>13–16</sup>.

Alternatively, the structural monomers can be modified with acidic groups to achieve sufficient adhesion. In its extreme this approach is realized in the polyacids used in glass ionomer cements<sup>17</sup>. However, polyacids cannot contribute to the radically polymerized network due to lack of polymerizable groups. Recently, a modified polyacid system of high molecular weight (MOPCS) has been formulated and patented to merge the self-adhesive properties of classical polyacids known from glass ionomer cements with the crosslinking ability of structural monomers known from composites<sup>18</sup>. The self-adhesive resin-based bulk-fill restorative (classified as self-adhesive composite hybrid by the manufacturer) has been launched under the brand name Surefil one (Dentsply Sirona, Konstanz, Germany). The manufacturer describes the initiator system as a combination of the

<sup>1</sup>Dentsply Sirona, Konstanz, Germany. <sup>2</sup>University of Ulm, Faculty of Dentistry, Ulm, Germany. <sup>3</sup>The McGuire Institute, Houston, TX, USA. <sup>4</sup>Department of Restorative, Preventive and Pediatric Dentistry, zmk Bern, University of Bern, Bern, Switzerland. <sup>5</sup>email: andreas.kouhnen-rathke@dentsplysirona.com

# Results

41 (of 60 at baseline) Surefill one restorations were evaluated at one year

One class II restoration in a fractured maxillary molar was partially lost resulting in an annual failure rate of 2%. No adverse events associated with the use of the restorative material were observed. The lowest number of acceptable scores after 1 year was found for colour match (88%).

Scientific Manual

Surefil one™

Self-Adhesive Composite Hybrid



Do you want to read more?

Massive amount of scientific data, some independent testing, some Dentsply in-house testing

However, this material was withdrawn from the market approx. one year ago

# 3M Self-adhesive bulk fill (SABF)

“SABF is a tooth-coloured, dual-curing, self-adhesive, resin-based bulk-fill restorative material, consisting of a powder and a liquid part in a capsule. The powder = acid-reactive glass fillers; the liquid = acidic polymerizable components which promote self-adhesion. It does not need retentive cavity preparation. Dual-cure initiator system is distributed between the powder and the liquid. SABF has a CE mark”.

**This is obviously a resin-based material**

# Clinical placement of 3M SABF

The placement procedure for SABF was similar to that of known glass ionomer cements. The capsule tip was placed in the proximal box and while gradually moving the tip in a coronal direction the material was extruded, ensuring that the material adapted itself to the cavity bottom and the cavity

Filler: Strontium fluoride glass oxide

Resin: Propoxylated Bisphenol A DMA, TEGDMA

Resin: Phosphoric acid fractionalised methacrylate

Initiator: CQ + Copper complex

Powder/liquid in a capsule/mix 15sec, place in bulk

# One year data on 3M Self-adhesive bulk fill (SABF)

Clinical Oral Investigations (2022) 26:449–461  
<https://doi.org/10.1007/s00784-021-04019-y>

ORIGINAL ARTICLE



## One-year results of a novel self-adhesive bulk-fill restorative and a conventional bulk-fill composite in class II cavities—a randomized clinical split-mouth study

Fabian Cieplik<sup>1</sup> · Konstantin J. Scholz<sup>1</sup> · Julian C. Anthony<sup>1</sup> · Isabelle Tabenski<sup>1</sup> · Sarah Ettenberger<sup>1</sup> · Karl-Anton Hiller<sup>1</sup> · Wolfgang Buchalla<sup>1</sup> · Marianne Federlin<sup>1</sup>

Received: 9 December 2020 / Accepted: 31 May 2021 / Published online: 15 June 2021  
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### Abstract

**Objectives** In the context of the phase-down of amalgam, development of easily applicable, permanent restorative materials is of high clinical interest. Aim of this study was to evaluate the clinical performance of a novel, tooth-colored, self-adhesive bulk-fill restorative (SABF, 3M Oral Care) and a conventional bulk-fill composite (Filtek One, 3M Oral Care; FOBF) for restoring class II cavities. The null-hypothesis tested was that both materials perform similar regarding clinical performance.

**Materials and methods** In this randomized split-mouth study, 30 patients received one SABF and one FOBF restoration each. Scotchbond Universal (3M Oral Care) was used as adhesive for FOBF (self-etch mode), while SABF was applied directly without adhesive. Restorations were evaluated by two blinded examiners at baseline, 6 months and 12 months employing FDI criteria. Non-parametric statistical analyses and  $\chi^2$ -tests ( $\alpha=0.05$ ) were applied.

**Results** Thirty patients (60 restorations) were available for the 6- and 12-month recalls exhibiting 100% restoration survival. All restorations revealed clinically acceptable FDI scores at all time points and for all criteria. Only regarding esthetic properties, FOBF performed significantly better than SABF regarding *surface lustre* (A1) and *color match and translucency* (A3) at all time points and *marginal staining* (A2b) at 12 months.

**Conclusions** The null-hypothesis could not be rejected. Both materials performed similarly regarding clinical performance within the first year of clinical service. SABF exhibited slightly inferior, but clinically fully acceptable esthetic properties as compared to FOBF.

**Clinical relevance** Within the limitations of this study, the self-adhesive bulk-fill restorative showed promising results and may be recommended for clinical use.

**Keywords** Class II · Filtek one · Self-adhesive · RBC · Bulk-fill

*Randomised controlled trial*, split mouth design, 30 patients each received one SABF and one Filtek One Bulk Fill/SBUniv.

Mainly 2-surface restorations, but some 3- and 4- surface

Reason for restoration placement was caries/failed restoration, predominantly. All teeth vital. Placed in Univ. Hosp, Regensburg

Examined by 2 blinded, trained examiners

# One year data on 3M Self-adhesive bulk fill (SABF)

## RESULTS

All restorations examined at one year

Surface lustre: SABF surfaces were more dull than Filtek One

Margin staining: Both showed an increase, but this was more in SABF

Margin adaptation: No differences

Occlusal contour and wear: No difference compared with enamel

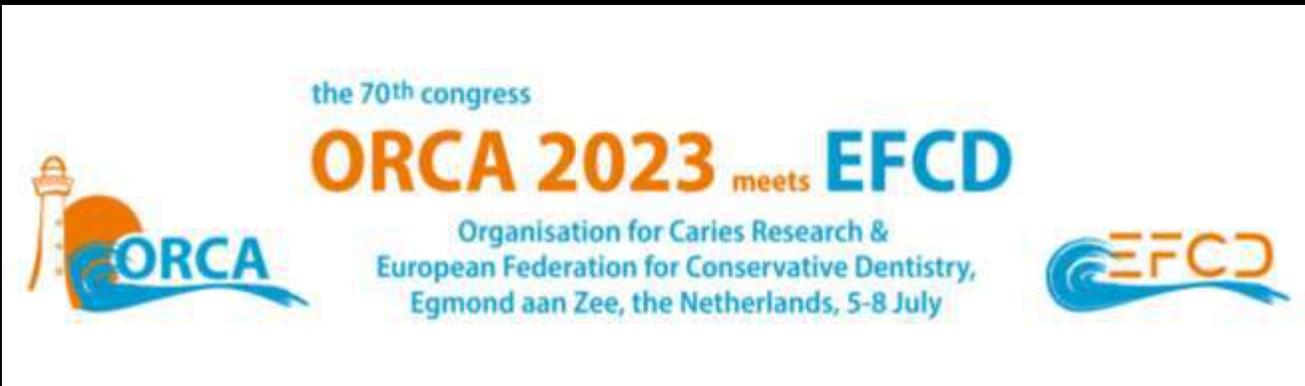
# One year data on 3M Self-adhesive bulk fill (SABF)

## CONCLUSIONS

In summary, the null-hypothesis of this study could not be rejected: both restorative materials exhibited only clinically acceptable scores in all examined FDI criteria. FOBF and SABF exhibited similar clinical performance in functional and biological properties, but FOBF showed significantly better performance with regard to esthetic properties *surface lustre* and *color match and translucency* at all examination time points and *marginal staining* at 12-mo than SABF. These differences in esthetic properties were already observed at BL and did not intensify over time up to 12-mo of clinical observation. Therefore, SABF seems to be a slightly less esthetic restorative material as compared to FOBF. Within

The novel self-adhesive bulk-fill restorative SABF showed promising results and may be recommended for clinical use.

# New 3M self adhesive composite holds promise at 4 yrs



Scholz KJ, Cieplik F, Ettenberger S, Hiller K-A, Buchalla W, Federlin M. Prospective randomized split-mouth study investigating class-II-Restorations with novel self-adhesive-bulk-fill and conventional bulk-fill composites:4-year results. Abstract No 25:ORCA (Organisation for Caries Research) and European Federation for Conservative Dentistry Joint Meeting, July 2023.

25 Prospective randomised split-mouth study investigating class-II-restorations with novel self-adhesive-bulk-fill and conventional bulk-fill-composites: 4-year results

Scholz, Konstantin Johannes\* | Hiller, Karl-Anton | Ettenberger, Sarah | Cieplik, Fabian | Buchalla, Wolfgang | Federlin, Marianne | Department of Conservative Dentistry and Periodontology, University Hospital Regensburg, Regensburg, Germany | Department of Conservative Dentistry and Periodontology, University Hospital Regensburg, Regensburg, Germany | Department of Conservative Dentistry and Periodontology, University Hospital Regensburg, Regensburg, Germany | Department of Conservative Dentistry and Periodontology, University Hospital Regensburg, Regensburg, Germany | Department of Conservative Dentistry and Periodontology, University Hospital Regensburg, Regensburg, Germany | Department of Conservative Dentistry and Periodontology, University Hospital Regensburg, Regensburg, Germany

**AIM:** Clinical performance evaluation of a novel, tooth-coloured, self-adhesive bulk-fill material (SABF, 3M) in comparison with a conventional bulk-fill composite (Filtek One, 3M; FOBF) for class-II-restorations. The null-hypothesis was that both materials perform equally in terms of survival and FDI-criteria. **METHODS:** In this prospective, randomized split-mouth study, 30 patients received one SABF and one FOBF posterior restoration. Before FOBF-application, a universal adhesive (Scotchbond Universal, 3M) was applied (self-etch-mode). SABF was applied without adhesive. The restorations were evaluated by two calibrated, blinded examiners using FDI-criteria at baseline (BL) and 48 months. Nonparametric statistical analyses,  $\chi^2$ -tests ( $\alpha=0.05$ ), error rates method, and survival-analyses were performed. **RESULTS:** Twenty-six from initially 30 patients were available with at least one restoration under risk at 48-months. Survival was 96% for SABF (one restoration: secondary caries) and 92% for FOBF (one restoration: secondary caries, one restoration: fracture). All other restorations showed clinically acceptable (1-excellent, 2-good, 3-satisfactory) FDI-ratings for all criteria and time points. Error rates method revealed significantly better aesthetic properties for FOBF compared to SABF, but no significant differences in functional and biological properties. FOBF performed significantly better regarding surface lustre (A1,  $p<0.001$ ), surface staining (A2a,  $p<0.01$ ), and colour match/translucency (A3,  $p<0.001$ ). Over time, surface lustre (A1,  $p<0.01$ ), surface staining (A2a,  $p<0.05$ ), marginal discoloration (A2b,  $p<0.001$ ), and marginal adaptation (B6,  $p<0.001$ ) deteriorated significantly for both materials. **CONCLUSION:** The null-hypothesis could not be rejected. Both materials performed similarly regarding survival-rate and FDI-criteria within 48 months of clinical use. SABF exhibited significantly less favourable but clinically acceptable aesthetic properties compared with FOBF. After 4 years, the new self-adhesive bulk-fill restorative material showed clinically satisfactory results and can be recommended for clinical use.

The study was supported by 3M Oral Care.

# New **3M** self adhesive composite holds promise at 4 yrs

**AIM:** Clinical performance evaluation of a novel, tooth-coloured, self-adhesive bulk-fill material (SABF, 3M) in comparison with a conventional bulk-fill composite (Filtek One, 3M; FOBF) for class-II-restorations. The null-hypothesis was that both materials perform equally in terms of survival and FDI-criteria. **METHODS:** In this prospective, randomized split-mouth study, 30 patients received one SABF

materials. **CONCLUSION:** The null-hypothesis could not be rejected. Both materials performed similarly regarding survival-rate and FDI-criteria within 48 months of clinical use. SABF exhibited significantly less favourable but clinically acceptable aesthetic properties compared with FOBF. After 4 years, the new self-adhesive bulk-fill restorative material showed clinically satisfactory results and can be recommended for clinical use.

under risk at 48-months. Survival was 96% for SABF (one restoration: secondary caries) and 92% for FOBF (one restoration: secondary caries, one restoration: fracture). All other restorations showed clinically acceptable (1-excellent, 2-good, 3-satisfactory) FDI-ratings for all criteria and time points.

## Product profile



- Amalgam alternative
- No primer* or curing light, therefore quick, and bulk fill possible
- Non-adhesive (undercut) cavity*
- Indicated Class I & II
- F, Ca, OH release
- 4 instead of 11 steps
- More aesthetic than GI or amalgam



# Ariston: Advantages

- Amalgam alternative?
- Quick application
- Bulk fill possible
- Non-adhesive cavity preparation
- Indicated Class I, II, III, IV

Material changed drastically after a series of poor clinical evaluations

The new "smart" restorative that's a real alternative to amalgam

**Ariston PI**

- **Intelligent pH control**  
unique formulation releases active ions on demand to counter the effect of cariogenic acids around the restoration margins, thereby preventing, or significantly hampering, the formation of secondary caries.
- **Simple, ultra-fast technique**  
up to 40% quicker to place when compared to similar sized amalgam restorations.

Now it's your turn to get smart. Order Ariston PI from your dealer today.

A world of quality and innovation  
**IVOCCLAR · VIVADENT**  
DEDICATED TO DENTISTRY

Reader Service No 218

Slide made in 2000

# Publication after 4 years

Display Settings: Abstract

Performing your original search, *Ariston dental filling records.*

Schweiz Monatschr Zahnmed. 2004;114(11):1124-31.

**[Is it necessary to assess experimentally and materials already on the market?].**

[Article in German]

Merte J, Schneider H, Merte K.

