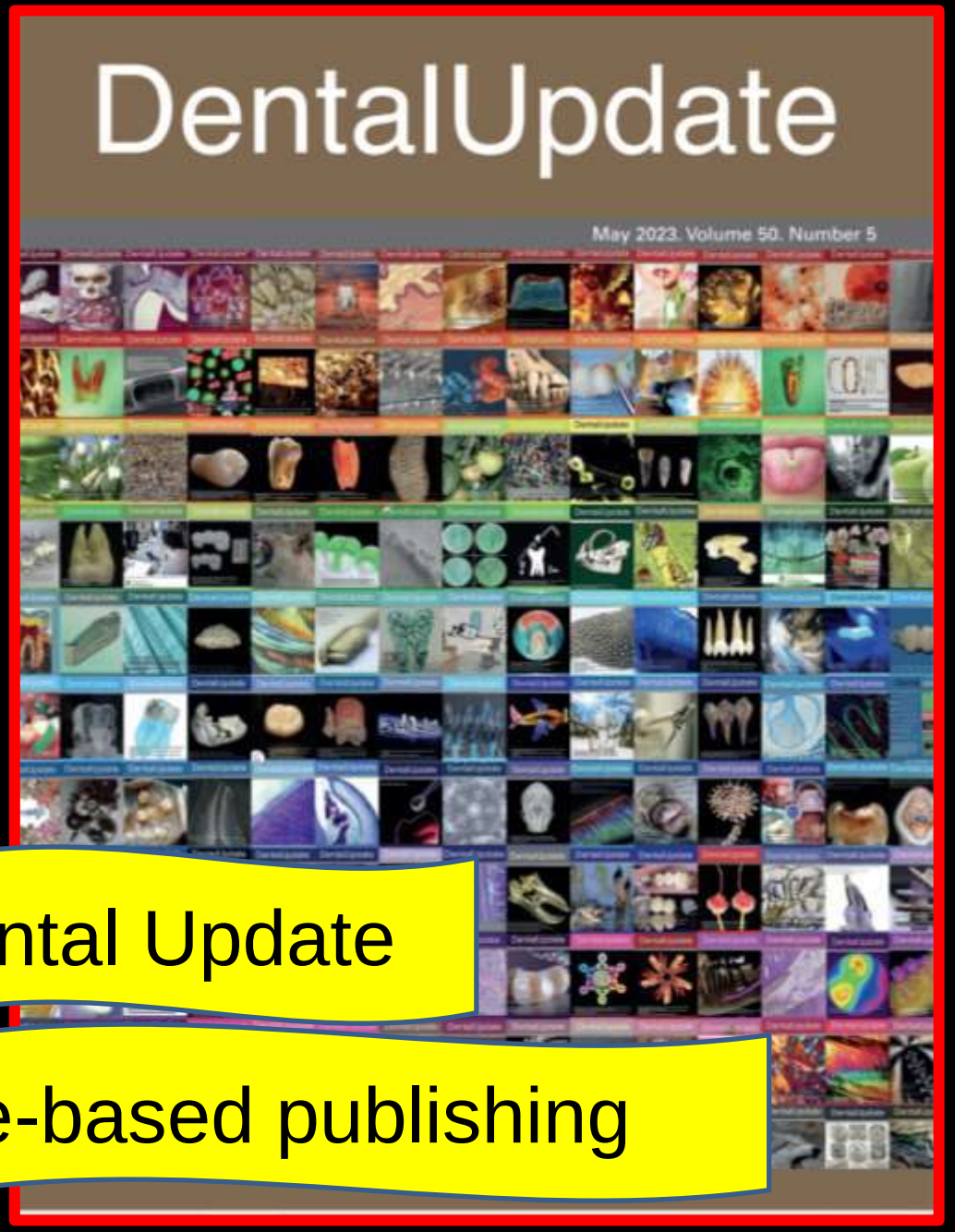
# Survival of the fittest

AKA

# Measuring restoration longevity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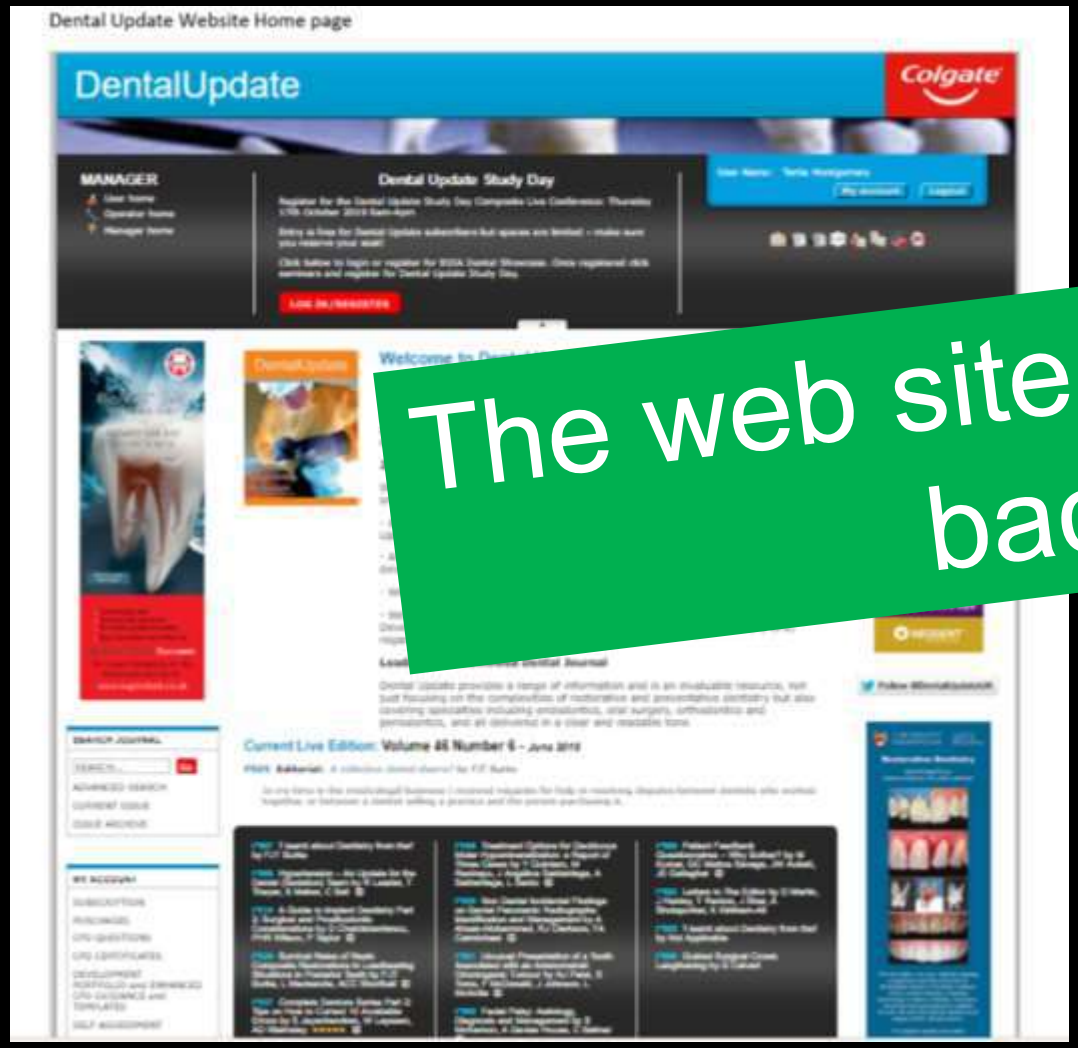
50 years of evidence-based publishing

# www.dental-update.co.uk





The web site has articles dating back to 1999

Disclosures

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

"I will discuss materials, devices and techniques that I have used, but there may be others that are better"

Some manufacturers fund my research"

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

# What I plan to talk about

- Sustainability and dental restorations
- History of restoration survival research in the UK
- Factors influencing restoration survival (dentists, patients, materials)
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making
- Survival of restorations in the dental literature

