Rules for survival

(of restorations & teeth)

"I am not paid by any company to promote their products"

"Some manufacturers fund my research"

"I will try to be evidence-based rather than anecdotal"

Objectives

Following attendance on this course, delegates should:

- Be aware of value of choosing the correct, high-quality material for a given clinical situation
- Be aware of the latest information on bonding to dentine and survival of resin composite materials, including bulk fill and optimum matrix systems
- Have a modest awareness of what Kaplan Meier statistical analysis is about
- Know the clinical situations when a crown (as opposed to a direct-placement restoration) might adversely affect the survival of the restored tooth

What I plan to talk about

- Choosing a reliable material
- Choosing the “right” material
- Bonding to dentine and survival of resin composite materials, including bulk fill and optimum matrix systems
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making

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

Own label brands: baked beans

Heinz was twice the price!

Energy	164 Kcal	165 Kcal
Protein	9.7g	9.0g
Carbohydrate	26.7g	29.6g
Fat	0.4g	1.1g
Fibre	7.7g	8.6g

You can
save £40 by
buying an
own-label
5ml bottle of
bonding
agent

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

DentalMaterials

Steffen Mickenautsch

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

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

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

Dent Update 2011; 38: 634–644

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

FJ Trevor Burke

Me Too 3

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

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

References

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

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

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

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

Methods

The abstract memory stick for the IADR meeting in March 2011 in San Diego was examined. All abstracts included in the 'Dentine adhesives' and 'Composite' sections were read in full and examined in order to identify the names of products mentioned in the abstracts. These were recorded and tabulated. Any product which did not state the manufacturer was further investigated by an internet search.

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

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

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 FTIR 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 further in an internet search and their manufacturers identified. No OL brands were identified during the search.

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
EstheticX (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.

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.

Shaw K et al. Eur.J.Prosthodont.Rest.Dent.2016:24:22-28.

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

Johnsen GF et al. J.Dent.2017:56:84-98.

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

The OBLs were, in general, outdone by the conventional composite

Dentists are highly recommended to reconsider utilization of OBLs lacking sound scientific scrutiny.

Our findings warrant a legitimate concern regarding OBLs.

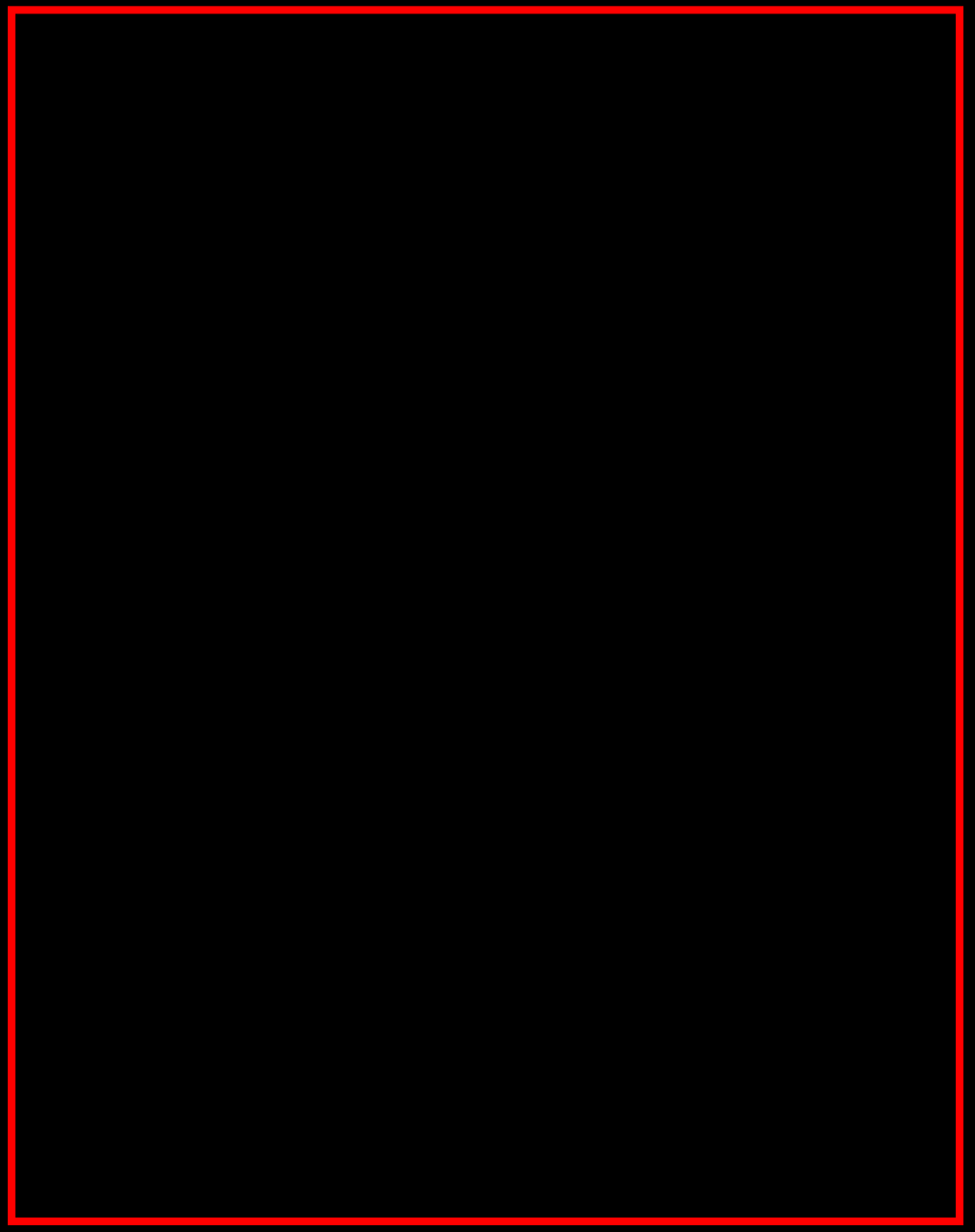
What is the cost of one failed adhesive restoration?

A % of your monthly charm quotient!

Replacement restoration = £XXX

At least 30 – 40 minutes of your time

Own label brands: Do they have any research evidence?