Poliklinik für Konservierende Zahnheilkunde und Parodontologie, Z

The material was withdrawn from the market

“As long as laboratory methods cannot substitute clinical evaluations, the introduction of new materials should be supported by short term clinical studies”

g medical products, e.g. n  
clinical reliability. The latter  
available standards or, if not  
specific products Ariston LI  
amalgam substitute, the m  
orative dentistry. Although  
ulp and dentin were free fr  
failed within the 18 month  
arginal caries. After six months of functi  
assessed bene...  
to increase. Gap formations and porou  
ected in  
the composite-tooth...  
in vitro as well as in vivo. Neither  
the passage of cations a...  
ions out of the filling material, n...  
cept of an adequate  
caries protective effect proved...  
successful. Marginal caries...  
sensitivity of teeth were  
the main reasons for the replacem...  
ave. The specific material  
combination was withdrawn from the market. As long...  
laboratory methods cannot substitute  
clinical evaluations, the introduction of new materials or systems into the market should be  
supported by short-term clinical studies and the further quality assessment should result from  
intermediate to long-term longitudinal studies. In this respect guidelines are valuable, such as  
the Swiss guidelines concerning materials as amalgam substitute.

Merte J, Schneider H,  
Merte K.  
Schweiz Zahnmed  
2004;114:1124-1131



## CONCLUSION

“Retentive undercuts similar to that needed for amalgam are necessary” (Product Profile)

Manufacturers have now changed instructions to state that an adhesive can be used for non-retentive cavities

## Clinical performance of an alkasite-based bioactive restorative in class II cavities: a randomized clinical trial

### Abstract

Fatma Dilad OZ<sup>1</sup>  
Ece MERAL<sup>1</sup>  
Sevil GURGAN<sup>1</sup>

**Objective:** This clinical study aimed to evaluate the clinical performance of an alkasite-based bioactive material by comparing it with a conventional resin composite (RC) in the restoration of Class II cavities over a year. A total of one hundred Class II cavities were restored at 31 patients. The restorations were divided as follows: Cention N (CN) (Ivoclar Vivadent, Schaan, Liechtenstein) and G-aenial Posterior (GP) (GC, Tokyo, Japan) in combination with Prime & Bond (etch&rinse). Restorative systems were applied following manufacturer's instructions. They were finished and polished immediately after curing. The restorations were evaluated and scored based on retention, marginal discoloration, marginal microleakage, color sensitivity, surface texture, and color match using modified USPHS criteria at 1 week (baseline), 6 months, and 12 months. Statistical analyses were performed using chi-square, McNemar's, and Kaplan-Meier tests.

bravo ( $p=1.00$ ). None of the restorations demonstrated post-operative sensitivity or secondary caries at any examinations. **Conclusion:** The tested restorative materials performed similar successful clinical performances after 12 months. ClinicalTrials.gov (NCT04825379).

**Keywords:** Composite resins. Permanent dental restoration. Randomized controlled trial.

Corresponding address:  
Fatma Dilad Oz / Ece Meral / Sevil Gurgan  
Hacettepe University - School of Dentistry -  
Department of Restorative Dentistry - Sıhhiye -  
06100 - Ankara - Turkey  
Phone: +90 3123052270  
e-mail: ddilad@yaho.com /  
e-mail: sevil@hacettepe.edu.tr

...most recently

31 patients, 100 class II restorations, 50 in Cention N (CN), 50 in GC G-aenial (RC)

Evaluated at one year by 2 researchers

3 CN restorations lost retention, 1 RC

At 1 year, survival rate of CN was 92.5%, 97.7% for RC, no significant difference

based adhesive systems. To improve its mechanical properties, several attempts are still underway. Recently, a manageable self-mixing capsule has been developed for reassessment of the material properties; however, opportunities for improvement

## Three Year Results of a Clinical Trial With two Basic Filling Materials in Cambodia

**Objectives:** To compare the success of GIC (*GC - Fuji IX*) and Cention-N (*Ivoclar Vivadent*) restorations in Class II cavities on the permanent teeth of young adults in Cambodia.

**Methods:** This study was a randomized controlled clinical trial involving students from the University of Puthisastra. Ethical approval was obtained from the Cambodian National Health Research Ethical Committee. Following an examination and PBW radiographs to identify caries, students who met the inclusion criteria (ICDAS code 4 or 5 proximal lesions on molars/premolars) for the trial were invited to participate and provided informed consent. Restorations were placed by two experienced dentists and the material used was based on random allocation of either an ion-releasing, self-curing, resin-based material Cention N (Ivoclar Vivadent), or Fuji IX Glass Ionomer Cement (GIC). A third calibrated dentist evaluated the restorations (clinically and radiographically) at the 3-year follow-up using the FDI criteria

**Results:** 238 restorations were placed (124 Cention-N vs 114 GIC); 4 participants (13 restorations) choose to withdraw from the study; 17 restorations had failed by 2-years leaving 208 restorations in the active cohort of which 149 (71.6%) were followed at 2-years. Thirteen participants (5.5%) chose to withdraw from the study. There was a statistically significant difference in the failure of restorations whereby GIC restorations were six-times more likely to fail (P-value <0.001;chi squared test). 2 Cention-N restorations failed (1.8%) compared with 8 GIC restorations (8.2%).

**Conclusions:** Cention N restorations had a significantly higher success rate (98.2%) after three years compared with Fuji IX GIC restorations (success rate 91.8%). The success rate of Cention N restorations is comparable to clinical studies using other composite restorative materials.

Division:

Meeting: 2021 South East Asian Division Meeting (Hong Kong)

Local

Year:

Final

Abstract Category|Abstract Category(s): Dental Materials 8: Clinical Trials

Author

- 
- 
- Turton, Batsheba ( University of Puthisastra , Phnom Penh , Cambodia )

Financial Interest Disclosure: The study was sponsored by Ivoclar Vivadent company.

Support Funding Agency/Grant Number: Ivoclar Vivadent

### SESSION INFORMATION

Oral Session

Cariology and operative dentistry

Thursday, 12/09/2021 , 02:00PM - 03:30PM

238 class II restorations, 124 Cention N, 114 Fuji IX

Success rate of CN (98%) better than Fuji IX (92%)

## Trevor's view

At least one major manufacturer has produced a self-adhesive resin-containing restorative which appears to hold promise. This may be the nearest we can get to a true amalgam replacement.

Disclaimer:

There may be other self-  
adhesive composites out  
there!

# Choosing a reliable material

# Cost

- Materials' costs in an average practice are 5% to 7% of total expenses
- Always speak to a sales rep before purchasing a material from a major manufacturer, as they know the deals
- While there is variety in pricing, the only materials that are significantly cheaper are the "Own Label" brands



FJ Trevor Burka

## 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. Burka FJT. Me too. *Dent Update* 2010; 37: 137.
2. Burka 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

### Results

A total of 189 abstracts from the IADR classification 'dentine adhesives' were identified, although 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 that 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 353 bonding agents were tested in these abstracts. The most frequently researched 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.

The same exercise was carried out for 255 'Composite' abstracts. Of these, 44 did not state the type of composite tested, eight were on the subject of light curing, one was on the subject of FTR and one on veneering porcelain. In the remaining 201 abstracts, there were 601 occasions when the name and manufacturer of the resin composite was stated. Most frequently mentioned materials are presented in Table 2. Nine materials did not specify their manufacturer, so these materials were investigated

Product Name	Number of Mentions in Research Abstracts
Filtek Supreme/Z350 (3M ESPE)	51
Filtek Z250 (3M ESPE)	35
Filtek Z100 (3M ESPE)	18
Venus Diamond (Heraeus Kulzer)	18
EsthetX (Dentsply)	18
Kalore (GC)	17
Premise (Kerr)	12
Grandio (Voco)	10
Gradia Direct (GC)	10

Table 2. Most frequently mentioned resin composite materials in the 'Composite' research abstracts.

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 'own label' brands of resin-based restorative dental products.

### Acknowledgment

Thanks are due to Mrs Jeannette Hiscocks for tabulating the data.

### Disclosure

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

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



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**

# 'Own-Label' Versus Branded Commercial Dental Resin Composite Materials: Mechanical And Physical Property Comparisons

## Keywords

Filler  
Degree of Conversion  
Own-Label  
Private-Label  
Resin Composite  
Flexural Modulus

## Authors

Dr Kathryn Shaw \*  
(MDF, RCS (Eng.))

Dr Ricardo Martins \*  
(LMD, MSc)

Dr Mohammed Abdul Hadis \*  
(PhD, BSc (Hons.))

Prof. Trevor Burke \*  
(BDS, MSc, DDS, MSc, MGD, FDS RCS  
(Edin.), FDS RCS (Eng.), FFGDP(UK), FRCR)

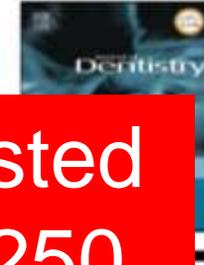
Prof. William Palin \*  
(BMedSci, MPhD, PhD, MSc, FRCR)

## ABSTRACT

A majority of dental materials are manufactured by companies who have experience in the field. However, a number of "own label" materials have become available, principally marketed by distributors and other companies with little or no experience in the field. These materials are attractive because of their reduced cost, but they may have no research on which clinicians might base their potential performance. It is therefore the purpose of this work to compare the performance of different batches of a number of "own-label" dental materials with a similar number from manufacturers with experience in the field, using a variety of laboratory test regimes which include filler determination, degree of conversion, flexural strength and flexural modulus, in order to evaluate key material properties. The 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.

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

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



Two own brand label (OBL) materials tested (various laboratory tests) against 3M Z250

## Own brand label restorative materials—A false bargain?



Gaute Floer Johnsen<sup>a</sup>, Minh Khai Le Thieu<sup>a</sup>, Badra Hussain<sup>a</sup>, Elzbieta Pamuła<sup>b</sup>, Janne Elin Reseland<sup>a</sup>, Ståle Petter Lyngstadaas<sup>a</sup>, Håvard Haugen<sup>a,\*</sup>

<sup>a</sup> University of Oslo, Department of Biomaterials, Institute of Clinical Dentistry, Faculty of Dentistry, Geitmyrsveien 71, Oslo, NO 0455, Norway

<sup>b</sup> AGH University of Science and Technology in Kraków, Kraków, Małopolska, Poland

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Flexural strength

Residual monomers

### ABSTRACT

**Objectives:** This study aims at evaluating and comparing mechanical, chemical, and cytotoxicological parameters of a commercial brand name composite material against two 'own brand label' (OBL) composites.

**Methods:** Parameters included depth of cure, flexural strength, degree of conversion, polymerization shrinkage, filler particle morphology and elemental analyzes, Vickers hardness, surface roughness parameters after abrasion, monomer elution, and cytotoxicity.

**Results:** The conventional composite outperformed the OBLs in terms of depth of cure ( $p < 0.001$ ), degree of cure at the first and last time intervals ( $p < 0.001$ ), hardness ( $p < 0.001$ ), and post-abrasion roughness ( $p < 0.05$ ). The polymerization volumetric shrinkage ranged from 2.86% to 4.13%, with the highest

should be prioritized and remain ever vigilant. At the present, the OBLs studied herein, must be considered at the very least a false bargain.

# SHORT ANSWER!

Is it worth using low-cost glass ionomer cements for occlusal ART restorations in primary molars? 2-year survival and cost analysis of a Randomized clinical trial

Isabel Cristina Olegário<sup>a,b</sup>, Nathalia de Miranda Ladewig<sup>b</sup>, Daniela Hesse<sup>c</sup>,  
Clarissa Calil Bonifácio<sup>c</sup>, Mariana Minatel Braga<sup>b</sup>, José Carlos Pettorossi Imparato<sup>b</sup>,  
Fausto Medeiros Mendes<sup>b</sup>, Daniela Prócida Raggio<sup>b,\*</sup>

*NO! They don't last as long, and, despite the fact that Fuji IX is more expensive, they are not cost-effective.*

## Trevor's view

In the current situation, it might be tempting to save £s on materials, but the saving should be considered alongside the cost of one premature failure

# What I plan to talk about (not necessarily in this order!)

- Amalgam, briefly
- Resin composites – a true alternative?
- Latest on self-adhesive composite materials
- Current status of GICs and Glass Hybrids for restoration of posterior teeth
- How to place these
- Are these good enough to change our philosophy today?
- Final thoughts

# Bonding to dentine

Chemical = Glass ionomer cement

Micromechanical = Dentine bonding systems

- A Glass Ionomer Cement (GIC) consists of a basic glass and an acidic polymer which sets by an acid-base reaction between these components

McLean et al., 1994

# Bond strength improved by 20% Polyacrylic Acid (PAA)



# Characteristics of Original GICs

- 👄 Release of fluoride
- 👄 Adhesion to enamel and dentine
- 👄 Reasonable biocompatibility
- 👄 Low thermal diffusivity
- 👄 Early types needed initial protection from moisture
- 👄 Aesthetics
- 👄 *Mechanical strength (poor in compressive)*
- 👄 *Erosion/abrasion/wear resistance (suboptimal)*

# Glass-ionomer Restoratives: A Systematic Review of a Secondary Caries Treatment Effect

R.C. Randall\* and N.H.F. Wilson

Restorative Dentistry, Manchester University Turner Dental School, Higher Cambridge Street, Manchester, M15 6FH, Un

\*corresponding author

**Abstract.** It is generally accepted that glass ionomers inhibit secondary caries *in vivo*, and data from *in vitro* studies support this effect. The aim of this review was a systematic assessment, from the literature, of clinical evidence for the

## Introduction

There is increasing interest in evidence-based dentistry (Antczak-Bouckoms *et al.*, 1994; I

## CONCISE REVIEW

# Fluoride IS released by glass ionomers F release by F-containing composites is negligible

## Glass-ionomer Restoratives: A Systematic Review of a Secondary Caries Treatment Effect

R.C. Randall\* and J.H.L. Wilson

No conclusive evidence for or against inhibition of secondary caries by the glass ionomer restoratives was obtained from the systematic review

assessment, from the literature, of clinical evidence for the

There is increasing interest in evidence-based dentistry (Antczak-Bouckoms *et al.*, 1994; I



## In vivo vs in vitro anticariogenic behavior of glass-ionomer and resin composite restorative materials

Lisa Papagiannoulis<sup>\*</sup>, Afrodite Kakaboura, George Eliades

Department of Pediatric Dentistry, School of Dentistry, University of Athens, 2 Thessalon Street (Goudi), 115 27 Athens, Greece

Received 14 November 2000; revised 9 August 2001; accepted 14 August 2001

### Abstract

**Objective:** To evaluate the in vivo vs the in vitro anticariogenic potential of glass-ionomer and resin composite restoratives, utilizing a standardized interfacial gap model.

“No preventive effect was exerted *in vivo* from the GIC to protect the adjacent enamel from caries attack”

depth between the restorative groups tested. Lesion length was increased in composite, and decreased in glass-ionomer, whereas lesion depth in both restorative groups was increased in comparison to gap-free regions ( $p < 0.05$ ).