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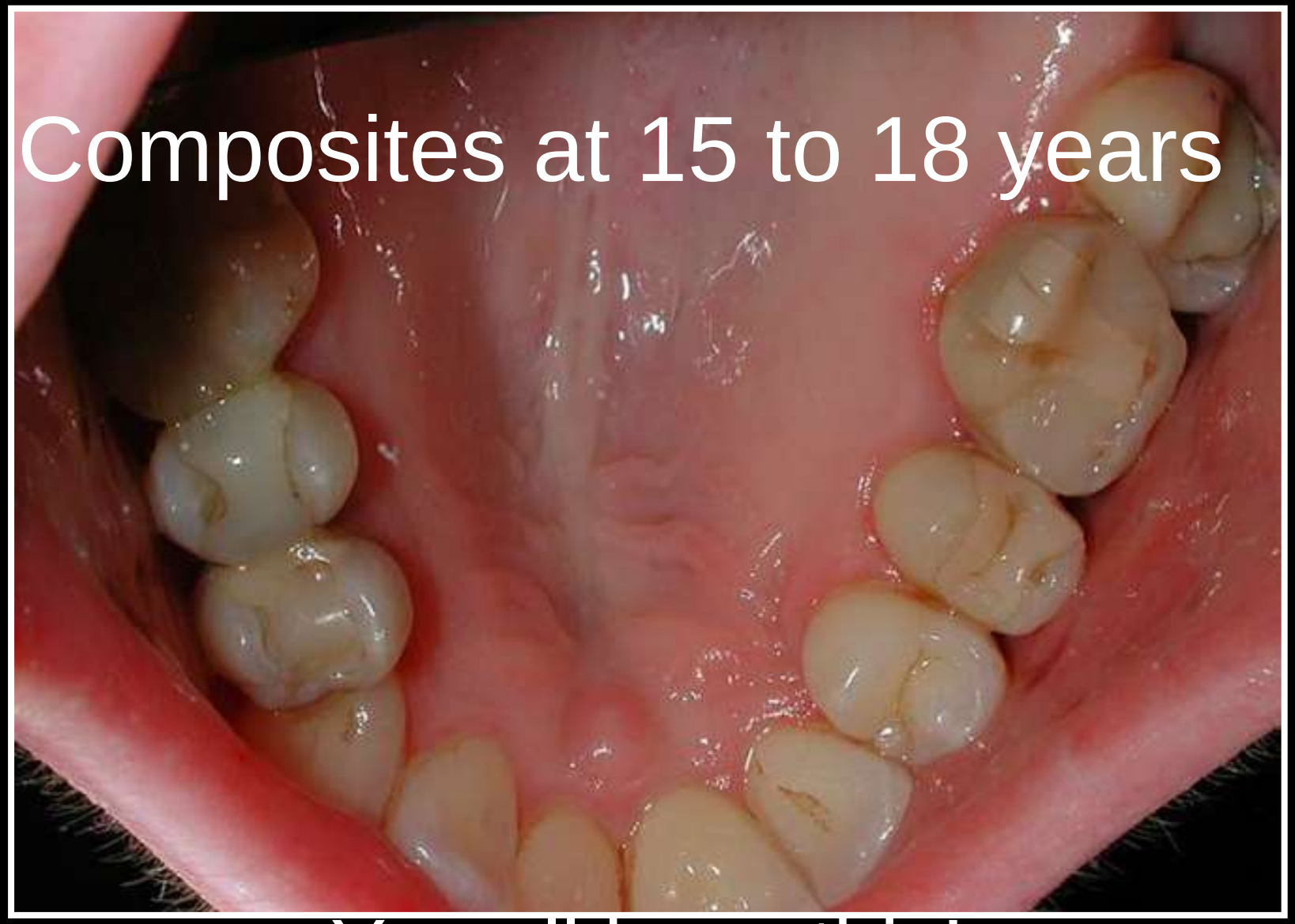
- Factors influencing restoration survival (dentists, patients, materials)
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making
- Survival of restorations in the dental literature

# Survival of the fittest: Measuring restoration longevity: This is how I used to do it




You all have this!

Personal evidence

# More personal evidence

# Why is restoration longevity important?

- Managing patient expectations (or not)
- Clinical Governance
- Third party funders want to know if they are getting value for money
- In the past, Government wanted to know!
- Avoidance of adverse medicolegal situations
- Dentists might want to audit their performance
- Keeping faith in the profession

…plus – good restoration survival enhances sustainability in dentistry

# Sustainability has interested me for some time!

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COMMENT

## A Green Issue?



Readers could be forgiven, on reading the above title and on noting the colour of the cover of this issue, that the Editorial Director was about to extol the beauty of the Lakes of Killarney or the Glens of Antrim, especially with St. Patrick's Day approaching. This is not the case, instead, it is the 'green' environmental issues relating to dental practice which this Comment will briefly address. When the effect of dentistry on the environment is considered, the discussions often commence with the use of amalgam; such discussions will probably continue for many years to come, and, while there is sufficient evidence to demonstrate that its use is safe for the patient[1], there is little question that the environment suffers if quantities of amalgam or mercury are discharged with the dental surgery effluent. The proper handling of scrap amalgam by recycling is also essential. The amalgam issue gets much publicity and can be emotive, but there are other matters which may be just as deserving of the profession's attention. The matter of the rubber 'mountain', for example. We use a lot of rubber in the dental surgery and the use of gloves by dental healthcare workers during patient treatment in the dental surgery has, rightly, been advised by many authorities, worldwide.[2] However, the matter of biodegradability of used latex gloves has been little discussed. Another rubber, polyvinylsiloxane, is also used in large quantities as an impression material in crown and bridge work. Its introduction was initially because of its good dimensional stability and, indeed, the stability of these materials is such that they do not easily degrade. Their use has increased further since it was considered essential to disinfect impression materials prior to handling by technicians, and again it was their stability under conditions of disinfection that made them popular. Perhaps a shift towards hydrocolloid would be more environmentally friendly, but perhaps the optimum environmental approach might be the use of CAD-CAM techniques which are becoming increasingly sophisticated and reliable. Our rubber impressions are not biodegradable; neither are the dies and casts constructed from them, but at least the large numbers of casts once examined at the Dental Practice Board (as illustrated in the cover photograph) could be used as hardcore in the building industry!

Infection control has, rightly, been the catalyst for the increasing use of disposable, single-patient-use items to replace those which are difficult or costly to autoclave. This has resulted in ever more voluminous bags of dental surgery waste which are disposed of by incineration. The plastics from which these disposable items and devices are manufactured may produce toxic fumes when incinerated, another matter which requires consideration. Dental practices may also generate substantial amounts of paper,[3] as paper towels and wrappings for instruments, let alone office activities, and consideration should be given to its recycling. There is also the matter of the disposal of chemicals used in the developing of radiographs. It is unacceptable to dispose of these through the sewerage system. Again, there is an environmentally friendly answer, digital radiography. However, while the techniques of digital radiography and CAD-CAM are potentially more 'green' than their traditional counterparts, they require capital expenditure and are therefore, in 1998, not available to all dental practices. It is hoped that, in due course, these techniques may become increasingly competitive in terms of real cost, to match their reduced cost to the environment. Green issues must be addressed in the dental surgery. Practitioners and manufacturers can help by becoming more environmentally aware, while those who fund dental treatment should realise that there may be a price to pay in monetary terms for a better environment. Happy St. Patrick's Day!

F. J. Trevor Burke

References
1. Burke FJT, Wilson NHF, Martin MV, Field EA. Barrier techniques for protection of dental workers and patients. Dent Update 1997; 24: Infection Control Supplement 3.
2. British Dental Association. BDA Fact File: Amalgam Safety. London: British Dental Association, Nov. 1996.
3. Farr PL, McGill SLL. How much waste do dentists generate? Canad Dent Assoc 1989; 57: 39-40.

Dental Update 1998

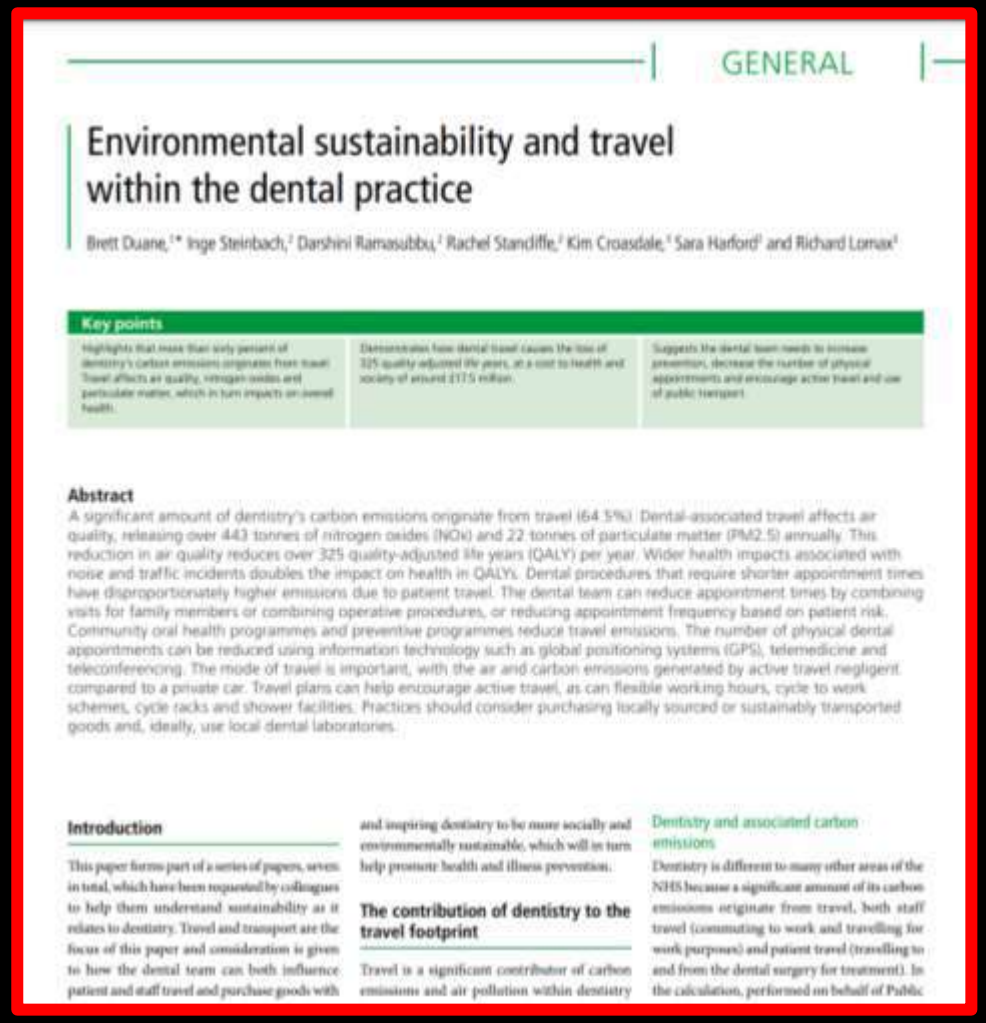
- Amalgam
- Poor biodegradability of latex gloves
- Ditto polyvinylsiloxane
- Disposable single-use items used in the surgery
- Bags of dental surgery waste
- Chemicals used in developing radiographs
- Paper

# Practice Environmental Audit

- Waste avoidance
- Awareness of new and alternative processes and products, including their composition and method of disposal
- Staff training in environmental matters
- Energy management and saving
- Water management and saving

*circa* 1997

# Now, thanks to recent work, we have a better understanding of sustainability



GENERAL

## Environmental sustainability and travel within the dental practice

Brett Duane,[1]* Inge Steinbach,[2] Darshini Ramasubbu,[2] Rachel Standiffe,[2] Kim Croasdale,[3] Sara Harford[3] and Richard Lomax[3]

**Key points**

Highlights that more than sixty percent of dentistry's carbon emissions originates from travel. Travel affects air quality, nitrogen oxides and particulate matter, which in turn impacts on overall health.