Avoiding adhesive failures

Use a material from a manufacturer with experience in the field
Follow the instructions!!
One bottle bonding (reduced risk of error)
Effective light curing (check your light regularly!)
Think seriously about selective enamel etching

Patients care more about the materials used in their mouths than we suspected!

10 members of the PREP Panel

CONCLUSIONS:

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

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- One third expressed anxieties regarding the use of amalgam in their teeth

Rules for survival

(of restorations & teeth)

There is no (economic) sense in buying a material with no research to back it up

What I plan to talk about

- Choosing a reliable material
- Choosing the “right” material
- Bonding to dentine and survival of resin composite materials, including bulk fill
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making

Black or white?

Non-adhesive	adhesive
Tooth destructive	non-destructive
Non-aesthetic	aesthetic
Technique friendly	difficult
Longlasting	?longevity

The physical properties of amalgam and resin composite are suitable for restoration of loadbearing cavities in back teeth, but what about glass ionomer?

Reinforced Glass ionomer materials in loadbearing situations?

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

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 ...orations and the potential need for the...

8 papers on GI in posterior teeth included

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

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

Conclusions

In clinical situations where there are no adverse situations at work (such as high occlusal loading or an acidogenic plaque), certain restorations in reinforced GI materials (such as Fuji IX) may provide reasonable longevity.

However, the conditions for longevity are not readily identified.

Two of the studies (Scholtanus and Huysmans, 2007: Basso, 2013) demonstrate higher than desirable failure rates for GI restorations in posterior teeth, especially in the longer term.

Trevor's view

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

GC EQUIA doing well at 4 years

©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 1 and Class 2 cavities subsequent to four-year evaluation.

SUMMARY

Objective: The aim of this study was to evaluate the clinical performance of a glass ionomer restorative system compared with a microfilled hybrid posterior composite in a four-year randomized clinical trial.

Methods: A total of 140 (80 Class 1 and 60 Class 2) lesions in 59 patients were either restored with a glass ionomer restorative system (Equia, GC, Tokyo, Japan), which was a combination of a packable glass ionomer (Equia Fil, GC) and a self-adhesive nanofilled coating (Equia Coat, GC), or with a microfilled hybrid composite (Gradia Direct Posterior, GC) in combination with a self-etch adhesive (G-Bond, GC) by two experienced operators according to the manufacturer's instructions. Two independent examiners evaluated the restorations at baseline and at one, two, three, and four years postrestoration according to

Sevil Gurgan, DDS, PhD, professor, Hacettepe University

Do amalgam substitutes exist?

Are reinforced glass ionomers an alternative?

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

GIs in posterior teeth – a medicolegal perspective

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

But, reinforced glass ionomers are a Godsend to special care dentists

Equia Forte holds promise: Differences from Fuji IX

New ultrafine highly reactive glass particles added

Higher molecular weight polyacrylic acid

20% improved flexural strength, 21% improvement in acid resistance, 40% wear resistance

Improved fluoride release

GC data

Rules for survival

(of restorations & teeth)

There is a need for an improved
Glass Ionomer: if we get that,
it could be our amalgam substitute

What I plan to talk about

- Choosing a reliable material
- Choosing the “right” material
- Bonding to dentine and survival of resin composite materials, including bulk fill
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making

Composites can be pretty!

and, bonding to enamel is easy

COMPOSITION OF DENTINE

70% Inorganic

20% Organic

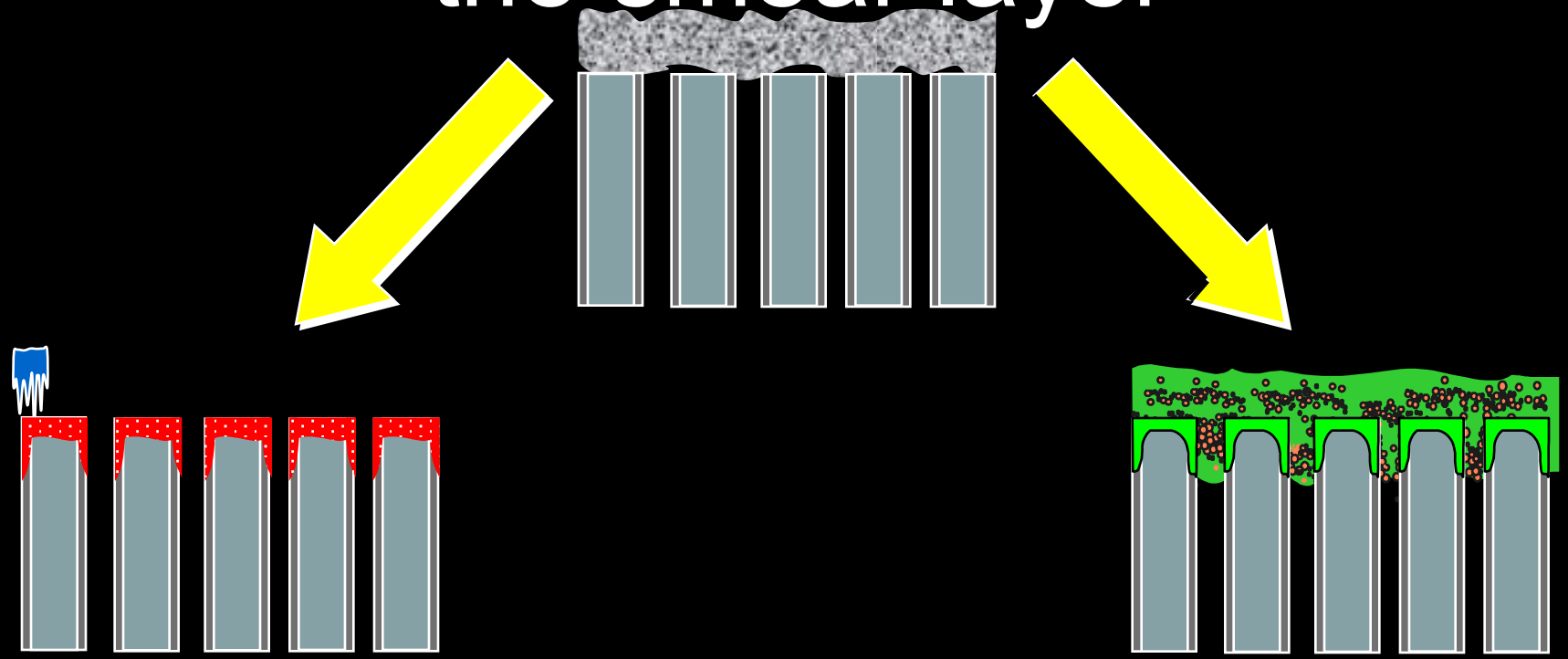
10% Water

Bonding to dentine is therefore more difficult

Why do dentists need adhesion?