(b) *In vivo* study. No lesions were observed at gap-free regions. At gap regions, 75.5% of glass-ionomer and 62.5% of composite restorations developed lesions. The lesion dimensions were significantly greater in glass-ionomer ( $p < 0.05$ ). A reduction in  $\text{PO}_4^{3-}$ ,  $\text{CO}_3^{2-}$ , Ca and P was found in lesions compared to intact tissues. No F was detected and no  $\text{CaF}_2$  lamellae vibrations were found at the enamel margins facing the gap adjacent to glass-ionomers.

**Significance:** In the presence of a standardized interfacial gap, no preventive effect was exerted in vivo from the glass-ionomer to protect the adjacent enamel wall from secondary caries attack. The lack of any correlation between the in vivo and in vitro models tested implies that artificial caries experiments have a negligible clinical relevance in predicting the in vivo effect. © 2002 Academy of Dental Materials.

# Characteristics of Original GICs

- Release of fluoride
- Adhesion to enamel and dentine
- Reasonable biocompatibility
- Low thermal diffusivity
- Early types needed initial protection from moisture
- Aesthetics
- Mechanical strength (poor in compressive)*
- Erosion/abrasion/wear resistance (suboptimal)*

# Characteristics of Original GICs

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- Chemical adhesion to enamel and dentine
- Reasonable biocompatibility
- Low thermal dif
- Early types need protection from moisture
- Aesthetics**
- Mechanical stre* (compression)
- Erosion/abrasio* (suboptimal)



Chemfill, circa 1979:

# Characteristics of Original GICs

- 👄 Release of fluoride
- 👄 Adhesion to enamel and dentine
- 👄 Reasonable biocompatibility
- 👄 Low thermal diffusivity
- 👄 Early types needed initial protection from moisture
- 👄 Aesthetics
- 👄 Mechanical strength (good in compression:  
?? in flexion)
- 👄 Erosion/abrasion/wear resistance (suboptimal)

**Direct placement  
restorations:  
Glass ionomer in class  
III and V cavities**

# Glass-Ionomer Restoration Survival Overall



# Summary:

Glass ionomers seem to be used as transitional restorations in many cases: dentists often replace them with alternative materials

# Conclusion

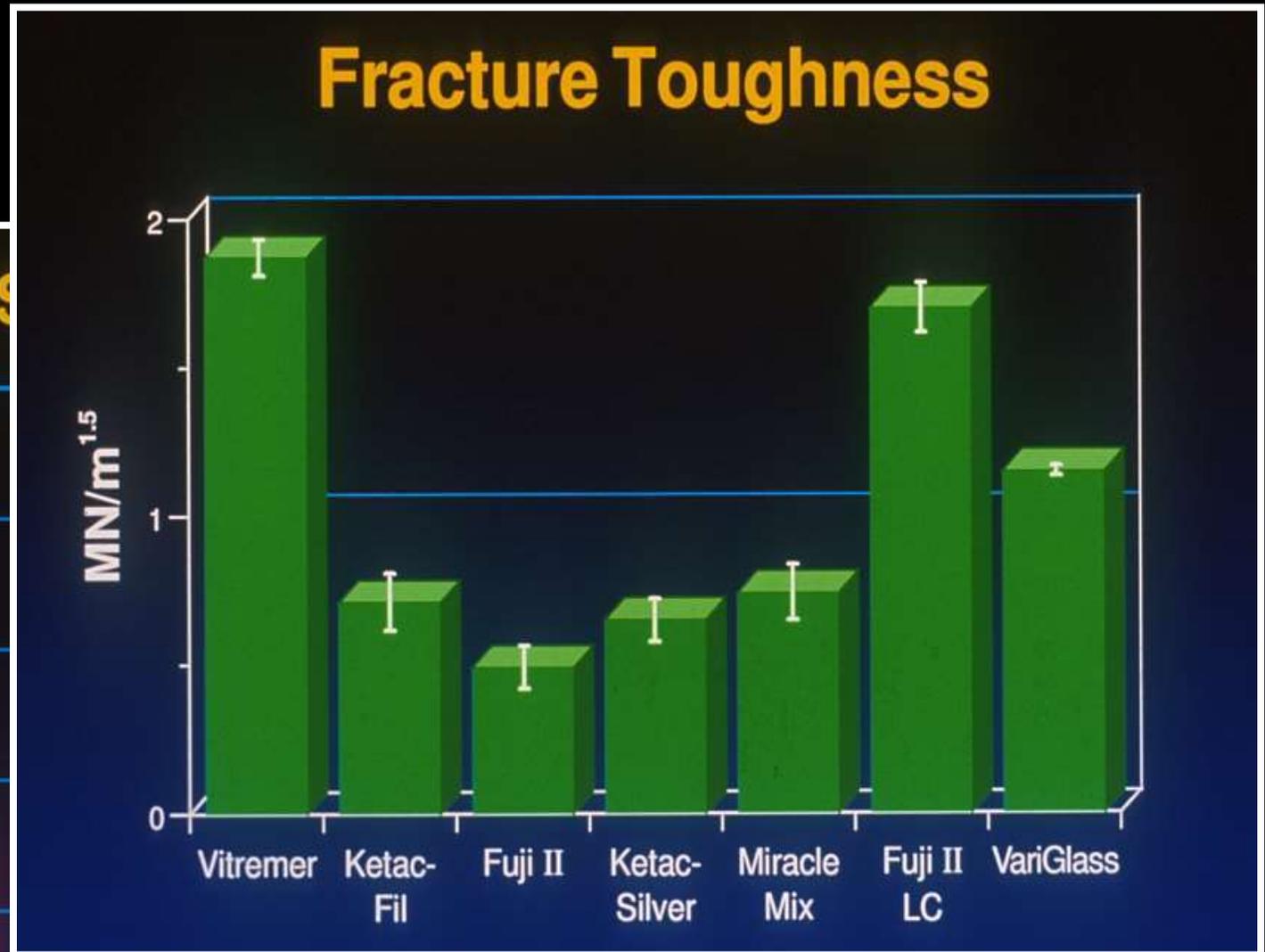
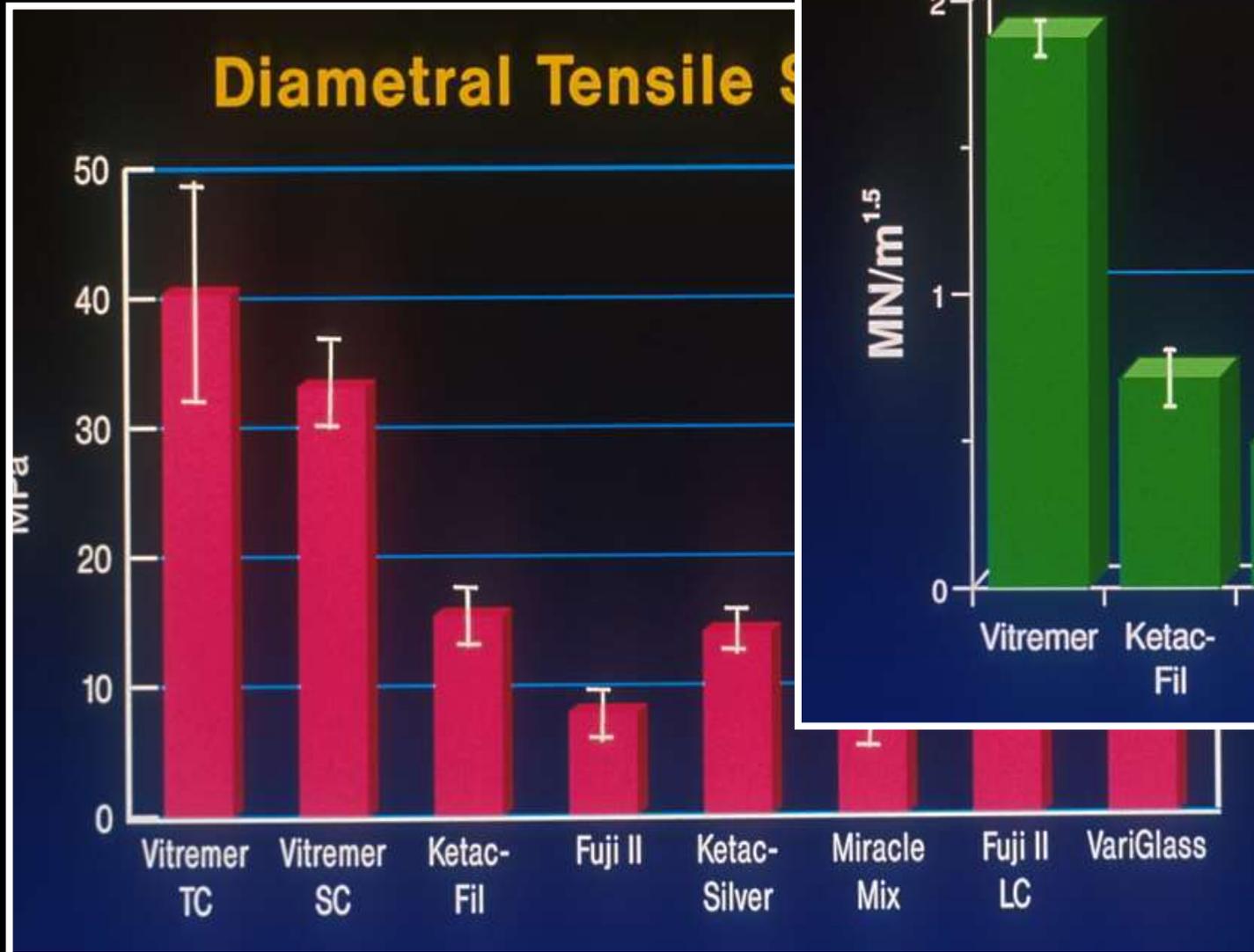
There was a need for an improved glass ionomer

# Hence, the development of Resin Modified Glass Ionomers (RMGI)

Hybrid materials that retain  
a significant acid/base  
reaction as part of their  
overall curing process.

McLean et al., 1994

# Improved physical properties of RMGI



# Advantages of RMGI

- ✓ Improved physical properties
- ✓ Command set
- ✓ Less susceptible to water loss or water contamination
- ✓ Immediate polishing possible
- ✓ Better aesthetics
- ✓ Better adhesion
- ✓ Better fluoride release

## Trevor's view:

Traditional glass ionomers have poor physical properties and should be confined to history.

Reinforced and RMGI materials are superior.

# More recently developed GICs

Reinforced GICs – smaller glass filler particles for faster reaction with the PAA liquid, plastic features, higher loading brings improved physical properties, but still a need for improved wear resistance

Glass hybrids - smaller, more reactive glass, improved PAA

# Reinforced Glass ionomer materials in loadbearing situations?

A crux question, because, if these work,  
they will be a cheaper replacement of  
amalgam than composite

What is the current status for survival of restorations in back teeth using Glass ionomer cements?



FJ Trevor Burke

# Dental Materials- What Goes Where? The Current Status of Glass Ionomer as a Material for Loadbearing Restorations in Posterior Teeth

**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 and the potential need for the

8 papers on GI in posterior teeth included

Burke FJT. Dent.Update: **2013**:40(10):840-844.

## Conclusions

Are reinforced glass ionomers  
an alternative to amalgam?

Not really, *at present*, because their  
wear resistance isn't good enough and  
they are soluble in dilute organic acids

Possibly OK in class I cavities?

Slide written in 2014

...there is now some  
new, more positive  
information on GIC  
in posterior teeth

RESEARCH

Open Access



## Clinical performance during 48 months of two current glass ionomer restorative systems with coatings: a randomized clinical trial in the field

Thomas Klinke<sup>1</sup>, Amro Daboul<sup>1\*</sup>, Anita Turek<sup>1</sup>, Roland Frankenberger<sup>2</sup>, Reinhard Hickel<sup>3</sup> and Reiner Biffar<sup>1</sup>

### Abstract

**Background:** This study was carried out as a prospective clinical field study with the aim of evaluating the clinical performance of Equia Fil<sup>®</sup> with a nanofilled resin coating and the conventional Fuji IX GP<sup>®</sup> fast with an LC coating according to the World Dental Federation (FDI) restoration material evaluation criteria.

**Methods:** The clinical performance of Equia Fil<sup>®</sup> and Fuji IX GP<sup>®</sup> fast was evaluated on permanent posterior teeth of 643 adult patients aged between 20 to 80 years old in randomly selected clinics across Germany. Occlusal cavities in posterior permanent teeth were restored with Equia Fil<sup>®</sup> with a nanofilled, light-cured resin coating ( $n = 515$ ) and Fuji IX GP<sup>®</sup> fast with an LC coating ( $n = 486$ ). Direct clinical assessment as well as photographic assessment and assessment of stone casts of the restorations were made at 1 year, 2 years, 3 years, and 4 years.

**Results:** In 4 years, a total of 1001 fillings from both materials were placed by 111 dentists in 643 patients. Random slope models showed that the Equia filling system had overall lower odds of obtaining a delta event (material needs replacement) in comparison to Fuji IX GP<sup>®</sup> fast with an LC coating within all models. In both materials, filling size/surface was the most important component affecting the clinical performance of the materials. When measuring the odds of obtaining a delta event (material needs replacement), the odds ratios jumped to approximately 43 and 296 times for class II (two surfaces) and class II mesial-occlusal-distal (three surfaces) respectively in comparison to class I fillings.

**Conclusion:** Both materials showed similar good overall performance in class I cavities; however, when including numbers from both class I and II fillings, the Equia system with a nanofilled resin coating showed better overall performance with fewer failures in all the follow-up intervals. Nonetheless, the percentage of unsatisfactory to poor fillings according to the FDI criteria was relatively high in two-surface class II fillings and higher in three-surface class II fillings for both materials.

**Trial registration:** Deutsches Register Klinischer Studien (German Clinical Trials Register): DRKS00004220. ([www.germanctr.de](http://www.germanctr.de)). Registration date: 6 Sept 2012.