Demonstrates how dental travel causes the loss of 325 quality adjusted life years, at a cost to health and society of around £17.5 million.

Suggests the dental team needs to increase prevention, decrease the number of physical appointments and encourage active travel and use of public transport.

**Abstract**

A significant amount of dentistry's carbon emissions originate from travel (64.5%). Dental-associated travel affects air quality, releasing over 443 tonnes of nitrogen oxides (NOx) and 22 tonnes of particulate matter (PM2.5) annually. This reduction in air quality reduces over 325 quality-adjusted life years (QALY) per year. Wider health impacts associated with noise and traffic incidents doubles the impact on health in QALYs. Dental procedures that require shorter appointment times have disproportionately higher emissions due to patient travel. The dental team can reduce appointment times by combining visits for family members or combining operative procedures, or reducing appointment frequency based on patient risk. Community oral health programmes and preventive programmes reduce travel emissions. The number of physical dental appointments can be reduced using information technology such as global positioning systems (GPS), telemedicine and teleconferencing. The mode of travel is important, with the air and carbon emissions generated by active travel negligent compared to a private car. Travel plans can help encourage active travel, as can flexible working hours, cycle to work schemes, cycle racks and shower facilities. Practices should consider purchasing locally sourced or sustainably transported goods and, ideally, use local dental laboratories.

**Introduction**

This paper forms part of a series of papers, seven in total, which have been requested by colleagues to help them understand sustainability as it relates to dentistry. Travel and transport are the focus of this paper and consideration is given to how the dental team can both influence patient and staff travel and purchase goods with and inspiring dentistry to be more socially and environmentally sustainable, which will in turn help promote health and illness prevention.

**The contribution of dentistry to the travel footprint**

Travel is a significant contributor of carbon emissions and air pollution within dentistry

Dentistry and associated carbon emissions

Dentistry is different to many other areas of the NHS because a significant amount of its carbon emissions originate from travel, both staff travel (commuting to work and travelling for work purposes) and patient travel (travelling to and from the dental surgery for treatment). In the calculation, performed on behalf of Public

- Patients usually come by car
- NHS accounts for 3.5% of all UK road traffic
- Dentistry responsible for 8% of all NHS travel
- Significant amount of carbon emissions come from (staff & patient) travel
- Short procedures have a disproportionally higher carbon emissions rate

# Now, thanks to recent work, we have a better understanding of sustainability

GENERAL

## Environmentally sustainable dentistry: energy use within the dental practice

Brett Duane,[1]* Sara Harford,[2] Inge Steinbach,[2] Rachel Stancliffe,[2] James Swan,[1] Richard Lomax,[2] Eleni Pasdeki-Clewer[3] and Darshini Ramasubbu[2]

**Key points**

Highlights that one seventh of the carbon footprint in dentistry comes from the way the profession uses energy

Suggests the dental team should consider renewable energy for their electricity

Suggests there are financial and sustainable savings to be made from the use of efficient heating systems, lighting, appropriate insulation and by regulating the use of larger appliances

This paper forms part of a series of papers, seven in total, which have been requested by a number of colleagues to help them understand sustainability as it relates to dentistry. This paper focuses on energy and how the dental team can influence the amount and type of energy it uses, in order to become more sustainable. It is the authors' hope that this series of papers stimulates interest, debate and discussion and that, as well as being economically responsible, ultimately motivates and inspires dental practices to be more socially and environmentally sustainable, which will in turn help promote health and illness prevention.

### Introduction

In 2014–2015, energy contributed 15.3% of the carbon emissions to the dental NHS England carbon footprint, which equates to approximately one seventh of all carbon emissions from NHS dentistry.[1] This is broadly similar to the Fife, Scotland carbon footprint study, where it was 18.3%.[2] Unexpectedly, the study in Fife showed that the older clinics generated lower carbon footprints than newer clinics; the reason for this being that the older clinics were smaller, with no air conditioning and fewer meeting rooms.[2] Based on this study, practitioners should not assume new buildings to be more energy efficient.

There are a number of ways practices can reduce both their costs and carbon emissions associated with energy. This paper will focus on the following elements: buying green energy, generating their practice's own energy, evaluating how the practice heats its building and water, and using space more effectively. Some practices lease their space while others own it. Depending on the specific arrangement, some changes suggested below will require cooperation from the building owner.

### Choosing sustainable energy

Dental practices usually use two sources of energy; energy for heating water and energy for heating the building. Most practices will use natural gas to heat the building. At the time of writing, according to the Department for Environment, Food and Rural Affairs, the average supplier of electricity uses a mix of fossil fuels, such as coal and gas, plus nuclear and renewable energy; producing 440.48 g of carbon dioxide equivalents ($CO_2e$) for every kWh of electricity.[3] The carbon emissions of electricity are negligible when suppliers use only renewable energy sources, such as wind and solar power. Readers need to be aware, however, that although the carbon emissions

Green energy suppliers, such as Bulb, Tonik, Good Energy, and UK Sustainable Energy have very low carbon emissions and information on emission levels can be found on energy comparison sites.[4] If dental practices, along with other consumers, choose to purchase green energy, this increase in demand will increase the supply of green energy available.

It should be noted that the carbon emissions of electricity are gradually decreasing as renewable energy increases and the use of coal is reduced in its production.[3] In Table 1, the emissions from an average fuel source mix can be seen.[3] A negligible amount of pumped storage has been removed in this table to improve simplicity.

#### Energy for heating

Heating consumes a substantial amount of energy and there are various fuel types that dental practices can purchase and use; these are shown in Table 2.[3] From an environmental perspective, a dental practice should choose the heating source with the lowest carbon emissions and lowest potential air pollution risk. Although wood pellets have the lowest

- Choose practice energy source with lowest emissions
- Lighting can use a lot of power
- Dental suction only uses £7 per year
- Autoclaves and washer disinfectors use £180 to £240 energy per year
- Energy efficient hard drives should be considered

# Should staff travel be included?

INTERNATIONAL DENTAL JOURNAL 72 (2022) 26–30

Commentary

**Environmental Sustainability Through Good-Quality Oral Healthcare**

In accordance with the FDI Vision 2030 document which calls for urgent action on oral health, the principal goal of oral health professionals is to promote universal oral health for diseases that are largely preventable and/or treatable in the early stages.[1] The provision of oral health care,[2] in the form of prevention, therapeutic interventions, or long-term maintenance, creates pollution and a significant carbon footprint. As oral health care providers, we have an ethical and moral responsibility to manage the impact of our activities on the environment and ensure that we do this in a sustainable manner.[3,4]

Oral health care contributes $CO_2$ emissions from 3 principal sources: (i) travel by patients and health personnel when commuting to and from care centres[5]; (ii) manufacturing, distribution, and procurement of materials and sundries along the supply chain; and (iii) waste generated and its management, including single-use plastics (SUPs) which present an environmental burden requiring urgent attention. The SUP burden is more pertinent now, with the huge volumes of SUP personal protective equipment (PPE) utilised during the ongoing COVID-19 pandemic.[6] The current increased use of SUPs highlights the difficulty of implementing sustainable health care practice as environmental impacts are often a secondary consideration to patient safety and optimal care. The challenges to sustainable health care practices are the perceived costs, individuals' attitudes, difficulties in the implementation of remediation measures, and the need to operate within the constraints of legislative frameworks. It is necessary therefore to structure a framework for oral health care provision that simultaneously advocates optimal patient care and promotes environmental sustainability at its core. This can be readily achieved for preventable oral diseases and through this paper, we aim to present a framework that reinforces the message that the delivery of good oral health care is key to disease reduction and, as an unintended consequence, through a reduced use of resources, it delivers environmentally sustainable outcomes (Table). In this way, a clear cause-and-effect relationship is established between the delivery of high-quality care and the achievement of practical and meaningful environmentally sustainable practice.

"dental practice" environment. This transition involves switching from a *behaviour* approach that is dictated by the location and circumstances in which we find ourselves to a stronger, more pervasive, and more persistent attitudinal approach.[6] This transition of our sustainability attitude from "home-based" private citizen behaviour to a "work-based" dental practice requires an understanding and appreciation amongst colleagues of our common beliefs on environmental issues. The first step is to normalise the subject of sustainability, which can be done through informal conversations and ongoing discussions amongst team members in the workplace. In this way, initial apprehension and resistance to environmentally sustainable behaviour changes in the dental practice can be addressed by increasing awareness and identifying common ground and strength of feelings amongst colleagues. The next step is to engage in real action through formal staff meetings in the dental practice. This can take place in the form of more focused discussions as part of the business agenda for the dental practice, perhaps with the appointment of a "practice sustainability champion." Simple actions that are achievable and impactful would be a perfect starting point, as suggested in this paper, to provide oral health care in an environmentally sustainable manner.