- Cervical restorations
- Build up of fractured anterior and posterior teeth
- Short clinical crown for full or partial coverage restorations
- Resin retained bridges

Previous strategies to treat the smear layer



Etch & Rinse/

Total etch

Self etch/

No Rinse

….introducing

a new group of dentine bonding agents

Universal bonding agents

Treatment of the smear layer

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

Bonding agents: The first “Universal”

Scotchbond Universal Adhesive

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

Scotchbond Universal Adhesive: Composition

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

SUGGESTION

Research sows that, for Scotchbond Universal, the concept of selective enamel etching should

My guess is that this applies to all Universals

Clearfil Universal Bond: What's in it?

10-MDP
Bis-GMA
2-HEMA
Hydrophilic aliphatic dimethacrylate
Colloidal silica
Silane coupling agent
Di-Camphorquinone
Ethanol
Water

Futurabond U

Liquid 1:
BisGMA, HDDMA, UDMA, HEMA, fumed silica, CQ, 10 MDP

Liquid 2:
Ethanol, water, catalyst

pH……2.3
(i.e. selective enamel etching indicated)

A new Universal from GC: Premio Bond

4-META
10-MDP
10-Methacroyldecyl dihydrogen thiophospate
Methacrylate ester
Acetone
Distilled water
Photoinitiators
Silica fine powder

Adhese Universal (Ivoclar-Vivadent)

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

Cotene One-Coat 7 Universal
What's in it?

10-MDP
Methacrylated polyacid
2-HEMA
Urethane dimethacrylate
Photoinitiators
Ethanol
Water

No silane: does that matter?

All-Bond Universal

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

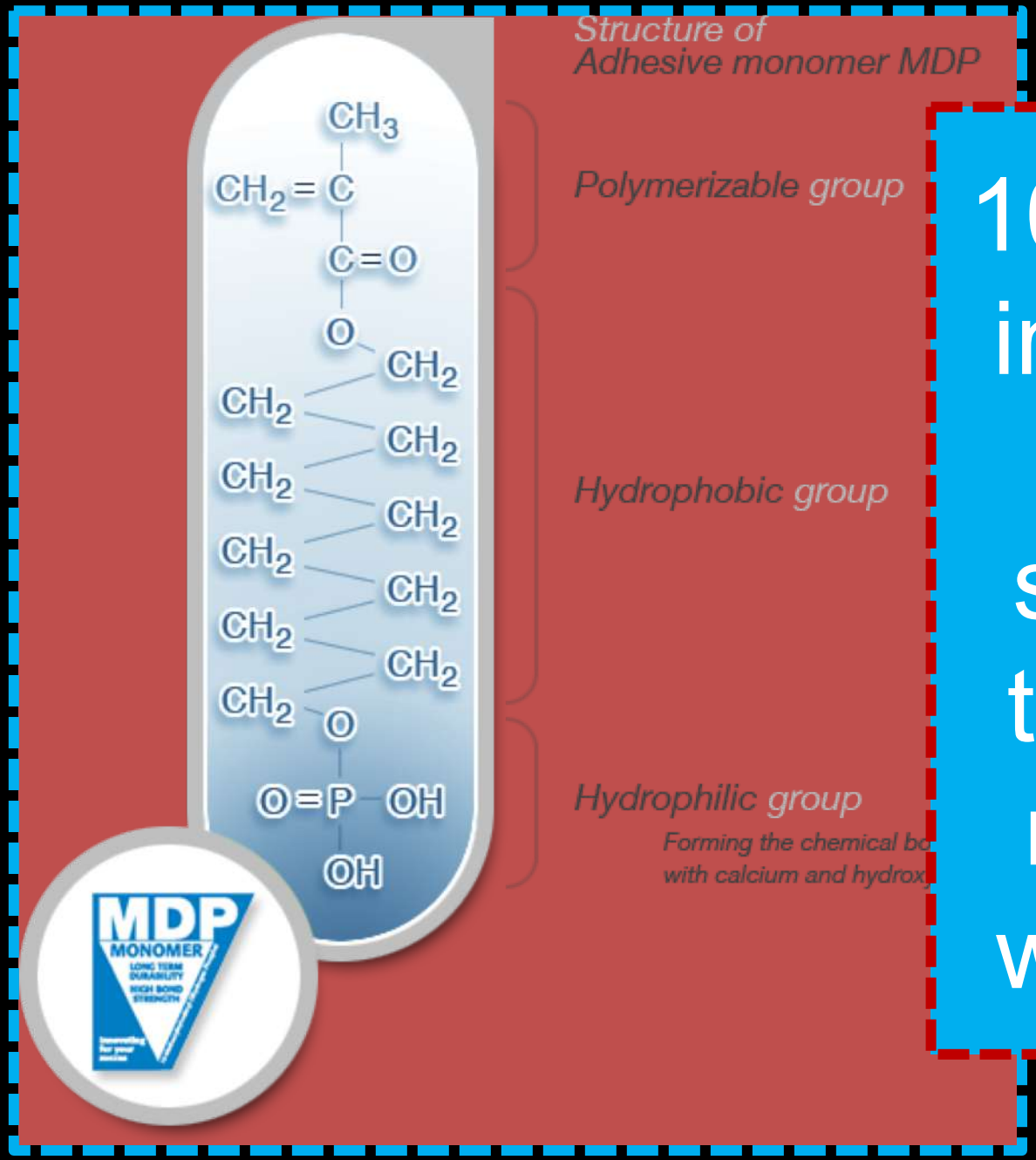
pH 3.1

A new Universal from Dentsply

What's in it?

10-MDP
PENTA
Initiator
Isopropanol
Water

pH=2.5



10-MDP is important for the status of the bond reaction with HAP

10-MDP seems to be the resin molecule of choice for bonding

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)

Can bond to different substrates

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.[1] 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.[2]

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

A dentine-bonding agent should perform the following functions:[3]

- 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[3] 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,[2] Green, Mackenzie and Banerjee[4] and others.[5,6]

A brief history of bonding to dentine

In the past, dentine-bonding agents were classified into generations.[7] 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.[8]

There are two principal means by which a bond to dentine may be achieved:[9]

- 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

Want to read more?