**Keywords:** Practice-based network, Dental restoration, Permanent, Glass ionomer, Multi-center study

# EQUIA Fil doing ok

1001 fillings placed by 111  
general dentists in 643 patients

EQUIA fil and Fuji IX with  
resin coating

Prospective *randomised*  
*controlled trial*

Evaluation by three  
calibrated examiners

# RESULTS

RESEARCH

Open Access



## Clinical performance during 48 months of two current glass ionomer restorative systems with coatings: a randomized clinical trial in the field

Thomas Klinke<sup>1</sup>, Amro Daboul<sup>1</sup>, Anita Turek<sup>1</sup>, Roland Frankenberger<sup>2</sup>, Reinhard Hickel<sup>3</sup> and Reiner Biffar<sup>1</sup>

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**Keywords:** Practice-based network, Dental restoration, Permanent, Glass ionomer, Multi-center study

## Conclusion

Within the limitations of the study, we can conclude that no significant difference in performance between both materials was found within 4 years. However, Equia Fil<sup>®</sup> with a nanofilled resin coating showed a slightly better overall performance than the conventional Fuji IX GP<sup>®</sup> fast with the LC coating and an overall lower odds to failure. Both materials performed well in class I cavities. In class II cavities, the dentist must pay attention to the cavity size. It was shown that higher odds of failure are associated with class II cavities, especially in

503 fillings placed

manufactured  
examined

Note from authors: For class II cavities, the dentist must pay attention to the cavity size

# GC Equia Fil doing well at 4 years

GC Equia Fil GIC  
vs Gradia Direct  
Composite in  
Class I and small  
class II cavities

100% success  
of GC Equia Fil  
at 4 years,  
40 Class I,  
30 Class II

*Operative Dentistry, 2015, 40-2, 134-143*

## Four-year Randomized Clinical Trial to Evaluate the Clinical Performance of a Glass Ionomer Restorative System

S Gurgan • ZB Kutuk • E Ergin  
SS Oztas • FY Cakir

### Clinical Relevance

The clinical effectiveness of Equia and Gradia Direct Posterior was acceptable in Class I and Class 2 cavities subsequent to four-year evaluation.

**Conclusions:** The use of both materials for the restoration of posterior teeth exhibited a similar and clinically successful performance after four years.

# BUT, The same study at 10 years The maths don't add up!

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Journal homepage: [www.elsevier.com/locate/jdent](http://www.elsevier.com/locate/jdent)

A randomized controlled 10 years follow up of a glass ionomer restorative material in class I and class II cavities

Sevil Gurgan, Zeynep Bilge Kutuk\*, Filiz Yalcin Cakir, Esra Ergin

Hacettepe University, Faculty of Dentistry, Department of Restorative Dentistry, Sıhhiye, Ankara Turkey

**ARTICLE INFO**

**Keywords:**  
Clinical longevity  
Glass ionomer  
Composite resin  
Posterior restoration

**ABSTRACT**

**Objective:** To evaluate the durability of a glass ionomer restorative material in Class I and Class II cavities during 10 years compared with a micro filled composite resin.

**Methods:** Fifty-nine participants (mean age 24 years) received 140 (80 Class I and 60 Class II) glass ionomer (GI) or composite resin (CR) restorations. Evaluation was performed with slightly modified USPHS criteria at baseline, and yearly during the 10 years. Data were analyzed with Cochran's Q and McNemar's tests.

**Results:** Fifty-one patients and 124 restorations (61 GI / 38 Class I - 23 Class II, 63 CR / 38 Class I, 25 Class II) were evaluated after 10 years. The recall rate was 86.4%. The overall clinical recall rate of restorations was 88.6%. The success rate of Class I and II restorations were calculated as 100% for both materials. The cumulative failure rate (CFR) of all Class I and Class II GI restorations was 3.17% in total, but CFR was 8% for Class II GI restorations. A significant difference was observed between the marginal discoloration scores of restorations at 10 years ( $p = 0.022$ ). No significant difference was seen between two restorative materials in terms of marginal adaptation ( $p > 0.05$ ). A significant change was seen in color match of GI restorations at 10 years ( $p < 0.05$ ). No significant change was found for the anatomical form, secondary caries, postoperative sensitivity, surface texture, and retention for either restorative material ( $p > 0.05$ ).

**Conclusion:** Both tested restorative materials showed an acceptable success rate in the restoration of Class I and Class II cavities during the 10-year follow up.

**1. Introduction**

Remarkable changes have taken place in the era of restorative dentistry, over the last 30 years. The concept has mostly been concentrated on minimally invasive tooth tissue removal and the use of adhesive restorative materials, which have the potential to procure therapeutic actions on demineralized dentin [1]. Eventually, marked innovations have been witnessed in restorative materials and biomimetic materials [2].

Programme (UNEP) [7]. Both the World Dental Association (FDI) and the World Health Organization (WHO) have called for alternatives to amalgam [8,9]. The long term clinically and micro morphologically examined performance of CR restorations in posterior teeth revealed the advantages and disadvantages of these tooth-colored restorative materials [10-13].

Glass ionomers (GIs) have also become considered as permanent restorative material for the restoration of posterior teeth in daily dental

## 3. Results

Fifty-one patients and 124 restorations (61 GI/38 Class I-23 Class II, 63 CR / 38 Class I, 25 Class II) were evaluated after 10 years. The patients recall rate was 86.4% (Fig. 1). Although the recall rate was 79.6% at the six-year recall, four patients who could not be reached at the six-year recall were available at the 10-year recall. The overall recall rate of restorations at the 10-year recall was 88.6%.

Class I GI restorations showed no failures during the 10-year period. One Class II GI restoration was missing due to a marginal fracture at three years and another one restoration at four 4 years. In contravention of a 96% success rate of Class II GI restorations at four-year recall, the success rate of Class II GI restorations was calculated as 100% at the 10-year recall, because of the absence of two patients with failed restorations at the 10-year evaluation. No failures were monitored, either in the Class I or Class II CR restorations during the 10-year follow-up. The cumulative failure rate (CRF) of all Class I and Class II GI restorations was 3.17% in total, but CFR was 8% for Class II GI restorations.

No failures in Class I GICs, 8% failures in Class II GICS @10years



### A randomized controlled 10 years follow up of a glass ionomer restorative material in class I and class II cavities

Sevil Gurgan, Zeynep Bilge Kutuk\*, Filiz Yalcin Cakir, Esra Ergin

Hassege University, Faculty of Dentistry, Department of Restorative Dentistry, 50bbps, Ankara Turkey



#### ARTICLE INFO

**Keywords:**  
Clinical longevity  
Glass ionomer  
Composite resin  
Posterior restorations

#### ABSTRACT

**Objective:** To evaluate the durability of a glass ionomer restorative material in Class I and Class II cavities during 10 years compared with a micro filled composite resin.  
**Methods:** Fifty-nine participants (mean age 24 years) received 140 (80 Class I and 60 Class II) glass ionomer (GI) or composite resin (CR) restorations. Evaluation was performed with slightly modified USPHE criteria at baseline, and yearly during the 10 years. Data were analyzed with Cochran's Q and McNemar's tests.  
**Results:** Fifty-one patients and 124 restorations (61 GI / 38 Class I - 23 Class II, 63 CR / 38 Class I, 25 Class II) were evaluated after 10 years. The recall rate was 86.4%. The overall clinical recall rate of restorations was 88.6%. The success rate of Class I and II restorations were calculated as 100% for both materials. The cumulative failure rate (CFR) of all GI and CR restorations was 3.17% in total, but CFR was 8% for GI restorations. A significant difference was observed between the marginal discoloration score of restorations at 10 years ( $p = 0.022$ ). No significant difference was seen between two restorative materials in terms of marginal adaptation ( $p > 0.05$ ). A significant change was seen in color match of GI restorations at 10 years ( $p < 0.05$ ). No significant change was found for the anatomical form, secondary caries, postoperative sensitivity, surface texture, and retention for either restorative material ( $p > 0.05$ ).  
**Conclusion:** Both tested restorative materials showed an acceptable success rate in the restoration of Class I and Class II cavities during the 10-year follow up.

#### 1. Introduction

Remarkable changes have taken place in the era of restorative dentistry, over the last 30 years. The concept has mostly been concentrated on minimally invasive tooth tissue removal and the use of adhesive restorative materials, which have the potential to procure therapeutic actions on demineralized dentin [1]. Eventually, marked innovations have been witnessed in restorative materials and biomimetic materials designed for treatment of carious lesions have been introduced into clinical use [2-5].

During the recent years, direct restorations have been mostly favored in posterior teeth over indirect restorations, as they require less hard tissue removal, shorter treatment time and offer the benefit of low cost, in addition to their acceptable clinical performance [6]. Today, composite resins (CRs) are regarded as the first choice for restorative materials for the restoration of posterior teeth as a consequence of the rejection of amalgam in many countries due to esthetic and potential toxic concerns. A number of countries have banned amalgam in response to the treaty agreed by the United Nations Environmental

Programme (UNEP) [7]. Both the World Dental Association (WDA) and the World Health Organization (WHO) have called for alternatives to amalgam [8,9]. The long term clinically and micro morphologically examined performance of CR restorations in posterior teeth revealed the advantages and disadvantages of these tooth-colored restorative materials [10-13].

Glass ionomers (GIs) have also become considered as permanent restorative material for the restoration of posterior teeth in daily dental practice [14]. Since their introduction by Kent and Wilson in 1970s [15], many modifications of these materials have been done to improve their mechanical and handling properties [16]. With these improvements, today, they are considered esthetically more attractive than metallic restorations and less expensive than CRs [5,14,17-19]. Current GIs are more translucent and provide more color options compared to conventional predecessors enabling a broader range of esthetic restorations [20]. GI have been used for decades in restorative dentistry due to their biocompatibility, bioactivity, long-term fluoride release, ability to adhere to moist enamel and dentin without necessitating an intermediate agent and the ability to use them in bulk [21]. The ability

**HOWEVER:**

Study carried out in a dental hospital  
Two experienced dentists

Motivated patients

All the restorations were small in size

High proportion of premolar teeth

Conservative cavity designs, no cusp replacements

More marginal discolouration found in

Glass Ionomer restorations

Power calculation not met

**BUT**

**No restorations required replacement because of wear**

# Recent clinical research on GIC

*Operative Dentistry*, 2016, 41-6, 587-598

## A Prospective Six-Year Clinical Study Evaluating Reinforced Glass Ionomer Cements with Resin Coating on Posterior Teeth: Quo Vadis?

LS Türkün • Ö Kanik

### Clinical Relevance

Despite minor repairable defects, the overall clinical performance of EquiaFil was found to be excellent even in large posterior class II restorations after a period of six years compared to Riva SC.

### SUMMARY

**Objective:** The aim of this study was to evaluate the long-term clinical performance of two encapsulated glass ionomer cements (GICs) (EquiaFil and Riva SC) covered with two different coatings (Equia Coat and Fuji Varnish) over six years using modified US Public Health Service (USPHS) criteria.

**Methods:** Fifty-four patients having class I and II restorations/caries were included in the study. A total of 256 restorations were made with EquiaFil and Riva SC. Equia Coat or Fuji

Varnish was used randomly on the surface of the restorations. After cavity preparations, the teeth were randomly restored with one GIC and coated with Equia Coat or Fuji Varnish. The restorations were evaluated at baseline; six, 12, and 18 months; and six years after placement using modified USPHS criteria. Two evaluators checked color match, marginal discoloration, marginal adaptation, caries formation, anatomical form, postoperative sensitivity, and retention rate, and photographs were taken at each recall. The results were evaluated with Pearson chi-square and Mann-Whitney U-test ( $p < 0.05$ ).

**Results:** Thirty-seven patients were evaluated. There was a significant difference between EquiaFil and Riva SC regarding retention rate and color match after six years ( $p = 0.033$  and  $0.046$ ). When comparing baseline to six years, the overall success of EquiaFil was better than Riva SC, having significant problems regarding retention rate and anatomical form ( $p = 0.016$  and  $0.031$ ). Class II cavities were

\*Lazise Selime Türkün, DDS, PhD, professor, Department of Restorative Dentistry, Bornova, Ege University School of Dentistry, Izmir, Turkey

Özgür Kanik, DDS, PhD, assistant professor, Department of Restorative Dentistry, Kocatepe University School of Dentistry, Afyon, Turkey

\*Corresponding author: Izmir 35100, Turkey; e-mail: selimeturkun@hotmail.com

DOI: 10.2341/15-381-C

256 fillings placed ( 124 Class I, 132 Class II

Equia Fil (+ coating)  
Riva SC (+ coating)

176 fillings (69% recall) at 6 years

“It was anticipated that some class II restorations might show chipping, so scored differently”

# CONCLUSIONS

*Operative Dentistry, 2016, 41-6, 587-598*

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<sup>1</sup>Lezize Sehoem Türkün, DDS, PhD, professor, Department of Restorative Dentistry Bornova, Ege University School of Dentistry, Izmir, Turkey

Özgur Kanik, DDS, PhD, assistant professor, Department of Restorative Dentistry, Kocasteppe University School of Dentistry, Afyon, Turkey

\*Corresponding author: Izmir 35100, Turkey; e-mail: sehoemturkun@hotmail.com

DOI: 10.2341/15-331-C

In the present study, the EquiaFil system in both cavity types exhibited significantly better clinical outcomes over the observation period of six years than Riva SC. Therefore, the null hypothesis formulated at the beginning of the study was rejected.

Reinforced GICs may be considered as the material of the future in restorative dentistry and minimally invasive dentistry. Their long-term clinical success is making them promising as a permanent restorative material, even in moderate-size class II restorations. Further developments are needed to improve their mechanical properties and extend their indications.

## CONCLUSION

The highly viscous reinforced GIC restorative system EquiaFil showed acceptable clinical performance according to modified USPHS criteria in class I and moderate-size to large class II restorations over a period of six years.

# 6 years of Glass Ionomer in Class II cavities

Journal of Dentistry 97 (2020) 103333

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ELSEVIER

Six-year results of a randomized controlled clinical trial of two cements in class II cavities

Katrin Heck\*, Iris Frasher, Christian Diegritz, Juergen Manhart, Reinhard Christina Fotiadou

Department of Conservative Dentistry and Periodontology, University Hospital, Ludwig-Maximilians-University Munich, Goethestr.

## ARTICLE INFO

**Keywords:**  
glass ionomer cement  
clinical study  
longevity  
class II restorations  
FDI criteria

## ABSTRACT

**Objectives:** Long-term survival of two highly viscous glass ionomer cements over a period of 6 years in vivo.  
**Methods:** A total of 85 two- or three-surface class II restorations (42 Equia Fil and 43 Fuji IX GP Fast / Fuji Coat LC, were placed in 34 patients. The restorations were assessed according to the FDI criteria. The statistical analysis was performed with the Mann-Whitney U test and the Kaplan-Meier method.  
**Results:** Forty-four restorations (22 Equia Fil and 22 Fuji IX GP Fast) were assessed at 6 years. During the whole study period, eight failures, four for each material, were observed. Two failures were proximal anatomical form. Two failures may be attributed to material fractures and retention loss, which were expected according to the radiographs. The Kaplan-Meier survival rate for Equia Fil at 6 years was 86.5% and that for Fuji IX GP Fast at 6 years was 86.8%.  
**Conclusion:** Both materials showed acceptable and comparable long-term survival in class II cavities.  
**Clinical significance:** Highly viscous glass ionomer cement is a suitable material for class II cavities.