Beyond the actions of the dental team, we should be mindful of the vital role that the patient has in their contribution to sustainable oral health care as the beneficiary of the service. In this respect, the individual patient carries a significant element of responsibility for their own oral health through their attitudes and behaviours to the management of recognised risk factors, such as plaque control, diet, smoking, and alcohol intake.

**Sustainability through our actions**

For oral health care provision to be sustainable, there is a requirement to meet the oral health care needs of society without compromising the ability to provide this same service in the future.

For this to be realised, active and coordinated engagement

N Martin & S.Mulligan

- Practical & patient-centred prevention (reduced disease = fewer appointments, less travel, less materials' use and SUPs, less packaging)
- High quality operative care (= durable treatment with fewer repairs and replacements)
- Integrated care (active participation of all stakeholders, combining managed treatment appointments, shared family appointments)
- Ownership of care


- Patient A: Good oral health, no active disease

=

LOW Environmental impact

A review of papers on sustainable dentistry has found few mentions of the environmental impact of restoration replacement


**Figure – Case study of two 50-year-old patients with low and high environmental impacts.**

**Patient A:** Good oral health, no active disease, some tooth-surface loss consistent with 50 years of service; *no restorative interventions and low disease risk.* ***The environmental impact is low*** and principally associated with regular hygiene maintenance.

**Patient B:** Failing dentition with *new and recurrent active disease* (endodontic, periodontic, and caries), tooth loss, extensive *restorative treatment* (2 root treated teeth, 8 intra-coronal restorations, 5 full-coverage crowns, an endosseous implant, and evidence of recurrent caries), and persistent *high disease risk factors.* ***The environmental impact is high*** and associated with a failure to manage disease, continuous and repetitive interventive care, laboratory services, multiple care appointments (travel journeys), and high use of materials, sundries and personal protective equipment. This health and environmental impact of the high disease risk, the need for repeat interventions, and ongoing management of active disease will continue throughout the patient's life.

- Patient B: Failing dentition, new and recurrent disease, tooth loss

=

HIGH Environmental impact:
Due to failure to manage disease, repetitive interventive care, labaratory services, multiple appointments, high use of materials, sundries and PPE

N Martin & S.Mulligan

A brief look at restoration replacement, because placing and replacing restorations has an environmental cost

J Dent Res 75(12): 1942-1946, December, 1996

# Prediction of Secondary Caries around Tooth-colored Restorations: A Clinical and Microbiological Study

E.A.M. Kidd[1] and D. Beighton[2]

[1]Department of Conservative Dentistry, United Medical and Dental School, Guy's Hospital, London Bridge, London SE1 9RT, England; and [2]Joint Microbiological Research Unit, King's College School of Medicine and Dentistry, Denmark Hill, London SE5 8RW, England

**Abstract.** Caries at the margins of restorations is difficult to diagnose, and the relevance of staining and ditching around tooth-colored fillings is unclear. This clinical study questions the relevance of marginal color change and marginal ditching to the level of infection of the dentin beneath the margins of tooth-colored restorations. Clinically visible sites (197) on the tooth/restoration margin were selected in 113 teeth. The filling margin and the enamel adjacent to each site were noted as stained or stain-free, and sites were graded as intact, having a narrow ditch, or having a wide ditch. Thirty sites with frankly carious lesions were also included. Plaque was sampled at the tooth-restoration margin and the filling removed. The enamel-dentin junction (EDJ) at each sample site was noted as hard or soft when probed, and the dentin was sampled. Samples were vortexed, diluted, and cultured for total anaerobic counts, mutans streptococci, and lactobacilli. There were more bacteria in the plaque over frankly carious cavities, and the dentin was soft and heavily infected. Only 38 out of 167 sites without frankly carious cavities had soft dentin at the EDJ. Both the plaque and dentin in these sites harbored more micro-organisms. However, none of the clinical criteria chosen would reliably predict the presence of this soft dentin. In this study, only a frankly carious lesion at the margin of the filling constituted a reliable diagnosis of secondary caries.

**Key words:** secondary caries, tooth-colored restorations.

## Introduction

The replacement of dental restorations accounts
75% of all operative work, and caries at the m
restorations (secondary caries) is frequently a reasc
dentists for replacing restorations (Kidd *et a*
Histological studies (Hals and Kvinnsland, 1974) d
secondary caries lesion in two parts: an outer lesi
on the surface of the tooth next to the filling and a
which is assumed to develop if there is leakage be
restoration and the tooth. While an outer lesion
tooth-colored restoration may be relatively easy to
the clinical manifestations of the wall lesion are n
In particular, the relevance of a line of stain aroun
colored filling and discoloration of the dentin s
through intact enamel adjacent to the restoration a
to interpret. Do these appearances indicate leakag
stain left when the restoration was originally in
new, active secondary caries in need of operative
preventive treatment? In addition, the clinical rele
macroscopic ditch in between a tooth-colored fillir
tooth is unknown, although both marginal staining and ditching have been shown to cause dentists to replace tooth-colored restorations (Qvist *et al.*, 1990).

It seems reasonable to suggest that areas of active secondary caries in need of operative intervention will be heavily infected with micro-organisms. A logical way to investigate these diagnostic difficulties may therefore be to investigate associations between color changes and marginal ditches noted with a restoration in place and the degree of infection of the dentin once the same restoration is removed, so that the reliability of these criteria can be determined. The inclusion of a group consisting of frank carious cavities next to the filling margin can serve as a useful control, since in these cases the clinical diagnosis is rarely in dispute.

In the present study, we have therefore investigated whether a line of stain at the margin of a tooth-colored restoration, discoloration of dentin shining up through intact enamel at the margin of the filling, and/or ditching predicted the presence of infected dentin below the restoration at the

Received January 31, 1996; Accepted July 19, 1996



Research on marginal ditching & staining

J Dent Res 74(5): 1206-1211, May, 1995

# Marginal Ditching and Staining as a Predictor of Secondary Caries Around Amalgam Restorations: A Clinical and Microbiological Study

E.A.M. Kidd[1], S. Joyston-Bechal[2], and D. Beighton[3]

[1]Department of Conservative Dental Surgery, United Medical and Dental School, Guy's Hospital, London Bridge, London SE1 9RT, England; [2]partment of Oral Medicine and Periodontology, London Hospital Medical College, Turner Street, Whitechapel, London E1 2AD, England; [3]Oral Microbiology, Royal College of Surgeons, Department of Dental Sciences, King's College School of Medicine and Dentistry, mark Hill, London SE5 8RW, England

**stract.** Caries at the margins of restorations is difficult to gnose. In particular, the relevance of both marginal ching and staining around amalgam restorations is lear. This clinical study questions the relevance of ginal ditching and color change to the level of infection he dentin beneath the margins of amalgam restorations. ically visible sites (330) on the tooth/restoration margin e selected on 175 teeth. The enamel adjacent to each site noted as stained (a grey discoloration) or stain-free. hundred and seventy-eight sites were clinically intact, ites had narrow ditches (< 0.4 mm), and at 49 sites, wide hes were present (> 0.4 mm). Twenty sites with frankly ous lesions were also included. Plaque was sampled at tooth-restoration margin, and the dentin was sampled at enamel-dentin junction below each site. Samples were texed, diluted, and cultured for total anaerobic counts, tans streptococci, lactobacilli, and yeasts. Plaque samples wed that margins with wide ditches (> 0.4 mm) harbored significantly more bacteria, mutans streptococci, and lactobacilli than did clinically intact margins and margins with narrow ditches. There were no significant differences in the degree of infection of the dentin beneath clinically intact restorations and those with narrow ditches, but samples associated with wide ditches and carious lesions yielded significantly more bacteria, mutans streptococci, and lactobacilli. The color of the enamel adjacent to the sample site was irrelevant to the level of infection of the dentin beneath the filling margin, provided a frankly carious lesion was not present. The results suggest that amalgam fillings where margins show wide ditches or carious lesions should be replaced. Narrow ditches and color change alone should not trigger the replacement of a filling.

**Key words:** ditching, staining, recurrent caries.

Received June 21, 1994; Accepted February 20, 1995

## Introduction

Replacement dentistry accounts for some 75% of all operative work, and caries at the margins of restorations (secondary caries) is frequently a reason given by dentists for replacing restorations (Allender *et al.*, 1990; Kidd *et al.*, 1992). However, secondary caries is difficult to diagnose (Kidd, 1989), and thus practitioners are often inconsistent and inaccurate in this diagnosis (Merritt and Elderton, 1984), no doubt resulting in the unnecessary replacement of restorations. The relationship between marginal integrity and secondary caries is not entirely clear. Histological studies (Hals *et al.*, 1974) describe the secondary carious lesion in two parts: an outer lesion formed on the surface of the tooth next to the filling, and a wall lesion which is assumed to develop if there is leakage between the restoration and the tooth. This would indicate that demineralization can develop adjacent to the margin of a restoration that is clinically intact, but allowing leakage. Early laboratory studies suggest that defective margins on amalgam restorations predispose to secondary caries (Jorgensen and Wakumoto, 1968). Later laboratory work shows no such relationship (Kidd and O'Hara, 1990). However, clinical studies indicate that practitioners frequently replace restorations with defective margins (Dahl and Eriksen, 1978); Qvist *et al.*, 1986; Mjör, 1981; Kelsey *et al.*, 1981; Boyd and Richardson, 1985).