Rules for survival

(of restorations & teeth)

New “Universal” dentine bonding agents hold great promise.

What I plan to talk about

- Choosing a reliable material
- Choosing the “right” material
- Bonding to dentine and survival of resin composite materials, including bulk fill
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making

Dr.Steve Lucarotti

without re-attendance for i months will eventually re-attend. Then

$P(i)$ can be estimated as $P(i) = \dfrac{E_i}{\sum_{j=i+1}^{M} (N_j + R_j)}$ (1)

E_i satisfies the following recurrence relation:

$$E_i = \sum_{j=i+1}^{M} R_j + \sum_{j=i+1}^{M} P(j)N_j \quad (2)$$

Furthermore, because non-attendance for M months is regarded as indicative of eventual non-attendance

$$E_M = 0 \quad (3)$$

Equations (1), (2) and (3) can now be used recursively to calculate E_i and $P(i)$ for all values of i from M down to 0.

An algorithm was developed, using the statistical package SPSS, to calculate $P(i)$ for the total population of patients, and for a range of sub-populations, defined by such characteristics as age and sex.

Adaptation of Kaplan-Meier

The interval between successive interventions on the same tooth will now be considered. If a tooth is restored at time 0, then various standard functions can be defined concerning the probability that certain events will occur before, on, or after any subsequent time T.

Let the total number of observed tooth restoration events be N.

that the tooth will receive an intervention at time t, or strictly between t and just less than $t+1$, conditional on it not having received an earlier re-intervention.

Define $H(T) = \sum_{1}^{T} h(t)$, the Cumulative Hazard function.

By taking progressively smaller units of time $H(T)$ can be expressed as

$$H(T) = \int_{1}^{T} h(t)dt,$$

but for practical purposes it is sufficient to approximate time as composed of discrete one day units.

Standard theory[7] shows that the relationship between S and H is given by

$$S(T) = \exp(-H(T)) \quad (4)$$

The function $h(t)$ can be estimated at each value of t for which a re-intervention has occurred within the observed data.

Let there be $V(t)$ observed interventions at exactly t units of time since restoration.

If no cases have been censored, then $h(t)$ can be estimated as

$$V(t)/(N - \sum_{1}^{t-1} V(u)).$$

If the number of cases known to be censored at exactly t units of time since restoration is $C(t)$, then the Kaplan-Meier estimate of $h(t)$ is

$$V(t)/(N - \sum_{1}^{t-1} V(u) - \sum_{1}^{t-1} C(u)).$$

The denominator is the number of restored teeth 'available' for re-intervention.

Suppose now that is not known, but that $L(t,i)$ is the number of restored teeth which reached the end of the observation period at time t without

The database

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

Because of the vast size of the dataset, we can now look at the effect of the restoration on *survival of the tooth*

I can give you lots of tables & figures!

Tooth Type	Survival (%) at 1 year	5 years	10 years	15 years	n
Upper Incisor	98	91	82	74	358,959
Lower Incisor	99	94	[illegible]	[illegible]	41,233
Upper Canine	98	[illegible]	[illegible]	[illegible]	74,059
Lower C[illegible]	[illegible]	[illegible]	84	76	17,043
Upper P[illegible]	99	92	85	77	241,686
Lower Premolar	99	93	86	80	129,724
Upper Molar	99	94	88	82	138,340
Lower Molar	99	94	89	84	200,889
All Restorations	99	92	84	77	1,202,005

But I don't want you to walk out now!

First, a brief lesson in Kaplan Meier

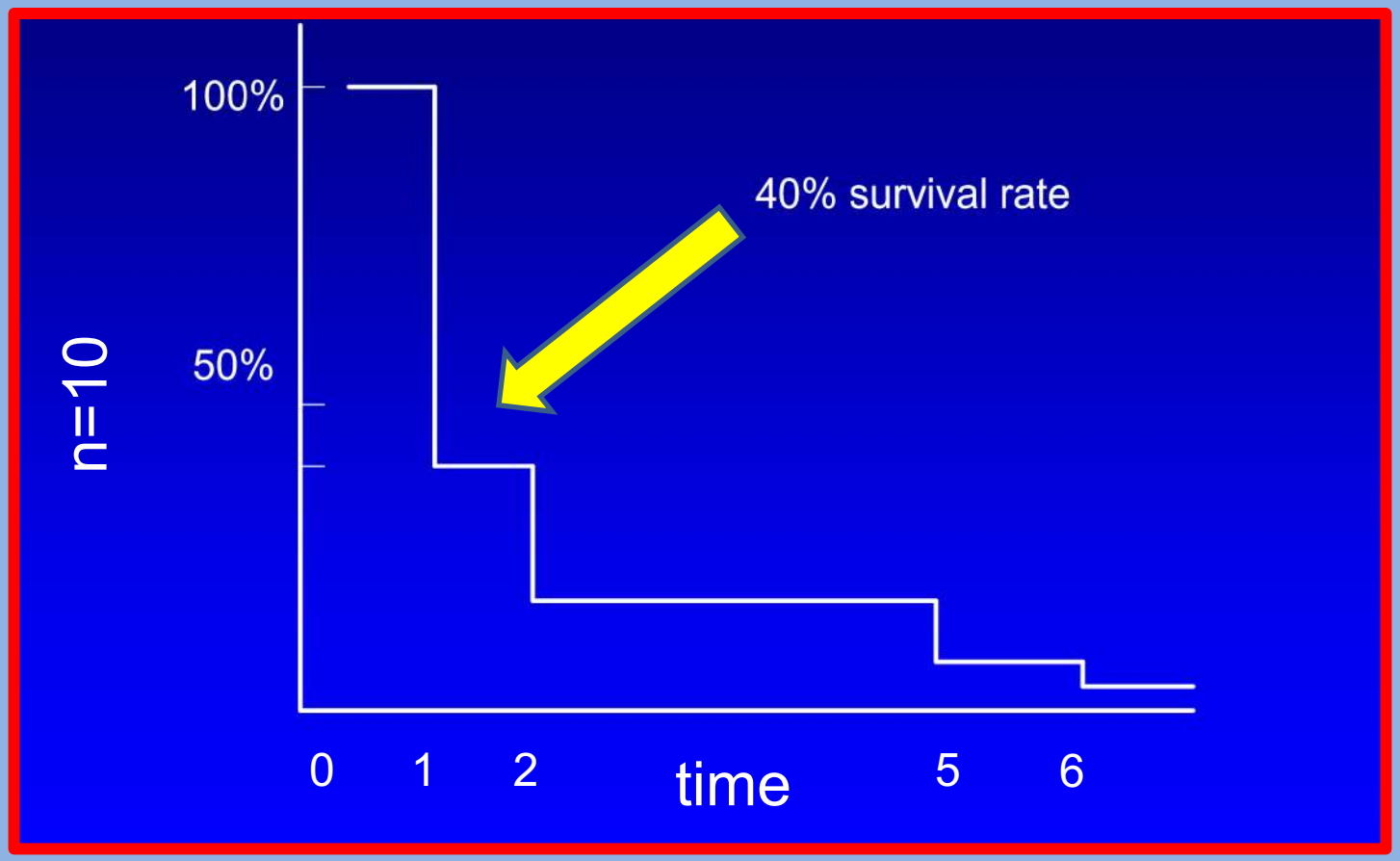
The goal is to estimate a population survival curve from a sample.
If every patient is followed until death, the curve may be estimated simply by computing the fraction surviving at each time.
However, in most studies patients tend to drop out, become lost to follow up, move away, etc.
A Kaplan-Meier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