## RESULTS

- 8 failures (4 in each group) of the 44 restorations examined at 6 years – 81.8% survival, Annual Failure Rate of 3%
- 7 failures because of restoration fracture, 1 due to secondary caries

in Class II cavities

- 85 restorations placed in 34 patients
- BUT**, only 44 restorations assessed at 6 years, because of “patient relocation, restorations replaced by other dentist, or unwillingness to attend for follow up”

# 6 years of Glass Ionomer in Class II cavities

Journal of Dentistry 97 (2020) 103333

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Six-year results of a randomized controlled clinical trial of two glass ionomer cements in class II cavities 

Katrin Heck\*, Iris Frasher, Christian Diegritz, Juergen Manhart, Reinhard Hickel, Christina Fotiadou

*Department of Conservative Dentistry and Periodontology, University Hospital, Ludwig-Maximilians-University Munich, Goethestr. 70, 80336 Munich, Germany*

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ARTICLE INFO      ABSTRACT

*Keywords:*      *Objectives:* Long-term survival of two highly viscous glass ionomer cements (Fuji IX GP Fast and Equia Fil) over a

proximal anatomical form. Two failures may be attributed to insufficient application of the materials, as suspected according to the radiographs. The Kaplan-Meier survival proportion for Equia Fil restorations at 6 years was 86.5% and that for Fuji IX GP Fast at 6 years was 86.8% (log-rank  $p = 0.907$ ). During the period from 3 to 6 years, only one filling in each group failed.

**Conclusion:** Both materials showed acceptable and comparable survival rates after 6 years.

**Clinical significance:** Highly viscous glass ionomer cement can be an acceptable restoration material for smaller class II cavities.

## Trevor's view:

Recently introduced reinforced GICs (e.g. EQUIA Fil) perform well in class I restorations and in small/medium class II restorations.

# More recently developed GICs

Reinforced GICs – smaller glass filler particles, for faster reaction with the PAA liquid

Glass hybrids – glasses of different sizes, more reactive glass, therefore improved crosslinking with the PAA, therefore improved physical properties

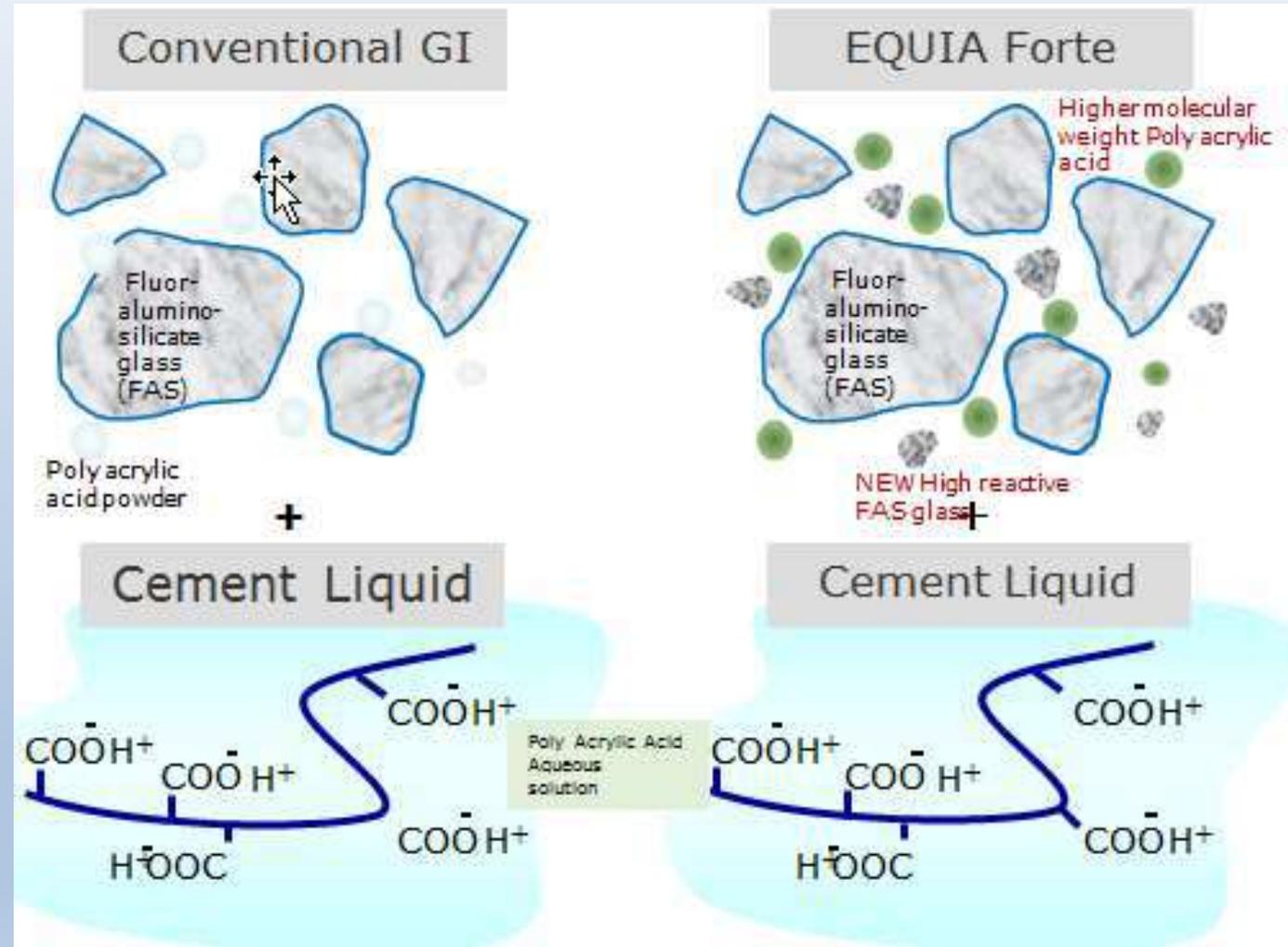
Higher molecular weight PAA, more chemically stable, improves physical properties of the matrix,  
+ better handling

Improved resin coating = smoother restoration surface and may improve wear resistance

# What is a Glass Hybrid?

The glass filler matrix combines fillers, Fluor-alumino-silicate (FAS) glasses of different sizes.

*This inclusion of filler particles of different sizes is similar to the evolution of the matrix of the Composites (from macro-filled to hybrid composites).*



**Glass Hybrid Technology** from GC

# 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

Is there independent work to confirm these data?

The logo for GC data, featuring the letters 'GC' in a stylized green font followed by the word 'data' in a lowercase green font.

# Recent laboratory research on EQUIA Forte (GC)

[Downloaded free from <http://www.ejgd.org> on Friday, November 27, 2020, IP: 78.148.241.24]

Journal List Acta Stomatol Croat v.53(2), 2019 Jun PMC6604565

## Water Sorption of Glass-Ionomer Cements

Department of Restorative Dentistry, Faculty of Dentistry, University of Zagreb, Croatia

### Abstract

**Aim:** The aim of this study was to compare the water sorption of a high-viscosity glass ionomer cement (hVGIC), Matea Stunja, and a glass hybrid restorative system (ghRS), Equia Forte. Sixty disc-shaped specimens (8 mm diameter) were prepared according to ISO 4049 requirements. Data were analyzed using a two-way ANOVA test ( $\alpha = 0.05$ ). **Results:** Equia Forte was more successful in terms of solubility, especially Final Varnish LC were

**Keywords:** Glass ionomer cement, water sorption, Equia Forte, Matea Stunja

### INTRODUCTION

Conventional glass ionomer cements were introduced to dentistry in 1970s and introduced under the name of Equia Forte due to the fact that it is a hybrid of glass ionomer and polycarboxylate cements.

GIC, which carry the optical properties of silicates with chemical adhesion, biocompatibility properties of zinc phosphate, and also widely used because of their low thermal expansion coefficient. Similar to other restorative ionomers have disadvantages such as long-hardening times, poor moisture sensitivity. These factors affect the clinical success of GIC restorations.<sup>1,2,3,4</sup>

## ACTA STOMATOLOGICA CROATICA

Acta Stomatol Croat. 2019 Jun; 53(2): 125–131.

doi: [10.15644/asc53/2/4](https://doi.org/10.15644/asc53/2/4)

PMCID: P6604565

PMID: 32111111

## Mechanical Properties of High Viscosity Glass Ionomer and Glass Hybrid Restorative Materials

Ivan Šalinović,<sup>1</sup> Matea Stunja,<sup>1</sup> Zdravko Schauerl,<sup>2</sup> Željko Verzak,<sup>3</sup> Ana Ivanišević Malčić,<sup>4</sup> and Valentina Brzović Rajić<sup>5</sup>

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This article has been cited by other articles in PMC.

### Abstract

Go to:

### Objectives

to determine the mechanical properties of hybrid and high-viscosity glass ionomer cements. Compressive strength and hardness of three glass ionomer cements (GIC) were measured: K Universal Aplicap™, EQUIA Fil® and EQUIA FORTE Fil®, and the SEM sample analysis performed.

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## In vitro wear of (resin-coated) high-viscosity glass ionomer cements and glass hybrid restorative systems

Andrej M. Kielbassa<sup>1,\*</sup>, Eric Paul Oehme<sup>2</sup>, Natalia Shakavets<sup>3</sup>, Michael Wolgin<sup>4</sup>

<sup>1</sup> Department of Operative Dentistry, Periodontology, and Endodontology, University School of Dental Medicine and Oral Health, Dantone Private University (DPU), Selter Landstraße 126, 3500, Krams, Austria

<sup>2</sup> Department of Pediatric Dentistry, Faculty of Dentistry, Indonesian State Medical University (IKMUI), Darmasari Avenue 83, 20136, Mbit, Jakarta

### ARTICLE INFO

**Keywords:**  
Abrasion  
Chewing simulation  
Equia  
Glass hybrid restorative system  
Glass ionomer cement  
High-viscosity glass ionomer cement  
OraCheck  
Resinous coating  
Wear

### ABSTRACT

**Objective:** The aim of the present study was to investigate the volumetric abrasive wear of a high-viscosity glass ionomer cement (hVGIC; Equia Fil) and a glass hybrid restorative system (ghRS; Equia Forte), each being recommended as amalgam alternatives. Both materials were applied with or without their respective resinous coating, and were compared with a conventional GIC (Ketac Fil) and a hybrid composite resin (CR; G-aestal Posterior). **Methods:** 78 standardized occlusal Class I cavities were restored with the various materials (n = 13 per group). Before and after chewing simulation (30,000 cycles at 40 N), each sample underwent optical scanning procedures (Orniscan). A comparison of the total wear using a fluorescence-aided identification technique (OraCheck) followed, and differences (n = 5%) between groups were compared by means of MANOVA. **Results:** Regarding the wear rates of hVGIC and ghRS, no differences could be observed (p > .050), and this was not affected by the resinous coating. All hVGIC and ghRS restorations showed significantly higher abrasive wear than CR (p < .001), while the conventional GIC displayed a significant underperformance compared with any other material (p < .001). **Conclusion:** Resinous coating of hVGIC or ghRS does not appear to exert an effective long-term protection against advanced abrasive wear. Compared to the conventional GIC showing a considerable substance loss, both hVGIC and ghRS materials revealed an improved abrasion resistance, but clearly failed to meet the excellent values of the CR. **Clinical Significance:** Occlusal loading should be carefully considered when using hVGIC or ghRS as amalgam (or composite resin) alternatives for the restoration of posterior teeth.

### 1. Introduction

From a historical perspective, the development and the introduction of conventional glass polyalkenoates (commonly known as glass ionomer cements, GIC [1]) in the mid-1970s was driven by the hope to provide a viable alternative solution for the replacement of dental amalgam as the direct restorative material of first choice in the (pre-)molar region. Unfortunately, both the general quality and the clinical

reputation to their general validity. Notwithstanding, a timely network meta-analysis has confirmed that classical GIC are not advisable for posterior use (at least with primary teeth) [8]. Although several material improvements announced by various developers and manufacturers promised to provide outstanding characteristics such as easy application, tolerance of moisture, chemical adhesion, as well as bioactive properties (anti-microbial and anti-cariogenic effects, due to a considerable fluoride release) [3], practitioners still were faced with significant

# 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

Independent testing partially confirms these claims

Clinical studies on EQUIA  
Forte are now starting to  
appear

(I am not including ART  
studies, or studies on  
primary teeth)

**J Adhes Dent 22 (2020), No. 3** 29. May 2020

J Adhes Dent 22 (2020), No. 3 (29.05.2020)

Page 235-247, doi:10.3290/j.jad.a44547, PubMed:32435764

**Clinical Performance of a Glass-Hybrid System Compared with a Resin Composite in the Posterior Region: Results of a 2-year Multicenter Study**

Miletić, Ivana / Baraba, Anja / Basso, Matteo / Pulcini, Maria Giulia / Marković, Dejan / Perić, Tamara / Ozkaya, Cigdem Atalayin / Turkun, Lezize Sebnem

**Purpose:** To compare the clinical performance of a glass hybrid restorative system, EQUIA Forte, with that of a nanohybrid resin composite, Tetric EvoCeram, in two-surface class II cavities.

**Materials and Methods:** This multicenter, randomized controlled clinical study was conducted at four different dental schools. In total, 360 restorations were placed in patients in need of two class-II, two-surface restorations in the molar region of the same jaw. Each patient received one glass hybrid restoration (EQUIA Forte, GC) and one resin composite restoration (Tetric EvoCeram, Ivoclar Vivadent). Two independent evaluators performed a clinical evaluation of each site after 1 week (baseline), 1 year, and 2 years using the criteria of the FDI World Dental Federation (FDI-2).

**Results:** The estimated survival rates at the 2-year recall were 93.6% and 94.5% for EQUIA Forte and Tetric EvoCeram, respectively. There were no significant differences in the survival rates or in any of the evaluated esthetic, functional or biological properties between EQUIA Forte and Tetric EvoCeram restorations ( $p > 0.05$ ).

**Conclusion:** Both the glass-hybrid restorative system and nanohybrid resin composite showed good clinical performance in moderate to large two-surface class II restorations in a 2-year follow-up.

**Keywords:** *clinical trials, resin composite, glass-hybrid system, multicenter, split-mouth*

[fulltext \(no access granted\)](#) [order article as PDF-file \(20.00 €\)](#) [Endnote-Export](#)

Long-term, split-mouth, randomized, prospective, multicentre clinical study enrolled 180 patients (mean age 34.6 years) identified as in need of two Class II, two-surface restorations in the molar region of the same jaw.

The estimated survival rates at the 2-year recall were 93.6% (EQUIA Forte) and 94.5% (Tetric EvoCeram), showing no significant differences between the two materials.

# A recent 4-year research abstract from the same study (i.e. not peer reviewed)

## 48-Month Clinical Performance of a Glass-Hybrid in Extended-Size Class-II Cavities

**Objectives:** To evaluate the clinical performance of a glass hybrid restorative compared to a resin composite in the restoration of large and deep Class II cavities after 48 months.