Discoloration around the margin of an amalgam filling may add to the diagnostic difficulty (Kidd, 1989). Discoloration may be due to the physical presence of the amalgam, corrosion products, or secondary caries. It is also possible that what appears to be active secondary caries at the margin of a restoration may in fact be residual caries that was left during cavity preparation. Studies using a caries detector dye (Fusayama and Terachima, 1972) indicate that faculty members frequently pass cavities prepared by students where use of the dye subsequently shows demineralized tissue on the enamel-dentin junction (Anderson and Charbeneau, 1985; Kidd *et al.*, 1989). It is

# Research on marginal ditching

- Patients who required replacement restorations were included.
- A total of 330 sites on 175 teeth in 118 patients were measured for marginal gaps (<0.4mm or >0.4mm)
- Each restoration removed using a turbine drill and sterile bur: a sample of dentine was removed from the enamel-dentine junction beneath the site and this was processed microbiologically.
- Mutans streptococci colonies were counted on agar plates, with lactobacilli and yeasts also being identified.
- RESULTS: The narrow ditch (<0.4mm) did not have significantly more bacteria than an intact margin. However, the wider ditch (>0.4mm) presented a different story – there were significantly more micro-organisms present beneath the wider marginal gaps, with a greater proportion of these being lactobacilli
- MESSAGE: “It might be prudent to replace restorations where marginal gaps exceeded 0.4mm”. They added that colour change adjacent to an amalgam restoration should not trigger its replacement.

Kidd EAM, Joyston-Bechal S, Beighton D. Marginal ditching and staining as a predictor of secondary caries around amalgam restorations: A clinical and microbiological study. J.Dent.Res.1995:74:1206-1211.

# Research on marginal staining

- 197 discrete sites in 72 patients with tooth-coloured restorations requiring replacement.
- 30 sites (12 on enamel and 18 on dentine) were carious and 167 sites were clinically non-carious. Margin sites selected for microbiological sampling.
- The colour of the margin was noted and the tip of an LA needle used for the removal of plaque from the tooth-restoration interface
- Restoration then removed using an air turbine and sterile bur. Sample of dentine was taken for microbiological testing.
- RESULTS: More bacteria in samples from carious than from non-carious sites: Not a surprise! But, more bacteria found in dentine beneath stained margins. Only margins >0.4mm yielded more micro-organisms in dentine.
- MESSAGE: “where the margin is not frankly carious, no clinical criteria (not even margin staining) will predict the presence of soft dentine”. Therefore, in the absence of patient concern about a discoloured margin around a tooth-coloured restoration, there is no indication from a caries viewpoint to replace a tooth-coloured restoration which has a stained margin.

Kidd EAM, Beighton D. Prediction of secondary caries around tooth-coloured restorations: A clinical and microbiological study. J.Dent.Res.1996:75:1942-1946.

Should this restoration be replaced? (Easy ones to start with!)

# Should this restoration be replaced?

On the basis of this research, how many restorations have I replaced erroneously ?

# Bulk staining is solely an aesthetic decision (for patient/dentist), related to the material and unrelated to caries

# Drilling isn’t great for teeth!!

Therefore, repair should be considered

This can often be done with no tooth preparation, other than cleaning

Blum IR. The management of failing direct composite restorations: replace or repair?
in: Lynch CD, Brunton PA, Wilson NHF, editors. successful posterior composites. London: Quintessence; 2008;101-
Blum IR, lynch CD, Wilson NHF. Factors influencing repair of dental restorations with resin composite.
Clin Cosmet Investig Dent. 2014; 17;6:81-88.
Blum IR, Schriever A, Heidemann D, Mjör IA, Wilson NHF The repair of direct composite restorations:
an international survey of the teaching of operative techniques and materials. Eur J Dent Educ. 2003;7:41-48.
Gordan VV, Mjör IA, Blum IR, Wilson NHF. Teaching students the repair of resin based composite restorations:
a survey of North American dental schools. J.Am.Dent.Assoc. 2003;134:317-323.

KEY WORDS

LEARNING OBJECTIVES

AUTHOR

IGOR R. BLUM

RESTORATION REPAIR AS A CONTEMPORARY APPROACH TO TOOTH PRESERVATION:

CRITERIA FOR DECISION MAKING AND CLINICAL RECOMMENDATIONS

Format: Abstract

Send to

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**Factors influencing repair of dental restorations with resin composite.**

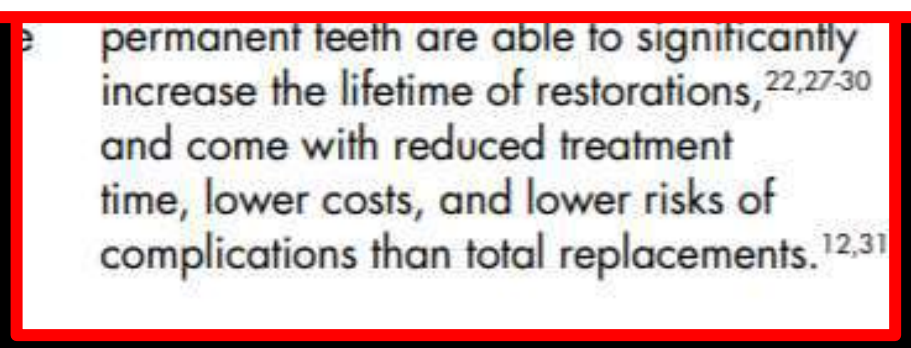
Blum IR[1], Lynch CD[2], Wilson NH[3].

Author information

Abstract

The presentation of patients with dental restorations that exhibit minor defects is one of the commonest clinical situations in the practice of general dentistry. The repair of such restorations, rather than replacement, is increasingly considered to be a viable alternative to replacement of the defective restoration. This paper considers factors influencing the repair of direct restorations, including indications and details of relevant techniques, based on the best available knowledge and understanding of this important aspect of minimal intervention dentistry. Practitioners who do not consider repair before deciding to replace restorations that present with limited defects are encouraged to consider including repair in the treatment options in such situations. The effective repair of direct restorations can greatly influence the rate of descent down the "restorative death spiral".

Blum and Ozcan stated unequivocally that “restoration replacement should be considered as the last resort when there are no other viable alternatives”.
“The literature on survival of repaired restorations concluded that numerous longitudinal clinical studies have shown that restoration repairs in permanent teeth are able to significantly increase the lifetime of restorations and the restored tooth unit”.



permanent teeth are able to significantly increase the lifetime of restorations,[22,27-30] and come with reduced treatment time, lower costs, and lower risks of complications than total replacements.[12,31]

The evidence base for repair is building

# Repair of restorations is no longer considered to be “dodgy”

Review

## Repair of restorations – Criteria for decision making and clinical recommendations

*Reinhard Hickel*, Katrin Brüshaver, Nicoleta Ilie*

*Department of Restorative Dentistry, Dental School Ludwig-Maximilians-University, Munich, Germany*

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ABSTRACT

*Objectives.* In the last decade, repair of restorations has become more and more popular while teaching repair of restorations is now included in most universities in Europe and North America. The aim of this paper was therefore to systematically review the clinical and the in vitro aspects of repair of restorations by considering different restorative materials – resin-based composites, amalgam, glass-ionomer cements, ceramics or metals. The paper gives also an overview of the occurrences of teaching repair in different universities. Furthermore, the paper outlines criteria for decision making when to treat a defect restoration with refurbishment, repair, replacement or no treatment.

*Data.* The database search strategy for resin based composite restoration repair ($n=360$) and the following hand search ($n=95$) retrieved 455 potentially eligible studies. After de-duplication, 260 records were examined by the titles and abstracts. 154 studies were excluded and 106 articles were assessed for eligibility by analyzing the full texts. Following the same search and selection process, 42 studies for amalgam repair, 51 studies for cast, inlay or porcelain restoration repair and 8 studies for teaching were assessed for eligibility by analysis of the full texts.

*Sources.* Following databases were analyzed: Cochrane Library, MEDLINE, EMBASE, BIOSIS and PUBMED.

*Study selection.* Papers were selected if they met the following criteria: replacement, refurbishment or repair of resin composite restorations or amalgam restorations or inlay, cast restoration or porcelain repair. Clinical studies, in vitro studies and reports about teaching were included.

*Conclusions.* Repair of restoration is a valuable method to improve the quality of restorations and is accepted, practiced and taught in many universities. However, there is a need for methodologically sound randomized controlled long-term clinical trials to be able to give an evidence based recommendation.