First, a brief lesson in Kaplan Meier

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

n=10 hypothetically

Kaplan Meier



Vertical axis represents estimated probability of survival for a hypothetical cohort, not actual % surviving.

Direct placement restorations: amalgam

7,425,049 amalgam cases included, of which 2,537,331, of which had a re-intervention

Rules for survival

This is only possible with adhesive dentistry

(of restorations & teeth)

Size matters – big fillings last less well than small.
Keeping fillings as small as possible is therefore important.

…a few more words on amalgam

IN BRIEF

- One hundred and eighty dental surgeries were tested for environmental mercury.
- Sixty eight per cent had environmental mercury readings over the occupational exposure standard.
- Greater emphasis is needed in the safe handling of mercury.
- Dentists were more likely to have suffered a kidney disorder than the control group.

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

K. A. Ritchie,[1] F. J. T. Burke,[2] W. H. Gilmour,[3] E. B. Macdonald,[4] I. M. Dale,[5] R. M. Hamilton,[6] D. A. McGowan,[7] V. Binnie,[8] D. Collington[9] and R. Hammersley[10]

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

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

Methods Dentists were asked to complete a questionnaire including items on handling of amalgam, symptoms experienced, diet and possible influences on psychomotor function such as levels of stress

significantly associated with their level of mercury exposure as measured in urine. One hundred and twenty two (67.8%) of the 180 surgeries visited had environmental mercury measurements in one or more areas above the Occupational Exposure Standard (OES) set by the Health and Safety Executive. In the majority of these surgeries the high levels of mercury were found at the skirting and around the base of the dental chair. In 45 surgeries (25%) the personal dosimetry measurement (ie in the breathing zone of dental staff) was above the OES.

- 122 surgeries had mercury levels higher than the Occupational Exposure Standard
- In 45 surgeries the personal dosimeter measurement was above the OES
- Dentists were 4 times more likely to have kidney disease
- Urinary mercury levels of dentists were 4 times greater than controls
- Dentists' reported short-term memory worse than controls

CONCLUSIONS

- Dentists short-term memory worse than controls
- Periodic health surveillance of DHCWs indicated
- Kidney disorders not correlated with surgery Hg vapour levels
- Safer handling of amalgam needed
- Further studies indicated on all members of the dental team

Contemporary UK dental practice 2015/16: Comparison with previous results: premolars Br.Dent.J.2018

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

Rules for survival

(of restorations & teeth)

Amalgam has maintained dental public health in the developed world for 125 years, but its days are numbered

And, don’t forget that patients seem to like tooth-coloured restorations in their back teeth!

Burke FJT.
Dent.Update.1989:16.114-116

Are success rates for posterior composite as good as for amalgam?

Some studies from general dental practice

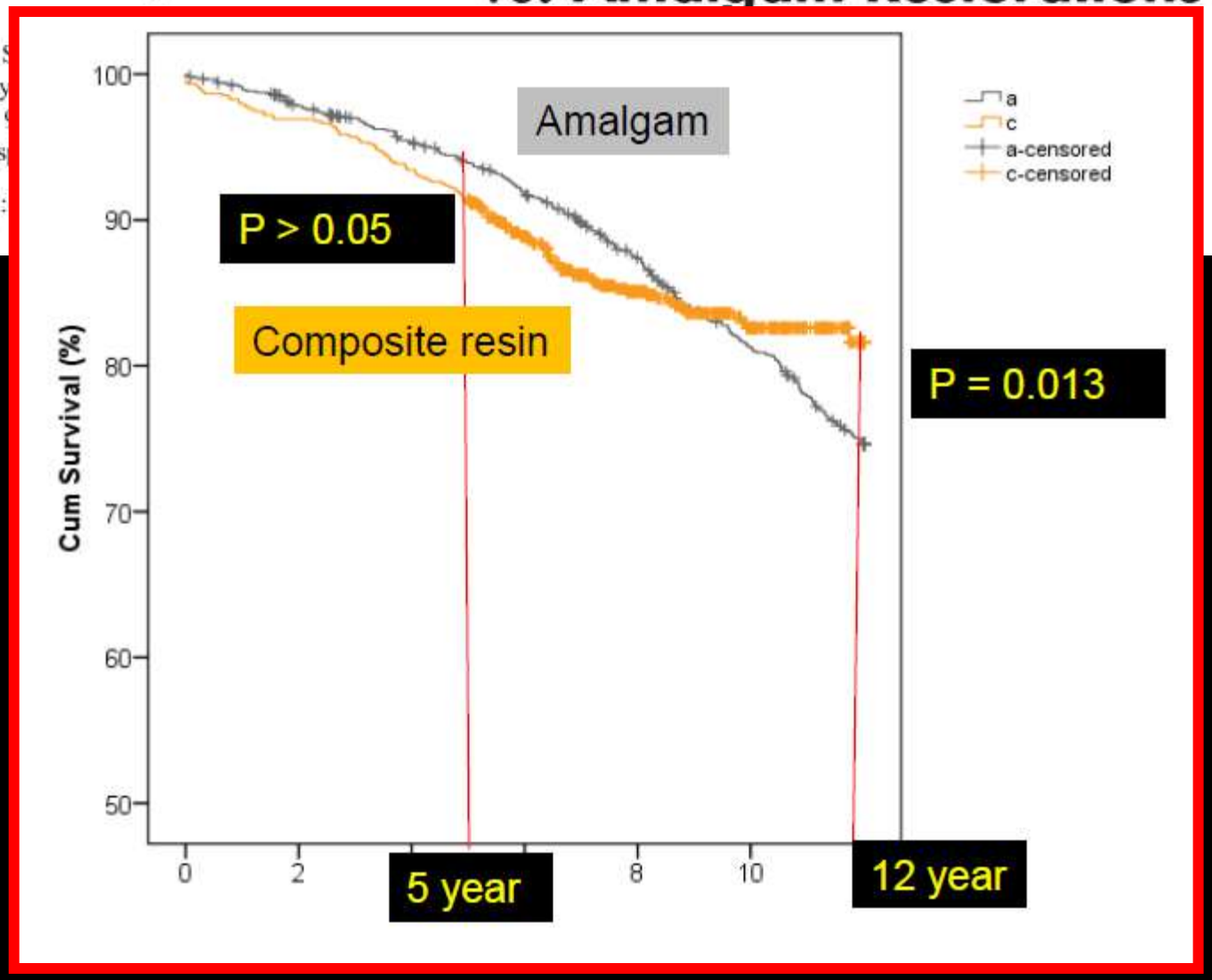
RESEARCH REPORTS
Biomaterials & Bioengineering