**Methods:** A total of 108 extended size (the proximal box in occlusion and width of the proximal box not interfering with the peak of the cusps) Class II lesions in 37 patients were either restored with a glass hybrid restorative or with a micro-hybrid composite resin in combination with selective etching by two experienced operators according to the manufacturer's instructions. Two independent examiners evaluated the restorations at baseline and at 12-, 24-, 36- and 48-month recalls according to the modified USPHS Criteria. Negative replicas at each recall were examined under SEM to evaluate surface characteristics. The Cochran Q-test was used to compare the changes across different time points within each restorative material. The changes in each category within the restorative groups were compared using the Fisher Exact test ( $\alpha=0.05$ ).

**Results:** After 48 months, 90 restorations were evaluated in 32 patients (recall rate: 86.5%). Five glass hybrid restorations were missing; 4 were due to bulk fractures (3 were at 12 months, 1 was at 48 months) and 1 was due to proximal fracture at 24 months. Six glass hybrid restorations exhibited color differences starting from baseline ( $p<0.05$ ). Both restorative materials showed increased bravo scores in terms of anatomic form, marginal adaptation and polishability compared to baseline. Secondary caries was not seen in any groups. No significant differences were observed between the two restorative materials for the other criteria evaluated ( $p>0.05$ ). SEM observations exhibited acceptable surface and marginal adaptation characteristics for both restorative materials.

**Conclusions:** Although glass hybrid restorations showed mismatch in color, these materials could be considered as permanent restorative materials for the restoration of large Class II cavities after 48 months.

Division: IADR/AADR/CADR General Session

Meeting: 2020 IADR/AADR/CADR General Session (Washington, D.C., USA)

Location: Washington, D.C., USA

Year: 2020

Final Presentation ID: 1389

Abstract Category|Abstract Category(s): Dental Materials 8: Clinical Trials

### Authors

- Gurgan, Sevil ( Hacettepe University , Ankara , Turkey )
- Kutuk, Zeynep ( Hacettepe University , Ankara , Turkey )
- Ozturk, Canan ( Hacettepe University , Ankara , Turkey )
- Soleimani, Riza ( Hacettepe University , Ankara , Turkey )
- Yalcin Cakir, Filiz ( Hacettepe University , Ankara , Turkey )

# A recent 4-year research abstract from the same study

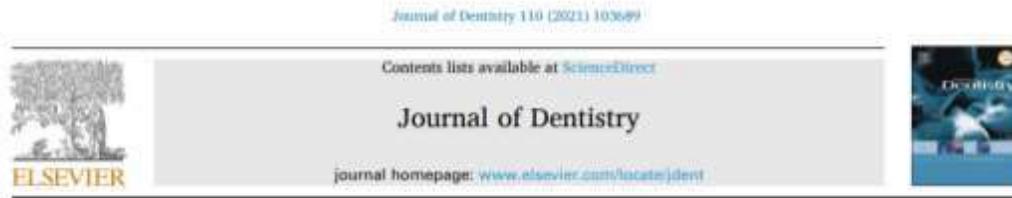
## **KEY POINTS:**

- 👄 90 restorations evaluated in 32 patients
- 👄 4 restorations failed, 3 due to bulk fractures (after 12 months), 1 due to interproximal fracture (i.e. 4.5% failure rate overall, or 1.2% AFR)
- 👄 6 exhibited colour changes

## **AUTHORS' CONCLUSION**

Although glass hybrid restorations showed a mismatch in colour, these materials (EQUIA Forte vs composite) could be considered as permanent restorative materials for the restoration of large class II cavities after 48 months.

# 3-year Class V evidence from Germany



## Glass hybrid versus composite for non-carious cervical lesions: Survival, restoration quality and costs in randomized controlled trial after 3 years

Falk Schwendicke<sup>a,\*</sup>, Anne Müller<sup>a</sup>, Tilmann Seifert<sup>b</sup>, Linda-Maria Jeggie-Engbert<sup>c</sup>, Sebastian Paris<sup>d</sup>, Gerd Göstemeyer<sup>d</sup>

<sup>a</sup> Department of Oral Diagnostics, Digital Health, Health Services Research, Charité – Universitätsmedizin Berlin, Germany

<sup>b</sup> Department of Periodontology, Oral Medicine and Oral Surgery, Charité – Universitätsmedizin Berlin, Germany

<sup>c</sup> Department of Cranio-Maxillofacial Surgery, University Hospital Münster, Germany

<sup>d</sup> Department of Operative and Preventive Dentistry, Charité – Universitätsmedizin Berlin, Germany

### ARTICLE INFO

#### Keywords:

Composite  
Glass ionomer  
Non-carious cervical lesions  
Randomized controlled trial  
Restoration  
Sclerotic dentin

### ABSTRACT

**Objective:** This study compared survival, restoration quality and costs of glass hybrid (GH; EQUIA Forte-FIL/EQUIA Forte-Coat) and resin composite restorations (RC; Optibond FL/Filtek Supreme XTE) of sclerotic non-carious cervical lesions.

**Methods:** This is a cluster-randomized trial (ClinicalTrials.gov: NCT02631161). 88 patients (50–70 years) with 175 sNCCLs were randomized to receive GH or RC. Restorations were placed without mechanical cavity preparation and followed for a mean 36 (min/max: 31/55) months (variable follow-up due to COVID-19 lockdown). Restoration quality was re-evaluated at 1-, 18- and 36-months using FDI-criteria. Survival was assessed using multi-level Cox-regression analysis. Costs were estimated from a payer's perspective in Germany. Initial costs were determined based on micro-costing using time recordings and hourly costs, and follow-up costs based on statutory insurance fee-item-catalogues.

**Results:** 88 patients (175 restorations) were treated; 43 received GH (83 restorations), 45 RC (92 restorations). 17 GH and 19 RC showed total retention loss, 5 GH were partially lost ( $p = 0.396/\text{Cox}$ ). FDI ratings were not sufficiently different for any domain except surface luster, where RC showed higher score ( $p < 0.001$ ). Costs were initially lower for GH (32.57; SD 16.36 €) than RC (44.25; SD 21.40 €), while re-treatment costs were similar (GH: 9.15; SD 15.70 €; RC: 7.35; SD 14.51 €), resulting in significantly lower costs for GH (GH: 41.72; SD 25.08 €) than RC (51.60; SD 26.17 €) ( $p < 0.001/\text{GLM}$ ).

**Conclusions:** While survival was not significantly different, GH was significantly less costly both initially and long-term.

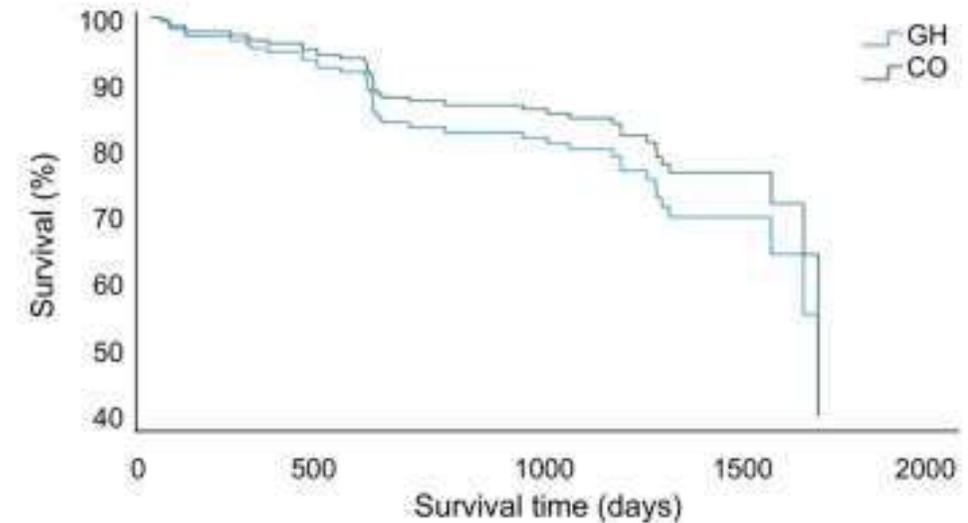


Fig. 2. Survival of Glass Hybrid (GH) and Resin Composite (RC) restorations.

**Conclusions:** While survival was not significantly different, GH was significantly less costly both initially and long-term than RC for restoring non-carious cervical lesions.

**Clinical significance:** Within this trial, survival was not significantly different between GH and RC to restore sclerotic NCCLs. As GH was significantly less costly both initially and long-term than RC, using RC was only cost-effective for payers willing to invest high additional expenses per minimal survival gains.

# Evidence on Class II from Croatia, Serbia, Italy & Turkey

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## Cost-effectiveness of glass hybrid versus composite in a multi-country randomized trial

Falk Schwendicke<sup>a,\*</sup>, Jesus Gomez Rossi<sup>a</sup>, Joachim Krois<sup>b</sup>, Matteo Basso<sup>b</sup>, Tamara Peric<sup>c</sup>,  
Lezize Sebnem Turkun<sup>d</sup>, Ivana Miletic<sup>e</sup>

<sup>a</sup> Department of Oral Diagnostics, Digital Health and Health Services Research, Charité - Universitätsmedizin Berlin, Germany

<sup>b</sup> Center of Minimally Invasive, Aesthetic and Digital Oral Rehabilitation (COMEDI), IRCCS Galeazzi Orthopedic Institute, University of Milan, Milan, Italy

<sup>c</sup> Department of Pediatric and Preventive Dentistry, School of Dental Medicine, University of Belgrade, Belgrade, Serbia

<sup>d</sup> Department of Restorative Dentistry, Ege University School of Dentistry, Izmir, Turkey

<sup>e</sup> Department of Endodontics and Restorative Dentistry, School of Dental Medicine, University of Zagreb, Croatia

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Dental materials  
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Health services research

### ABSTRACT

**Objectives:** We assessed the cost-effectiveness of two amalgam alternatives, glass hybrid (GH) and composite (CO) in a multi-country randomized controlled split-mouth trial.

**Materials:** University clinics in Croatia, Serbia, Italy and Turkey participated. Pairs of GH (EQUA Forte, GC) and a nano-hybrid CO (TetricEvoCeram, IvoclarVivadent) were randomly placed in occlusal-proximal two-surfaced cavities in permanent molars of adults ( $n = 180/360$  patients/molars). We used 3-years interim data for this evaluation. FDI-2 criteria were applied and teeth requiring repair, re-restoration, endodontic treatment or extraction recorded. Our outcome was the time until any or major complications (requiring endodontic treatment or extraction) occurred. Costs were calculated in US Dollar (USD) 2018, with the local currencies being converted using Purchasing Power Parities. To estimate initial and re-treatment costs, a payers' perspective was taken and direct medical costs estimated from fee item catalogues. Incremental-cost-effectiveness ratios (ICER) were used to express the cost difference per gained or lost effectiveness.

**Results:** Overall costs were lower for GH than CO in Croatia, Turkey and Serbia, while this difference was minimal in Italy. GH tended to survive longer than CO in Croatia and Italy, and shorter in Serbia and Turkey; overall survival time was not significantly different ( $p = 0.67/\log\text{-rank}$ ). The cost-effectiveness differences indicated CO to be more expensive at limited (ICER: 268.5 USD/month without any complications) or no benefit at all (-186.2 USD/month without major complications).

**Conclusions:** GH was less costly than CO both initially and over 3 years. Efficacy differences were extremely limited.

**Clinical significance:** Given their low initial costs and as efficacy between GH and CO did not differ significantly, GH had a high chance of being more cost-effective within this specific trial.

360 restorations (2 per patient)

Randomised controlled split mouth trial, 4 dental schools  
Equia Forte v Tetric Evo Ceram

Placed by 2 operators of 3 years' experience in each dental school

Two examiners per school

# Evidence on Class II from Croatia, Serbia, Italy & Turkey

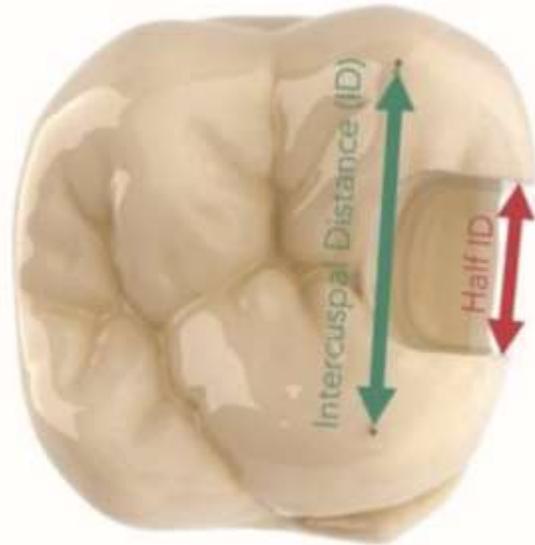
*Results:* Overall costs were lower for GH than CO in Croatia, Turkey and Serbia, while this difference was minimal in Italy. GH tended to survive longer than CO in Croatia and Italy, and shorter in Serbia and Turkey; overall survival time was not significantly different ( $p = 0.67/\log\text{-rank}$ ). The cost-effectiveness differences indicated CO to be more expensive at limited (ICER: 268.5 USD/month without any complications) or no benefit at all (-186.2 USD/month without major complications).

*Conclusions:* GH was less costly than CO both initially and over 3 years. Efficacy differences were extremely limited.

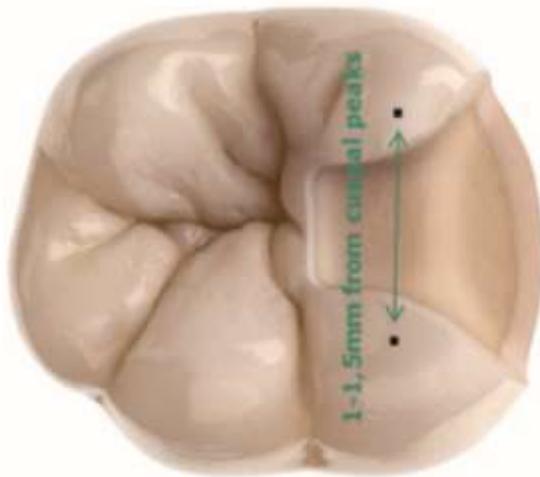
*Clinical significance:* Given their low initial costs and as efficacy between GH and CO did not differ significantly, GH had a high chance of being more cost-effective within this specific trial.

**RESULTS**

# Manufacturer's (GC) suggestion



Recommended Class II Cavity size as per EQUIA IFU



Recommended Class II Cavity size as per EQUIA Forte IFU

Perhaps! But, clinical trials on this cavity design are needed.