Hickel R.et al. Repair of restorations. Dent.Mater. 2012:

# Repair of restorations is no longer considered to be “dodgy”



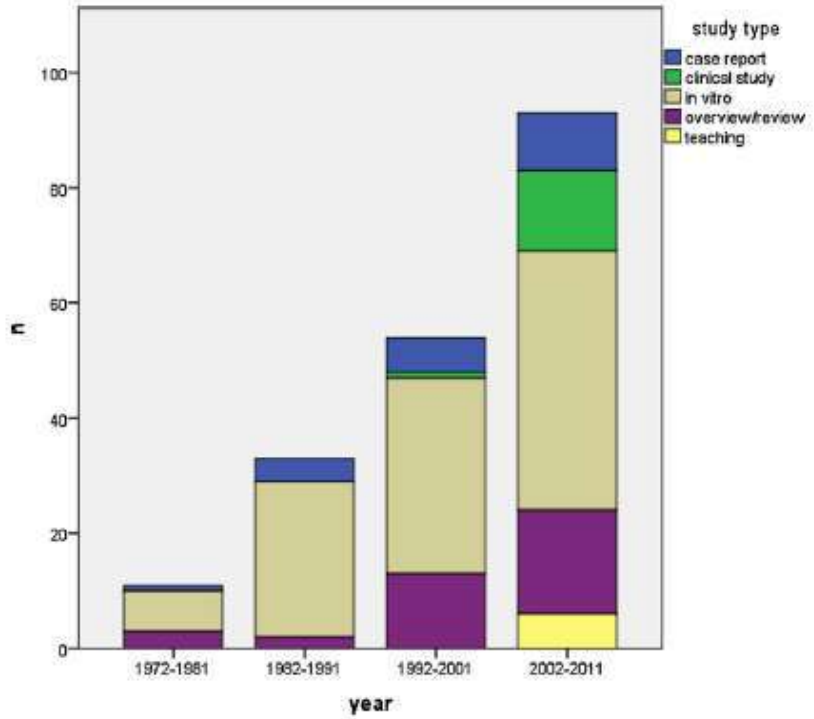


Fig. 3 – Frequency of publications about repair of restorations (resin based, amalgam, inlay, cast restoration and porcelain) selected in the paper, according to clinical and in vitro studies, reviews and teaching topics. Case reports were additionally considered.

Hickel R.et al. Repair of restorations. Dent.Mater.2012:

# Handling of imperfect restorations

(Hickel et al., Dent.Mater.2012)

- No treatment (monitor)
- Refurbishment (removal of overhangs, removal of discolouration, smoothing or glazing of the surface)
- Repair of localised failures, with or without preparation in the restoration or dental hard tissues
- Replacement – if repair is not feasible or reasonable

# Advantages of repair (Blum IR et al., J.South African Dent.Assoc.2011:66:114-118)

- Less loss of tooth substance
- Reduced harm to the dental pulp
- Often, no need for LA
- Less risk of iatrogenic damage to adjacent teeth
- Reduced treatment time
- Reduced cost to the patient
- Good patient acceptance
- Improved longevity of the restoration

# Conditions amenable to repair

- Large marginal opening
- Severe localised marginal staining
- Secondary caries
- Margin fracture of restorative material
- Chipping fracture
- Erosive/abrasive loss of tooth structure at restoration margin
- Wear of restoration
- Minor cusp fracture

# Longevity of repaired restorations

Opdam NJM et al., J.Dent.2012:40:829-835


## RESULTS

- 61% of repaired restorations still in service at 5 years
- Annual failure rates of repaired amalgams was 9.3%, for composites 5.7%
- Restorations which failed due to fracture had a lower survival than those which were repaired because of caries

# Longevity of repaired restorations

Opdam NJM et al., J.Dent.2012:40:829-835

## CONCLUSION

- Repairs may enhance the longevity of restorations “considerably”
- Repairs on restorations which failed due to caries had a better prognosis than repairs on restorations which failed due to fracture

# Longevity of repaired restorations
## …covered in Dental Update

RestorativeDentistry



Igor R Blum
Daryll C Jagger and Nairn HF Wilson

Defective Dental Restorations: To Repair or Not To Repair? Part 1: Direct Composite Restorations

**Abstract:** The presentation of patients with failing dental restorations that exhibit minor defects is a common clinical situation in everyday dental practice. The repair of such restorations, rather than replacement, is increasingly considered to be a viable alternative to the replacement of the defective restoration. This first of two papers considers indications and techniques for the repair of defective direct composite restorations.
It is possible that some dental practitioners are unaware of the option of repair rather than replacement of composite restorations. This article provides an overview of contemporary knowledge and understanding of restoration repair in the clinical management of defective composite restorations.
**Clinical Relevance:** A sound understanding of the indications, benefits and techniques of direct composite restoration repair could allow the longevity of the existing restoration to be extended without unnecessarily sacrificing healthy tooth structure.
**Dent Update 2011; 38: 78–84**

There is clearly an increasing demand for aesthetic dental restorations from the general public and dentists are spoilt for choice as to which materials to use and how best to use them. There is no disputing the excellent aesthetics that can be achieved with composite resin as a restorative material; however, the longevity of these materials can be disappointing, especially if not placed using a careful incremental technique.[1] With the increasing use of these materials for the restoration of large defects in posterior teeth, these materials are tested to the maximum.

The management of composite restorations with localized defects is a common challenge in clinical practice. While some restorations will inevitably require replacement, it has been suggested that some deteriorating, yet serviceable, restorations may be given extended longevity through the use of damage, possibly obviate the need for the use of local anaesthesia and be more conservative of tooth tissue.[2-5] It is clearly preferable, therefore, to perform a restoration repair (ie partial replacement of the composite restoration allowing preservation of that portion of the composite restoration which presents no clinical or radiographic evidence of failure) as an alternative to restoration replacement (removal of an entire composite restoration followed by the placement of a new composite restoration) wherever possible. It is accepted that removal of part of the restoration without the aid of magnification loupes can further result in removal of sound

**Igor R Blum**, DDS, PhD, Dr Med Dent, MSc, MFDS RCS(Eng & Edin), PGCertHE, FHEA, Clinical Lecturer/Hon Specialist Registrar in Restorative Dentistry, University of Bristol Dental Hospital & School, **Daryll C Jagger**, BDS, PhD, MSc, FDS RCS(Eng), FDS RCS(Rest Dent), Professor of Restorative Dentistry, Glasgow Dental School and Hospital and

Rationale for restoration repair

- Preservation of tooth structure
- Enhanced restoration longevity
- Reduction in harmful effects on the pulp
- Reduced treatment time
- Reduced cost to the patient
- Good patient acceptance
- No need for LA in majority of repairs
- Reduced risk of iatrogenic damage ;;

A must read paper

RestorativeDentistry

David Green

Louis Mackenzie and Avijit Banerjee

# Minimally Invasive Long-Term Management of Direct Restorations: the '5 Rs'

**Abstract:** The assessment and operative long-term management of direct restorations is a complex and controversial subject in conservative dentistry. Employing a minimally invasive (MI) approach helps preserve natural tooth structure and maintain endodontic health for as long as possible during the restorative cycle. This paper discusses how minimally invasive techniques may be applied practically to reviewing, resealing, refurbishing, repairing or replacing deteriorating/failed direct coronal restorations (the '5 Rs') and provides an update of contemporary MI clinical procedures.

**CPD/Clinical Relevance:** The assessment and long-term clinical management of deteriorating/failing direct restorations is a major component of the general dental practice workload and NHS UK budget expenditure for operative dentistry.

**Dent Update 2015; 42: 413–426**

## What is a 'failing' restoration?

A failing restoration can be described as one that has suffered biomechanical defect or damage resulting in immediate or subsequent detrimental clinical consequences to the patient. This may affect the restoration alone (eg bulk fracture, staining etc), the supporting tooth structure (eg fractured cusps, new caries at the tooth-restoration surface (CARS) etc) or, more commonly, both, affecting the collective *tooth-restoration complex*. Such failure can present as obvious fractures of this complex, possibly detectable active caries associated with restoration/sealant surface (CARS, previously described as secondary or recurrent caries) or can be more subtle, such as marginal discoloration of an anterior aesthetic resin composite restoration or marginal ditching of a posterior restoration.

A number of clinical indices have against these criteria and given a score out of five, depending on the clinical findings. This classification has been proposed as a tool to evaluate and standardize new restorative materials, a method to determine if restorations require repair or replacement and a quality assessment tool for reviewing dental restorations. This classification has been shown to be more sensitive at determining differences between restorations than older classifications.[2] There are a number of challenges, which include the universal uptake of the new classification system and how the scoring

**David Green,** BSc(Hons) BDS(Hons) MFDS RCS(Ed), StR in Restorative

# The 5Rs!

Reviewing
Resealing
Refurbishment
Repair

and, where necessary,
Replacement

Dent.Update 2015:42:413-426

# What I plan to talk about

- Sustainability and dental restorations
- History of restoration survival research in the UK
- Factors influencing restoration survival (dentists, patients, materials)
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making

# The durability of conservative restorations

Allan DN. Br.Dent.J.1969: 126:172-177.

THE DURABILITY OF CONSERVATIVE RESTORATIONS

DOUGLAS N. ALLAN*, D.D.S., M.D.S.

**Introduction**

**Previous Surveys**

**Materials and Methods**

TABLE II.—MAXIMUM DURATION OF EACH TYPE OF FILLING MATERIAL

| *Material* | *Duration* |
|---|---|
| Gold foil | 45 years |
| Amalgam | 25 ,, |
| Bridges | 15 ,, |
| Silicate | 13 ,, |
| Gold inlay | 13 ,, |
| Porcelain veneer crowns | 12 ,, |
| Acrylic veneer crowns | 3 ,, |

difference. It was concluded that the way a material was employed was more related to its duration than the actual material used.

# THE LIFE OF A FILLING

A. D. ROBINSON[1], B.D.S.

*Brit. dent. J.*, 1971, 130, 206.

**Practice records over a period of twenty-one years are scrutinised to assess the useful life of amalgam and silicate fillings in patients attending regularly for dental examination and treatment.**

MUCH has been written on methods of making better fillings, on the desirable properties of filling materials and on the design of cavities intended to achieve the long life hoped for in a dental restoration. The causes of failure of amalgam fillings have been analysed by Healey and Phillips (1949) and by Allan (1969). In both cases, groups of patients were examined and causes of failure recorded. Allan also reported on the length of life of the fillings which had been made by a number of operators. There seemed to be an opportunity, however, to obtain useful information by examining the records of a limited number of patients over a considerable period. In a practice started in 1948 in a suburban area of London it was found that over 80 patients who first attended in 1948 and 1949 were still attending in 1969. This report is based on their records over a 21-year period.