N.J.M. Opdam*, E.M. Bronkhorst,
B.A.C. Loomans,
and M.-C.D.N.J.M. Huysmans

College of Dental S
Restorative Dentistry
Centre, PO Box
Netherlands; *corres

J Dent Res 89(10):

12-year Survival of Composite *vs.* Amalgam Restorations



22 year retrospective evaluation of posterior composites

DENTAL MATERIALS 27 (2011) 955–963

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.intl.elsevierhealth.com/journals/dema

ELSEVIER

dental materials

22-Year clinical evaluation of the performance of two posterior composites with different filler characteristics

Paulo A. Da Rosa Rodolpho[a], Tiago A. Donassollo[b], Maximiliano S. Cenci[b], Alessandro D. Loguércio[c], Rafael R. Moraes[b], Ewald M. Bronkhorst[d], Niek J.M. Opdam[d], Flávio F. Demarco[b,*]

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[d] Department of Restorative and Preventive Dentistry, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands

- Retrospective, practice-based design
- 80 adult patients selected (from 980) – continuous attenders for 22 years, invited to attend for examination: 19 declined
- The remaining patients had 362 restorations
- Full dentition and normal occlusion
- Examined by 2 independent examiners using USPHS criteria

22 year retrospective evaluation of posterior composites

- 📖 All cavities lined with Ketac Fil
- 📖 Two materials: P50 (3M) and Herculite (Kerr)

Restorations in premolatrs survive better!!

Overall failure was *circa* 2% per annum

8 year evidence from dental practice

Pallesen U et al. J.Dent.2013:41:297-306

- Dentists undertook a course on posterior composite placement
- Exclusion criteria were deep subgingival margins and inability to isolate
- Cavity outline determined by caries lesion
- Isolation with cotton rolls and suction
- Etch & rinse bonding agent, 2mm oblique increments of composite

8 year evidence from dental practice

- 2881 children, mean age 13.7years
- 4335 restorations placed by 115 dentists
- 49% of cavities were class I
- 3507 in molars
- Spectrum APH used for 88%, bonding agent Prime & Bond used for 94%

Overall failure rate: 2% failure per annum

Demarco FF et al. Dent.Mater:2012:28:87-101

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”.

Laske M et al.J.Dent.2016:46:12-17.

Electronic patient files from 24 dental practices

358,548 restorations in 75,556 patients, 67 gdps

AFR varied between 2.3% and 7.9%, mean 4.6% @10 years

Restorations in molars had higher AFR

AFR of composites was 4.4%, amalgam 5.1%, and GI 11.1%

- 10 year failure rate was 3.8%, but varied between practices (2% to 5%)
- Composite showed higher survival than amalgam
- Age of patient, gender, number of surfaces, operator, tooth type and endodontically treated teeth significantly influenced survival.

….finally

The ultimate evidence

Opdam N. et al. Longevity of posterior composite restorations: Systematic review and meta-analysis. J.Dent.Res.2013:41:297-306.

1,551 papers identified
25 met inclusion criteria
12 authors agreed to provide raw data
A total of 2,816 restorations included,
of which 569 had failed.

Conclusions

Short term studies are of limited relevance for clinical durability as most acceptable materials remain failure free in the first years

Restorations in premolars do better than those in molars

Caries risk plays a dominant role in restoration survival.

Liner or base in Glass Ionomer had negative effect on survival .
Overall, AFR of 1.8% at 5 years and 2.4% at 10 years

Are success rates for posterior composite as good as for amalgam?

YES – and we aren't even comparing composite in its best situation

Time taken for posterior composites =X2.5 time for amalgam

Burke F.J.T.

Attitudes to posterior composite filling materials: A survey of 80 patients.

Dent. Update. 1989:16:114-120.

DENTAL MATERIALS

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[1] in 1963. First reports of the use of such materials for restorations in load-bearing situations in posterior teeth were favourable,[2] but later reports[3-5] 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.[6]

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,[7] 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.[8] 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.[9-11] From further studies, it can be seen that Occlusin restorations performed their intended purpose satisfactorily for periods of at least five years.[12]

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,[13] alongside the realization that incremental curing is necessary to prevent cuspal movement,[14-16] 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.[17] 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.[17]

PATIENT AWARENESS OF DENTAL AESTHETICS

Patient concern about appearance may be more important than health concerns,[18] and attractive persons may be considered more qualified and reliable than their unattractive peers.[19,20] Moreover, the appearance of a patient's teeth has been shown not only to have an effect on that patient's self-esteem,[21] but also to change that person's social attractiveness when judged by their peers and others.[22-24] 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.*

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

The Class I molar composite restoration required 35% more time than the amalgam

Time required for placement of composite vs amalgam restorations

Dilley DC, Vann WF et al

J.Dent.Child 1990:May-June:177-181

Rules for survival

Perhaps the new bulk fill materials are the answer?