# Easy solutions even in difficult situations

**CASE 1:** EQUIA, Class V, Dr. José Zalba, private practitioner, Spain



**CASE 2:** EQUIA Forte, Class II, Professor Ivana Milečić, Zagreb University, Croatia



**CASE 3:** EQUIA, Class I, Professor Matteo Basso, Milan University, Italy



# Do you want to read more?

Introducing the restorative innovation of glass hybrid technology

A COMPREHENSIVE GUIDE TO EQUIA FORTE

EQUIA  
FORTE

GC

## Trevor's view:

EQUIA Forte seems to hold promise. Results good for class I restorations. Use a cautious approach in class II until more research appears.



FJ Trevor Burke

# Dental Materials- What Goes Where? The Current Status of Glass Ionomer as a Material for Loadbearing Restorations in D

I have now updated my 2013 paper!

...for 40 years, but have not been indicated for loadbearing restorations, other than  
...there is anecdotal evidence that dentists are using the reinforced versions of this material in  
...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  
potential need for the

8 papers on GI in posterior teeth included

Burke FJT. Dent.Update: **2013**:40(10):840-844.



F.J. Trevor Burke

Louis Mackenzie and Peter Sands

## Fifty Years of Glass Ionomers. Are the Latest GICs Suitable for Restoring Back Teeth?

**Abstract:** Glass ionomer cements (GICs) have been available for use by clinicians for almost 50 years. Their beneficial properties, such as adhesion to tooth substance, have long been recognized, but early materials suffered from brittleness, lack of translucency, poor wear resistance and solubility in oral fluids. Hence, over the years, new variants have been developed with a view to overcoming these difficulties. If the latest materials were found to be clinically successful in loadbearing situations in posterior teeth, they could hold advantages because of their easier placement than resin composite materials and possibly be more cost-effective. It is therefore the purpose of this article to review recent research into the performance of the laboratory and clinical performance of high viscous GICs and the so-called glass hybrid materials that have developed from the conventional GICs.

**CPD/Clinical Relevance:** Glass ionomer materials, which, unlike resin composite restorations do not need a separate bonding agent, may hold technique advantages during restoration placement.

**Dent Update 2023; 50: xx-xx**

It is the aim of this narrative review to (i) briefly trace the history of glass ionomer materials over the 50 years of their existence and (ii) identify and evaluate articles publishing clinical data (of more than 2 years' duration) on survival of restorations in Class I and II cavities formed in contemporary glass ionomer cement systems.

### Early history of glass ionomer materials

Glass ionomer materials were first described in a patent in 1969,<sup>1</sup> with the

first publication being in 1972 by Wilson and Kent.<sup>2</sup> They were originally considered to be a development of silicate cement,<sup>3</sup> which comprised a fluoro-alumina-silicate (FAS) glass, mixed with phosphoric acid. The mixed material suffered from many deficiencies, especially solubility in oral fluids, so, for the glass ionomer cements (GICs), an aqueous solution of polycarboxylic acid (a carboxylic acid being an organic acid containing one or more -COOH groups) was substituted for the phosphoric acid. When mixed together, a paste was formed that rapidly hardened

into a solid mass bound by a polysalt hydrogel (Table 1; Figure 1).

Commercially introduced in 1975 as ASPA (De Trey/Dentsply Ltd, UK), the ability of these materials to bond to tooth substance brought a new dimension to the properties of dental materials. Further development led to the production of an anhydrous GIC in 1981 (Chemfil, De Trey/Dentsply Ltd, UK), which simply required mixing of the powder with water. This was mainly recommended for use in Class V cavities, and in Class I and II cavities in primary teeth. These materials were based upon polyacrylic acid (PAA), which formed a chemical bond with hydroxyapatite. Another manufacturer (ESPE, Seefeld, Germany) used polymaleic acid in its glass ionomer cement, Ketac Bond, which became available in 1984. Both contained an FAS glass, which had an acid-base reaction with the acid, with the attendant release of fluoride.

**F.J. Trevor Burke**, DDS, MSc, MDS, MGD, FDS (RCS Edin), FDS RCS (Eng.), FCG Dent., FADM, Emeritus Professor, University of Birmingham School of Dentistry Birmingham B5 7EG UK. **Louis Mackenzie**, BDS, FDS RCPD, FCG Dent., Head Dental Officer, Denplan UK, Andover, and, Clinical Lecturer, University of Birmingham School of Dentistry. **Peter Sands**, MSc, BDS, LDS, MCGD, General Dental Practitioner, Abingdon, England. email: f.j.t.burke@bham.ac.uk

## Conclusion

Amalgam and resin composite restorations, placed in loadbearing situations in posterior teeth, have stood the test of time and may be considered to have extensive research to back up their clinical effectiveness. The present review has indicated that contemporary GICs and their variants, such

as glass hybrids, feature in an increasing number of publications, which suggests that their clinical effectiveness in Class I and small-to-medium sized loadbearing Class II cavities holds promise. Accordingly, we conclude that composites, glass hybrids and GICs all have their merits and, when faced with a patient, restoration and clinical scenario, the clinician has to weigh up the options and decide what material to use.

# Placement tips for Glass Ionomer in posterior teeth

-  Glass Ionomer adheres chemically to metal, therefore can bond/stick to metal matrices: as the matrix is (forcefully) pulled off with the GIC not fully matured, microcracks can form in the proximal surface or result in partial debonding of the material at the bottom:
-  Therefore use a coated matrix, or coat matrix with Vaseline
-  DO NOT pull the matrix off in an occlusal direction

# Placement tips for Glass Ionomer in posterior teeth

-  Use rounded internal cavity line angles
-  Use an anatomically contoured matrix such as a sectional
-  Or burnish out matrices with flatter interproximal contour

# Placement tips for Glass Ionomer in posterior teeth

-  GI is soluble in dilute organic acids, therefore can dissolve interproximally in high caries cases
-  For materials which comprise a coating, therefore, pass the coating down the interproximal surface using floss
-  Another reason for interproximal coating - GIs may react to apple juice and orange juice due to chelating carboxylic acids in the juices. Conversely, the phosphoric acid in cola drinks has no effect!

# Placement tips for Glass Ionomer in posterior teeth

-  Presence of an occlusal contact on the interproximal box area of a GI restoration leads to increased risk of bulk fracture of the restoration (Frankenberger et al, Int.Dent.J., 2009)
-  Therefore, for GIs, **AVOID OCCLUSAL CONTACTS ON CLASS II BOXES!**

-  If your curing light gets hot at the tip, light cure the GI for 30 seconds maximum

# What I plan to talk about (not necessarily in this order!)

- Amalgam, briefly
- Resin composites – a true alternative?
- Latest on self-adhesive composite materials
- Current status of GICs and Glass Hybrids for restoration of posterior teeth
- How to place these
- Are these good enough to change our philosophy today?
- Final thoughts

Are the new glass hybrids  
better or worse than  
amalgam?

## Are glass hybrids an ideal material?

- ❖ No toxicity issues to patients: To dentists?? To the environment? ✓
- ❖ Physical properties good ✓ X
- ❖ Relatively easy placement, said to be “forgiving”, but, can it be placed under saliva and blood contamination? ✓
- ❖ Comparatively cost effective (reduced surgery time) ✓
- ❖ High thermal conductivity ✓
- ❖ Did not need an intermediate bonding agent ✓
- ❖ But, required retentive cavity features = tooth destruction ✓
- ❖ Plenty of research “evidence” on longevity ✓ X
- ❖ Aesthetics poor (although colour contrast facilitates removal) ✓
- ❖ Waste is highly regulated ✓

10/2

# Some final thoughts



Why direct-placement  
restorations are king/queen!

## The ultimate guide to restoration longevity in England and Wales. Part 10: key findings from a ten million restoration dataset

F. J. T. Burke\*<sup>1</sup> and P. S. K. Lucarotti<sup>1</sup>

### Key points

Overall, almost 14 million tooth restorations were included in the analysis, with survival to re-intervention at 15 years ranging by tooth type between 32% and 42%; with regard to time to extraction of the restored tooth, the range is from 77.8% to 84.2%.

Larger restoration of all types and in all types of teeth generally performed less well than smaller restorations. Crowns perform better in time to re-intervention than direct restorations, but worse, particularly for younger patients, in time to extraction.

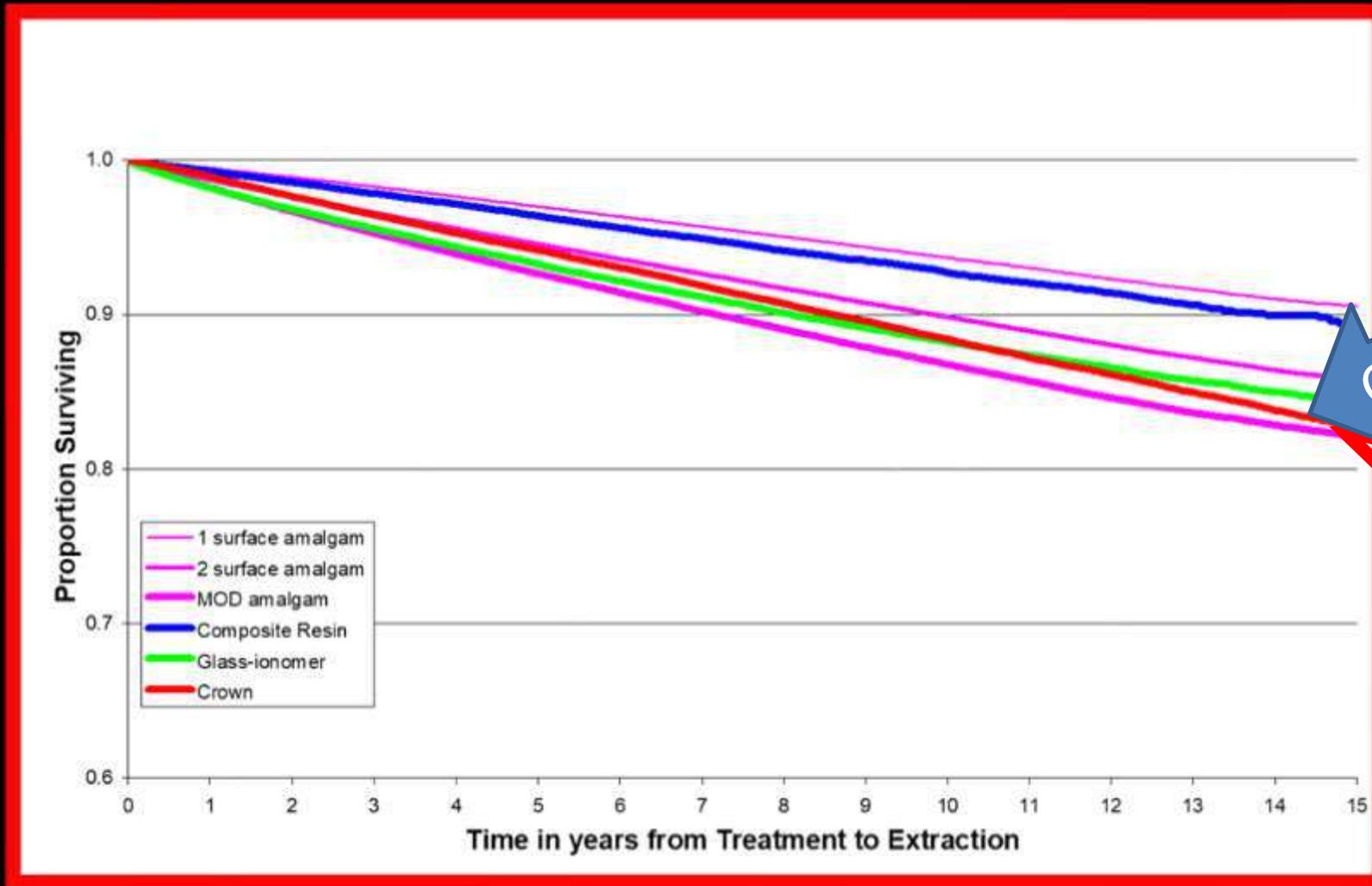
Patient treatment history is a major factor in the survival of restored teeth, both to re-intervention and to extraction. The greater the previous spend on treatment, the worse the survival. Dentists' age has been shown to play a part in the present investigation, with restorations placed by younger dentists performing better for all types of restoration except crowns.

Dataset of 10 million restorations followed for 16 years

Molar teeth: 6,311,720 restorations

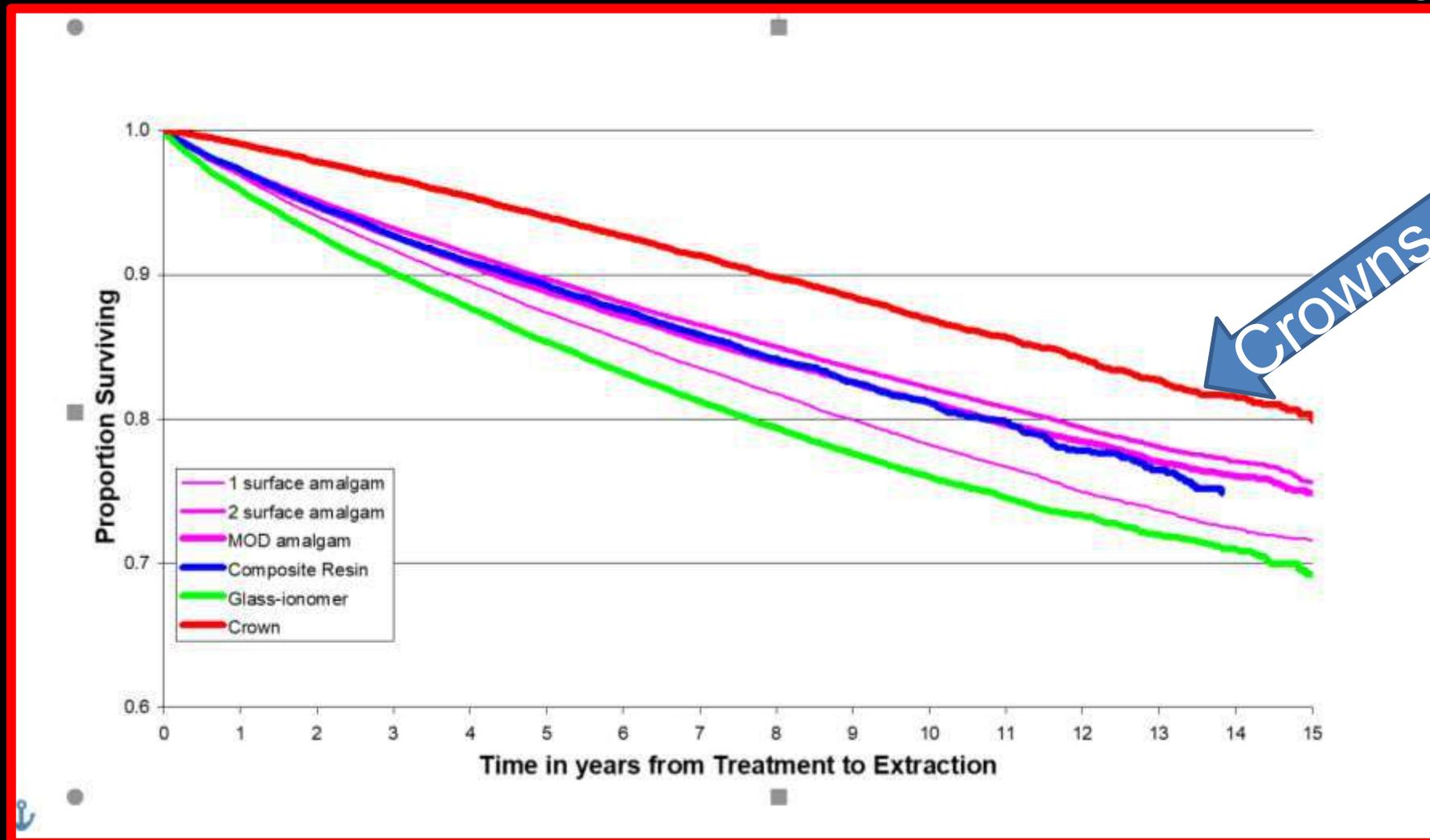
The effect of crowns

# Crowns in molar teeth: *survival of the restored tooth to extraction*, patients *under 40 years*



Crowns are worst!