## Method

Some of the patients were known to have sought treatment elsewhere at some time during the period and these were eliminated from the investigation. Any patient whose records showed an interval of over 2 years at any time between attendances was eliminated, as also were those for whom no fillings were done in 1948 or 1949. This left a list of 43 patients aged 13 to 57 at the beginning of the study with continuous records of treatment by the author from 1949 to 1969. Two of them also had fillings done in 1948 and for these the period 1948 to 1968 was also included. Only amalgam and silicate fillings in permanent teeth were studied.

For each patient a note was made of the fillings done in the first year. Detailed examination of the records in the ensuing 20 years indicated when these were lost by extraction, replaced by similar or more extensive fillings or by crowns. As there is bound to be some ambiguity about dental records, the following criteria were adopted:

(1) Where a tooth was extracted, all the fillings in that tooth were recorded as having failed.

(2) Where a new filling of the same denomination was inserted, for example, occlusal, disto-occlusal, mesio-occlusal, the original one was deemed to have failed except that for upper first and second molars and lower first premolars, where anatomical conformations lend themselves to making 2 separate occlusal fillings in the 2 pits, allowance was made. For example, if one occlusal filling was recorded in 1949, a second in 1950 and a third in 1959, it was assumed that the second one was in the other pit and was not reported as a failure. It was assumed that the third one (1959) was a renewal of the first.

Any occlusal restoration of lower molars and second premolars or of upper premolars was recorded as a failure of the original filling, similarly for the buccal and lingual surfaces of all teeth.

(3) Placing an occluso-buccal was considered to indicate failure of a buccal or an occlusal filling.

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In general, it was not thought that a filling should count as having failed simply because the surface had to be involved to provide retention for a new filling on another surface. Having regard to this, the criteria were possibly somewhat stringent and when interpreting the findings this must be borne in mind.

No attempt is made to define exactly the criteria employed when deciding to replace a filling. This involves clinical judgment and it is recognised that much variability may exist between the judgments of various operators. In general terms, however, a filling was replaced when it had ceased to function adequately, as a result of caries, fracture, attrition, corrosion, and in the case of silicates, æsthetic deterioration or solution.

In order to obtain a general picture of the dental histories of this group of patients, their records for the 21 years (since the first and last

[1]Department of Conservative Dental Surgery, Guy's Hospital Dental School, London, S.E.1.



# Robinson's Rules

Br.Dent.J.1971:130:206-208

Records of 80 patients who attended a suburban London practice in 1948, still attending in 1969

Patients who had sought treatment elsewhere were "eliminated", as were patients who had a gap in treatment of < 2 years

This left 43 patients aged 13y 57y. Only amalgam and silicate fillings were studied.

For each patient, a *note* was made of the fillings done in the first year.

*Detailed* examination of the records of the following 20 years

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# Robinson's Rules

TABLE II.—PATIENTS' AGES AND NUMBERS OF TEETH AT COMMENCEMENT OF STUDY, WITH FILLINGS AND EXTRACTIONS PERFORMED DURING PERIOD

| Patient | Age at commence-ment | No of teeth at commence-ment | Total number of fillings in the period of 21 years | Total number of extractions in period of 21 years |
|---|---|---|---|---|
| 1 | 32 | 22 | 47 | 1 |
| 2 | 19 | 21 | 28 | 11 |
| 3 | 34 | 24 | 48 | 6 |
| 4 | 44 | 27 | 43 | 0 |
| 5 | 38 | 24 | 6 | 0 |
| 6 | 29 | 24 | 98 | 7 |
| 7 | 29 | 23 | 73 | 2 |
| 8 | 47 | 24 | 32 | 0 |
| 9 | 44 | 22 | 78 | 6 |
| 10 | 40 | 26 | 27 | 1 |
| 11 | 24 | 26 | 52 | 1 |
| 12 | 42 | 21 | 10 | 19 |
| 13 | 59 | 27 | 62 | 0 |
| 14 | 35 | 25 | 33 | 1 |
| 15 | 39 | 14 | 46 | 3 |
| 16 | 30 | 25 | 45 | 1 |
| 17 | 37 | 26 | 102 | 2 |
| 18 | 23 | 30 | 63 | 7 |
| 19 | 37 | 26 | 61 | 3 |
| 20 | 38 | 22 | 46 | 6 |
| 21 | 33 | 30 | 25 | 1 |
| 22 | 29 | 28 | 18 | 0 |
| 23 | 33 | 27 | 30 | 1 |
| 24 | 27 | 25 | 40 | 3 |
| 25 | 21 | 28 | 76 | 5 |
| 26 | 31 | 26 | 26 | 1 |
| 27 | 43 | 24 | 26 | 2 |
| 28 | 38 | 16 | 38 | 8 |
| 29 | 28 | 28 | 50 | 1 |
| 30 | 38 | 25 | 64 | 2 |
| 31 | 29 | 22 | 71 | 5 |
| 32 | 30 | 28 | 30 | 1 |
| 33 | 37 | 27 | 28 | 3 |
| 34 | 42 | 27 | 11 | 4 |
| 35 | 42 | 6 | 13 | 2 |
| 36 | 28 | 27 | 53 | 0 |
| 37 | 57 | 19 | 19 | 7 |
| 38 | 61 | 26 | 42 | 19 |
| 39 | 23 | 30 | 28 | 0 |
| 40 | 33 | 21 | 23 | 0 |
| 41 | 13 | 26 | 20 | 3 |
| 42 | 26 | 24 | 28 | 0 |

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6th year) 39 amalgam fillings had failed, just over one-quarter of the total. After 10 complete years a further 33 had failed, making 72 in all, or approximately one half. After 20 years a further 40 had failed, making 112 in all, 33 still remained in place. The accumulating total of failed fillings is plotted on the graph (fig. 1). Table IV shows the number and type of amalgam fillings still standing after 20 complete years.

The silicate fillings were fewer in number. There were very few lost in the first 5 years but by the end of 10 years about half had failed and

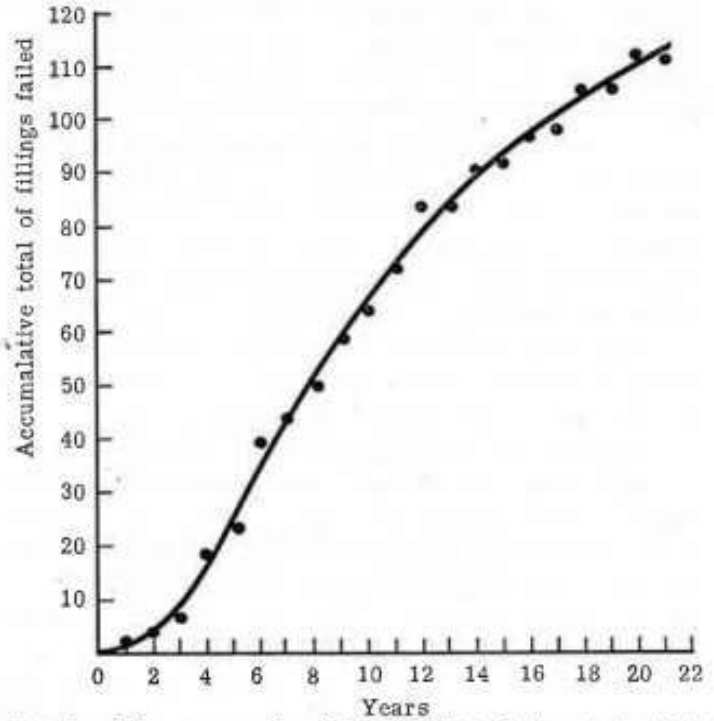


FIG. 1.—The progressive failure of 112 of the original 145 amalgam fillings, over a period of 21 years.

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No attempt is made to define exactly the criteria employed when deciding to replace a filling. This involves clinical judgment and it is recognised that much variability may exist between the judgments of various operators. In general terms, however, a filling was replaced when it had ceased to function adequately, as a result of caries, fracture, attrition, corrosion, and in the case of silicates, æsthetic deterioration or solution.

In order to obtain a general picture of the dental histories of this group of patients, their records for the 21 years (since the first and last

[1]Department of Conservative Dental Surgery, Guy's Hospital Dental School, London, S.E.1.



**Discussion**

It must be pointed out that the 43 patients cannot be regarded as a representative sample of the population. They are a special and a small section of those who are dentally conscious and regular in their visits to the dentist. It would not even be fair to regard them as a true sample of the patients in this particular practice.