Longevity of posterior composite restorations is at least as good as amalgam, but they take longer to place

BULK FILL IS IN!

My new classification for **BULK FILL** materials:

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

BULK FILL RESTORATIVE MATERIALS
(satisfactory wear resistance)

BULK

Bulk fill base materials needed a topping because their wear resistance wasn't good enough

So, the bulk fill base materials are now history!

BULK FILL IS IN!

My new classification for **BULK FILL** materials:

BULK FILL RESTORATIVE MATERIALS
(satisfactory wear resistance)
which don't need a topping

Bulk fill (with no topping)

Sonic Fill (Kerr)

Viscosity change when sonic energy applied

More are appearing: For example…

Aura Bulk Fill (SDI)

VOCO Admira Fusion x-tra

NEW! BEAUTIFIL-Bulk Restorative

Beautifil-Bulk Restorative is a conventional packable composite resin indicated for direct posterior restorations including the occlusal surfaces. It has excellent condensability and sculptability as well as shade stability before and after light curing. Fully polymerized at 4mm depth of cure, Beautifil-Bulk Restorative has a high fill ratio at 87.0wt%, and low shrinkage stress.

- Complete polymerization at 4mm depth of cure
- Low shrinkage (1.7%) and shrinkage stress (1.06 MPa)
- Optimum translucency creates esthetic shades unaffected by surrounding intraoral color
- Fluoride release and rechargability
- Strong and radiopaque
- Excellent condensability and sculptability optimal for posterior restorations
- Shade stability before and after light-curing
- High Vickers Hardness Value (61), flexural strength (114 Mpa) and flexural modulus (11.4 Gpa)

Advantages of Bulk Fill *Restorative* materials

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

How do manufacturers do it?

For some:
More potent/efficient initiator systems

For all:
Increasing the translucency of the filler

For some: improved resin systems

Rules for survival

(of restorations & teeth)

Perhaps the new bulk fill materials are the answer for restorations in back teeth, at least in the medium term

General Rules for survival (of restorations & teeth)

Placing a dentine pin reduces the life of the filling and the tooth, but a confounding factor could be that the restoration may be large. The same applies to root fillings.

The effect of root filling on survival of the tooth

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

See Kidd E et al. Infected dentine revisited. Dent.Update:2015:42:802-809.

The effect of patient treatment volume/need on survival of the tooth

Be careful what you promise to a patient with history of high treatment need!

Future treatment need is closely correlated with past treatment need

The effect of patient age on survival of restorations

Be careful what you promise when restoring teeth for older patients

Restorations in older patients perform less well than those in younger patients

The effect of patient age on survival of restored teeth

Again, be careful what you promise when restoring teeth for older patients, and, plan for failure

The effect is even more dramatic when time to extraction is measured!

The effect of patient age on survival of restored teeth

- Younger patients' teeth are less likely to be weakened by previous restorations.
- Younger patients will potentially be more dextrous than older patients when it comes to oral healthcare maintenance
- Younger patients may be less likely to be on the multiple medications, with some of these potentially reducing salivary flow
- Some teeth may be lost in older patients because of periodontal disease: the dataset is unable to ascertain the reason for loss of a tooth

Is survival of teeth and restorations improving?

One would expect that improvements in materials and bonding agents would have a positive effect, but it has not!

Survival of composite restorations to reintervention in relation to year of placement

Glass Ionomer Restoration Survival Overall

1,598,698 glass ionomer restorations included, of which 689,532 had a re-intervention over the duration of the dataset.

Kaplan-Meier analysis indicated that 28% had survived without reintervention at 15 years.

We think that clinicians place GIs in teeth of suboptimal prognosis, almost as temporary restorations

Rules for survival

Whichever way we look, Glass Ionomer restorations perform less well than any other restoration type

Therefore use in compromise situations where you need adhesion but not strength

Molar teeth

Rules for survival

(of restorations & teeth)

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

Rules for survival

(of restorations & teeth)

In general, keeping an incisor tooth going with a direct placement filling is a a better option than reducing a tooth for a crown. The same applies to tooth wear cases.

Results from the old database for veneers

- Data on 2,562 porcelain veneers, placed for 1,177 adult patients (18 years or older) between 1991 and 2002

Survival without re-intervention:

- 89% at 1 year
- 67% at 5 years
- 53% at 10 years

Is this good enough for an elective restoration?

Conclusions

- 53% of porcelain veneers were present without re-intervention at ten years
- Veneers placed in male patients had less time to re-intervention than those in female patients
- Patients with high annual treatment, & those exempt from charges were associated with shorter time to re-intervention
- When re-intervention occurs, the most common is a direct restoration, replacement veneer or crown

Burke FJT, Lucarotti PSK. Ten-year outcome of porcelain laminate veneers placed within the General Dental Services in England and Wales. J.Dent.2009:37: 31-38.

Now, to some degree, I’m eating my hat!

Thomas Brydges’ Homer Travestie, 1797

For though we tumble down the wall,
And fire their rotten boats and all,
I’ll eat my hat, if Jove don’t stop us,
Or play some queer rogue’s trick to stop us.

Charles Dickens, the Pickwick Papers, 1837

If I knew as little of life as that, I’d eat my hat and swallow the buckle whole!

Rules for survival

(of restorations & teeth)

Longevity of veneers is poor, but,
the life of the tooth is not compromised

Premolar teeth, 3,591,372 restorations

Broadly similar to molars in terms of survival of restorations, including crowns

No differences in time to survival, but lower premolars perform better in terms of time to extraction

Premolar teeth: the effect of MODs

MOD restorations in premolars don’t do well, no matter how you look!
Therefore..

Avoid cusp fracture by……..

Rules for survival

(of restorations & teeth)

Crowning a premolar tooth leads to a reduced lifespan of the crowned tooth, in all age groups other than the over-60s. MOD restorations perform badly.

Canine teeth:1,232,041 restorations

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

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

Canine teeth: effect of root fillings

Root fillings in upper canine teeth perform worse than in any other tooth!