# Crowns in molar teeth: *survival of the restored tooth to extraction*, patients over 60 years



Crowns are best!

It's only in older patients that crowning a molar tooth is a good idea!

Therefore, *direct placement* restorations should be employed where possible

# The ideal restorative material

chemically resistant to  
acids & enzymes

strong & stiff    low dimensional change

non toxic            low wear            bulk fill

polishable

aesthetic            low sorption            easy to

use

good margins

self adhesive

tissue regenerating

self repairing

## Trevor's view:

Bulk fill resin composite bonded with a Universal adhesive remains the gold standard “amalgam replacement”, but new glass hybrid materials hold promise & are more cost effective

May 2013 . Volume 40 . Number 4

# DentalUpdate

Restorative Dentistry



# DentalUpdate

May 2023, Volume 50, Number 5



The web site has articles back to 1999

Changing Concepts in Endology: Forty Years On

Periodontics

Minimally-Invasive Non-Surgical Periodontal Therapy

Restorative Dentistry

Direct Anterior Composites: A Practical Guide

Dental Microbiology

Antibiotics in Dentistry – An Update

Oral Surgery

Minimally-Invasive Tooth Extraction: Doorknobs and Strings Revisited!

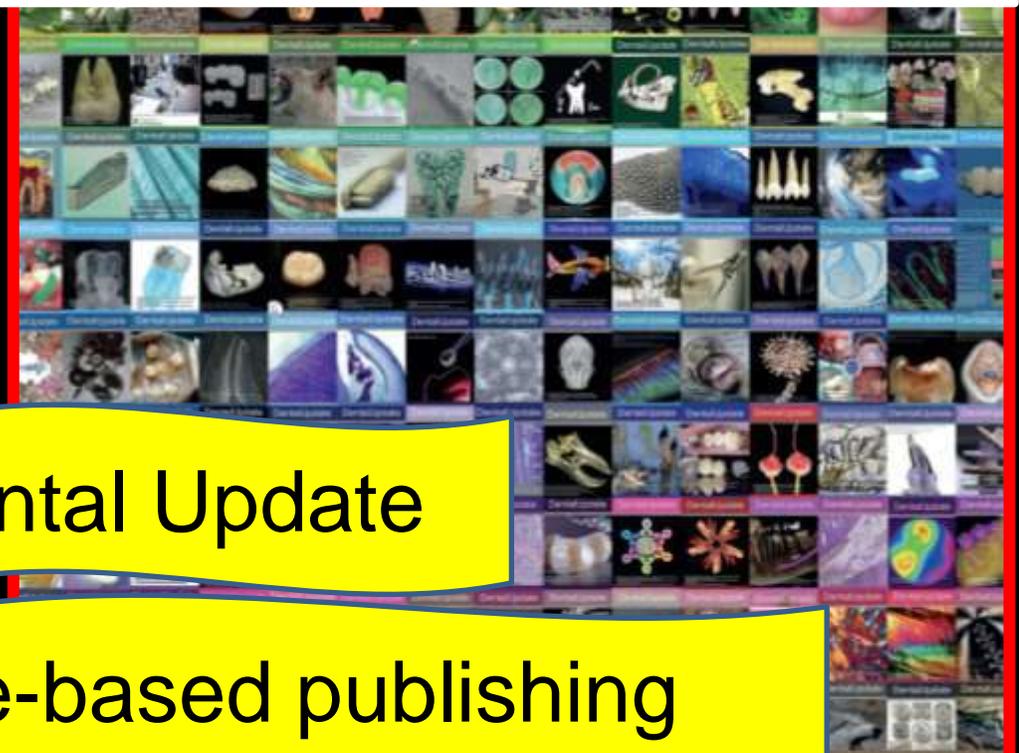
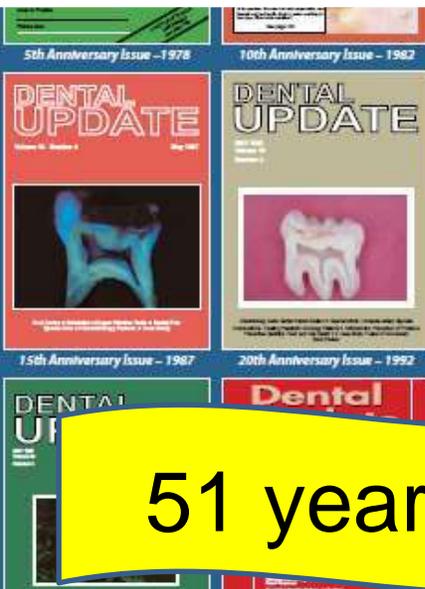
Dental Photography

Improving Your Image...Then and Now. Digital Photography in Dentistry

Practice-Based Research

Twenty Years of Handling Evaluations and Practice-Based Research by the PREP Panel

Case Report: Parotid Fistula – An Extra-Orally Draining Infected C Associated with a Superr Molar in Ascending Ram



51 years of Dental Update

51 years of evidence-based publishing

# After 2001: Changes for the dental team

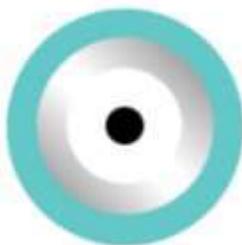
- Changes in disease patterns
- Increasing use of auxiliaries
- Increasing regulation of dentists
- Increasing emphasis on evidence based dentistry
- Decreasing emphasis on NHS treatment

Slide made *circa* 1995

In general, dentists have done a good job for their patients, under a fee per item system! They gave excellent value for money: why did the NHS have to change the system?

PERSPECTIVE

# How do we manage the aftermath of maximally invasive cosmetic dental treatment? Addressing the clinical and ethical dilemmas facing dental teams following extensive dental treatment elsewhere



**Koray Feran** is a multidisciplinary restorative dental surgeon and principal of L3AD Ltd. More information can be found here: <https://www.l3ad.co.uk/meet-the-team/koray-feran/>

**Key points**

- Some dental tourism, comprising of unethical, financially driven dental interventions, causes permanent and irreversible damage that ruins lives and brings our profession into disrepute
- Such practices are not embraced by most of our profession. We must educate patients into thinking hard before committing to such interventions and to consider the longer-term biologic and financial implications of their decisions. We must dissuade colleagues from doing this kind of 'treatment'
- Patients that have undergone such interventions must be treated sympathetically, without judgement, and with sound diagnosis and treatment planning for long-term predictable restoration. This will create a huge burden on public healthcare services and is more likely to require private sector treatment at substantially greater cost.

We see an increasing and worrying trend of patients receiving extensive, destructive, irreversible and unnecessary dental work. While this is usually seen in the form of dental tourism abroad ('Turkey teeth syndrome'), it can be seen anywhere. The case shown in this article was not

in fact carried out in Turkey but in the heart of London (Figures 1, 2, 3 and 4). The patient's motivation appears to be social media image-driven. The clinician's motivation unfortunately appears to be mainly financial in many cases.

The main issue is one of irreversible and extensive destruction of mostly healthy teeth

for 'restorations' of questionable quality. Examination, treatment and completion is often carried out in as little as a week. Occasionally, as demonstrated in a recent BBC documentary,<sup>1</sup> extensive treatment is recommended simply from a selfie.

One can speculate on the patient's and clinician's thoughts when committing to such treatment. Many patients are pleased with their treatment, regardless of the biologic cost. However, an unacceptably high number are left in distressing acute and chronic pain, or with rapid loss of restorations due to documentation or documentation of teeth, alterations in occlusion, or dissatisfaction with the aesthetics of the final work. The loss of teeth over time is also accelerated following endodontic, periodontal and structural complications of such 'restorative' work.

When this dentistry is carried out by a tourism arrangement, any complications often end up in the lap of UK clinicians, unfamiliar with what lies underneath the extensive crowns and bridges which are often linked together in multiple units.

Fig. 1 a, b, c, d) Pre-op images obtained from 'cosmetic' dentist



Koray Feran

The sensitive UK medicolegal environment engenders a 'you touch it, you own it' mentality. UK dental colleagues are reluctant to take on patients that have had treatment abroad for fear that any intervention to initially help a patient may have more extensive and expensive repercussions.

As patients have gone abroad for the sole reason that it is cheaper, they often do not have the funds for much outlier remedial work at home. It is often also difficult for patients who have had such work to seek recompense from clinics abroad. A trip back is often fruitless in the absence of local robust regulatory or insurance structures.

These clinics also have large advertising budgets, often assisted by the country's tourism and health ministries to being hard currency into the country through dental tourism.

**What is the solution?**

Education is key. The dental profession must make patients more aware of the irreversible damage that can be done to their teeth and the biologic and financial repercussions of ill-considered 'treatment'

Every patient should have a proper, sympathetic consultation to make them aware of the current situation in their mouth. We owe a duty of care to our patients regardless of their past decisions or where treatment was carried out. It is not for us to judge, but to assist. Unfortunately, when reality hits home, there is considerable distress and indignation that is deflected onto the home clinician. We must prepare for these discussions and give clear, sympathetic and firm advice.

The problem extends beyond the scope of this article, from the psychology of modern dysmorphia to the irrepressible need for some people to find a bargain without understanding the inherent compromises. From questionable ethics and financial motives without any thought for patients' long-term wellbeing, to the lack of regulatory assurances that allow patients recourse in claim against such work or the potential cost of litigation for both sides.

There will be a steady flow of patients requiring extensive rehabilitation in the future because of these dental interventions and we need to be prepared to do what is necessary to give patients the quality of life that our profession should be providing for them. ■

**References**

1. BBC. Turkey Teeth: Bargain Services or Big Mistake? 2022. Available at <https://www.youtube.com/watch?v=Uk8M10wG4> [accessed October 2023].

Fig. 2 Clinical situation after intervention from 'cosmetic' dentist



Fig. 3 Radiographic situation after intervention from 'cosmetic' dentist

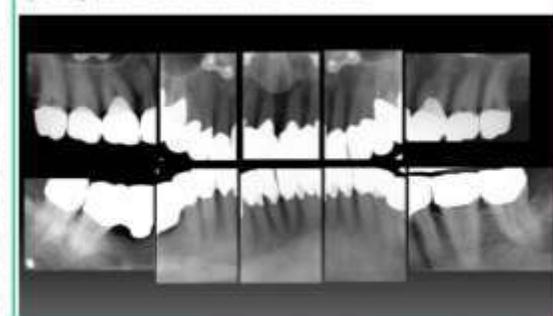
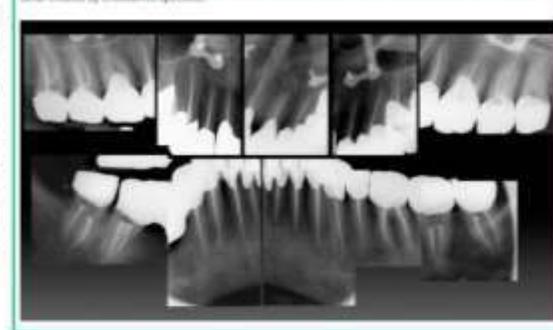


Fig. 4 Radiographic situation after retractable pain for seven months led patient to request all teeth to be root canal treated by endobiotic specialist



in fact carried out in Turkey but in the heart of London (Figures 1, 2, 3 and 4). The patient's motivation appears to be social media image-driven. The clinician's motivation unfortunately appears to be mainly financial in many cases.

The main issue is one of irreversible and extensive destruction of mostly healthy teeth

“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

DeVan MM. Basic principles of impression taking.J.Prosthet.Dent.2006:93:503-508

## Perspectives

### THE “DAUGHTER TEST” IN ELECTIVE ESTHETIC DENTISTRY

We read with interest the excellent overview of the 25-year status of porcelain laminate veneers by Dr. Mark Friedman<sup>1</sup> and agree with his statement “It is unfortunate that some members of our profession misrepresent porcelain veneer restorations as if they were completely innocuous to the dentition.” It is not our intention to initiate a witch hunt on the porcelain veneer technique but to express considerable disquiet regarding the seemingly

dentate patients adapt well to modest changes in vertical dimension without problems, a concept originally demonstrated by Anderson<sup>2</sup> and later by Dahl.<sup>3</sup> It is our view that, in many cases, long-term composite build-ups should be the preferred line of treatment and that these have shown demonstrable success with an excellent “fallback position”.<sup>4</sup> These provide esthetic restorations—as demonstrated by the mock-up for a 43-year-old patient in the recent article by Chen

conservative treatment modalities available.”<sup>5</sup> Many preparations that we see, originating from the United States, involve dentine, with the potentially deleterious effects on longevity of the restoration.<sup>6</sup> In this respect, the results from Dumfahrt and Schaffer indicated that the failure rate increased ( $p < 0.01$ ) when the finish line crossed an



tissue. This is the “Daughter Test.” This asks the question “Knowing what I know about what is involved with this proposed dentistry, would I carry out this treatment on my own daughter’s teeth?” Variations on this test include “Would I have this treatment carried out on my own teeth, my children’s teeth, or my partner’s teeth?” A negative response should prompt a radical rethink and probably initiate a change of plan involving a more sensible and less destructive approach with which the operator and his/her patient and family are more comfortable because it addresses the health of the teeth and the patient in the much longer term.

*That's  
“End of the road  
for dental  
amalgam?”*

Thanks for your interest