Root fillings

Tooth type	
Incisors	69%
Canines	61%
Premolars	71%
Molars	70%

WHY?

Canine teeth: effect of crowning

Crowns

Tooth type	
Incisors	75%
Canines	66%
Premolars	78%
Molars	83%

Crowns in canine teeth perform worse than in any other tooth (time to extraction)

Rules for survival

Rules for survival

(of restorations & tooth)

Crowning a canine tooth leads to a reduced lifespan of the crowned tooth.
Root fillings perform worse than for any other tooth.
Patients must be told!

Summary:

Drilling isn’t great for teeth!

Implants – will they be found out?

Ashbjorn Jokstad

0088 IADR Cape Town

- 364 dental implant manufacturers in 2014
- 254 have no clinical trials
- 110 have no documentation

Is this sustainable?

New words in the dental dictionary

Sims and Chapple 2012

Peri-implant mucositis: Reversible inflammatory process in the soft tissue surrounding a functional implant

Peri-implantitis: Inflammatory process additionally characterised by loss of peri-implant bone. Bleeding with bone loss.

A new word in the dental dictionary!

1 in 5 implants placed today will lose bone! P Weston

By kind permission of Paul Weston

Incidence

Mir-Mari (2012)
9.1% of implants with peri-implantitis
Implant in service 6.0 years (+/-3.9)

Systematic review:
10% of implants and 20% of patients affected (Montelli, 2012)

Jan Lindhe's view

Br.Dent.J. 2014:217:396-397

INTERVIEW

'THERE IS AN OVERUSE OF IMPLANTS IN THE WORLD AND AN UNDERUSE OF TEETH AS TARGETS FOR TREATMENT'

Professor Jan Lindhe is an emeritus professor at the University of Gothenburg, where he was previously Chair of Periodontics and Dean of the School of Dentistry. Lindhe graduated from the Royal School of Dentistry in Malmö, Sweden. He is now one of the world's most renowned researchers in periodontology and is well known for his book *Clinical periodontology and implant dentistry* as well as hundreds of other publications. Jan Lindhe acted as editor of the *Journal of Clinical Periodontology* for over 30 years and continues to contribute to scientific debate and research.

Research has linked periodontal disease to countless systemic illnesses. Is this the best way to stress the significance of good periodontal health to the public?

I believe there is some sort of association between periodontal disease and some general systemic conditions,

'We try to manage infections all over the body, why should we ignore them in the oral cavity?'

than a physician, but the responsibility should not be with the dentist to diagnose diabetes or other inflammatory diseases. On the other hand, communication between the dentist and patient is often very open and consequently if the dentist suspects something is wrong, they may recommend their patient see a physician

suspected a long time ago and there was indirect proof that this was the case. During the last 50 years it has been documented that if we don't allow bacteria to form plaque/biofilm on teeth, then gingival inflammation does not develop. In addition, if patients with advanced periodontal disease have their teeth cleaned and

Setzer FC, Kim S. J.Dent.Res.2014.93:19-26

A missing tooth is irreversibly gone and a tooth should only be removed after worthwhile deliberation

There is no lifetime guarantee for either a natural tooth or an implant

Implants

Will patients wise up?

Not while there are dentists around who are only in it for the money

Reasons to adopt minimal intervention

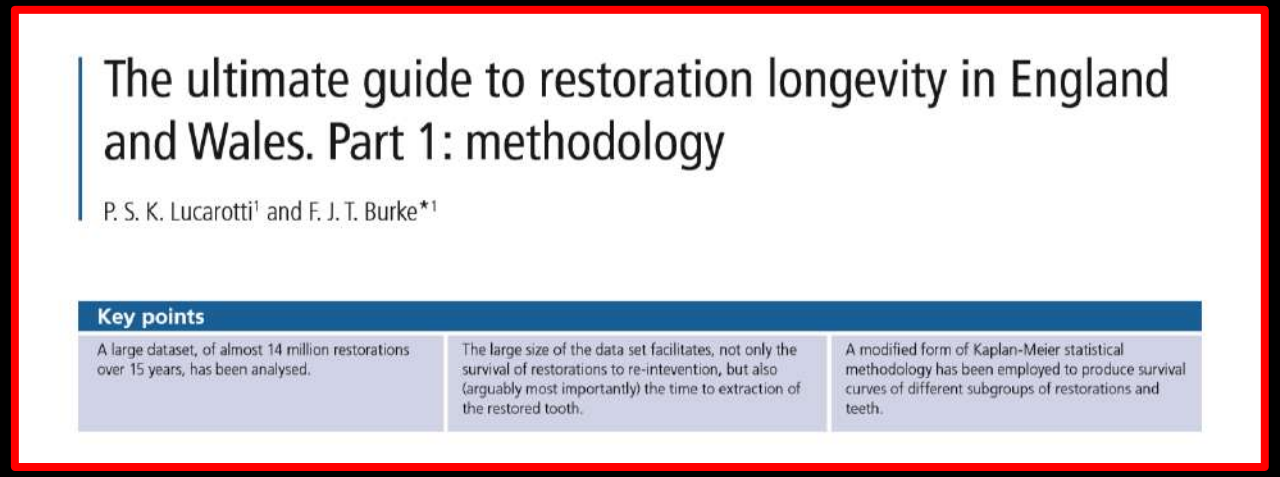
- Patients like it (if you advise them of your philosophy)
- Teeth like it (fewer die!)
- It's easier for dentists (fewer die: better for their blood pressure!)
- Lawyers hate it (fewer dentists sued!)
- We now have the materials to make this work

“The day is surely coming when we will be practising preventive rather than reparative dentistry”

G.V.Black, 1896

If you want to read it rather than listen to it…

BDJ 2018



The ultimate guide to restoration longevity in England and Wales. Part 1: methodology

P. S. K. Lucarotti[1] and F. J. T. Burke*[1]

Key points

A large dataset, of almost 14 million restorations over 15 years, has been analysed.

The large size of the data set facilitates, not only the survival of restorations to re-intevention, but also (arguably most importantly) the time to extraction of the restored tooth.

A modified form of Kaplan-Meier statistical methodology has been employed to produce survival curves of different subgroups of restorations and teeth.

And, another nine

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0044 121 466 5476

Handout also
available at:
www.fjtburke.com