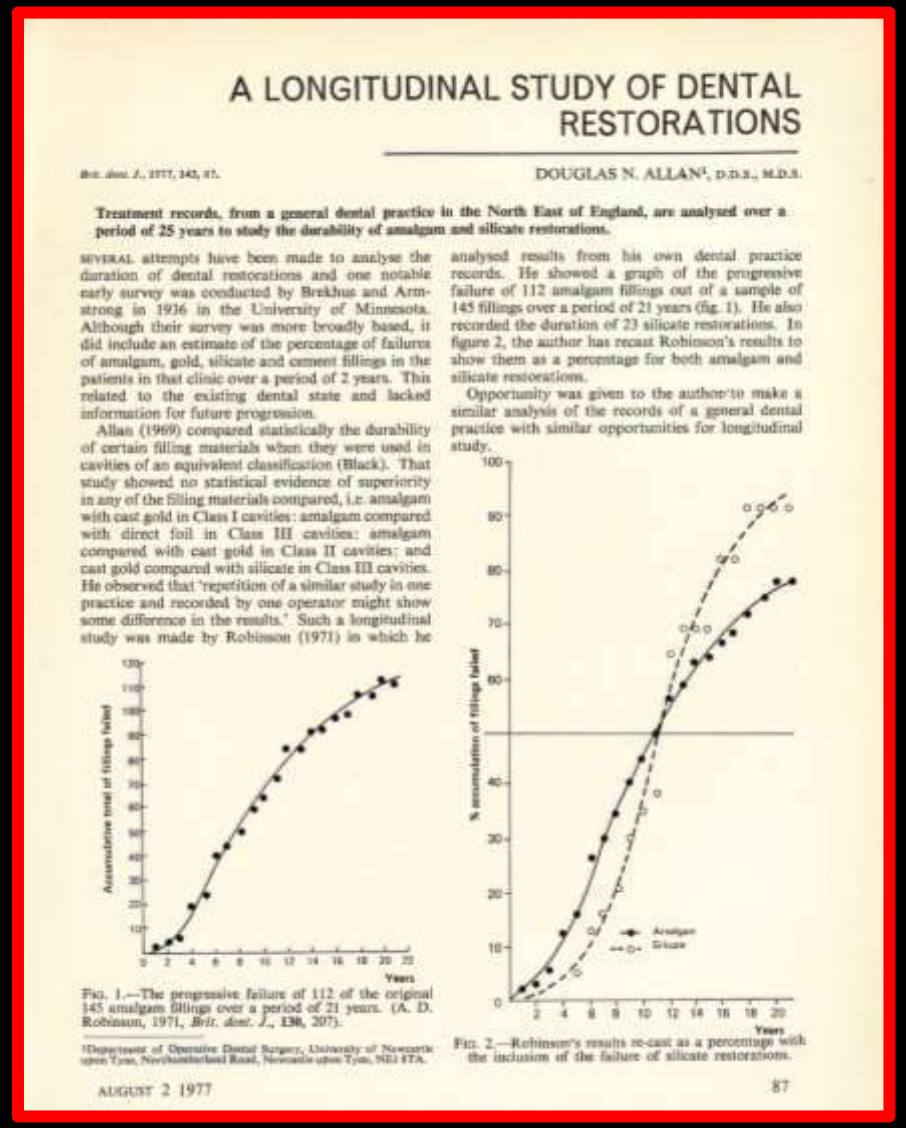
No attempt has been made to relate the life of fillings to particular techniques or to any other factor. No reference has been made to the

Some of the amalgam fillings lasted for only a short time but almost three-quarters of those under review lasted for 5 years or more. About half lasted for 10 years and almost a quarter lasted more than 20 years. There appeared to be a slight tendency for the rate of loss to diminish (fig. 1).

The value of fillings, as a means of saving carious teeth, is probably greater than these results appear to show. It will be remembered

# A longitudinal study of dental restorations

Allan DN. Br.Dent.J.1977:143:87-89.



A LONGITUDINAL STUDY OF DENTAL RESTORATIONS

*Brit. dent. J.*, 1977, 143, 87.

DOUGLAS N. ALLAN[1], D.D.S., M.D.S.

**Treatment records, from a general dental practice in the North East of England, are analysed over a period of 25 years to study the durability of amalgam and silicate restorations.**

SEVERAL attempts have been made to analyse the duration of dental restorations and one notable early survey was conducted by Brekhus and Armstrong in 1936 in the University of Minnesota. Although their survey was more broadly based, it did include an estimate of the percentage of failures of amalgam, gold, silicate and cement fillings in the patients in that clinic over a period of 2 years. This related to the existing dental state and lacked information for future progression.

Allan (1969) compared statistically the durability of certain filling materials when they were used in cavities of an equivalent classification (Black). That study showed no statistical evidence of superiority in any of the filling materials compared, i.e. amalgam with cast gold in Class I cavities: amalgam compared with direct foil in Class III cavities: amalgam compared with cast gold in Class II cavities: and cast gold compared with silicate in Class III cavities. He observed that 'repetition of a similar study in one practice and recorded by one operator might show some difference in the results.' Such a longitudinal study was made by Robinson (1971) in which he analysed results from his own dental practice records. He showed a graph of the progressive failure of 112 amalgam fillings out of a sample of 145 fillings over a period of 21 years (fig. 1). He also recorded the duration of 23 silicate restorations. In figure 2, the author has recast Robinson's results to show them as a percentage for both amalgam and silicate restorations.

Opportunity was given to the author to make a similar analysis of the records of a general dental practice with similar opportunities for longitudinal study.




FIG. 1.—The progressive failure of 112 of the original 145 amalgam fillings over a period of 21 years. (A. D. Robinson, 1971, *Brit. dent. J.*, **130**, 207).




FIG. 2.—Robinson's results re-cast as a percentage with the inclusion of the failure of silicate restorations.

[1]Department of Operative Dental Surgery, University of Newcastle upon Tyne, Northumberland Road, Newcastle upon Tyne, NE1 8TA.



recorded the duration of 23 silicate restorations. In figure 2, the author has recast Robinson's results to show them as a percentage for both amalgam and silicate restorations.

Opportunity was given to the author to make a similar analysis of the records of a general dental practice with similar opportunities for longitudinal study.

Records from a practice in NE England were made available

Records of 47 patients followed from 1951 to 1971 & 31 patients from 1954 to 1969.

# A longitudinal study of dental restorations

Allan DN. Br.Dent.J.1977:143:87-89.

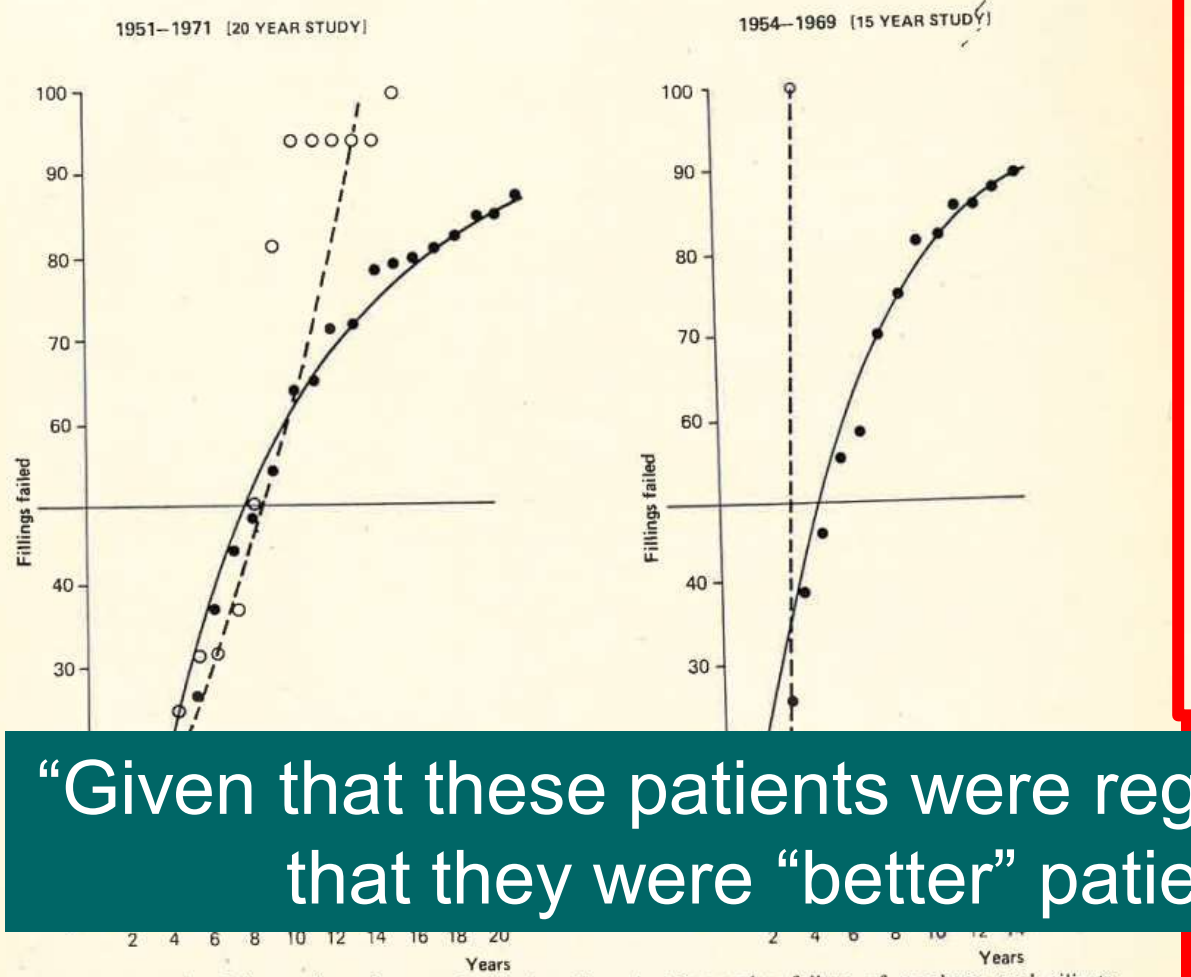



FIG. 3.—Progressive failure of amalgam and silicate restorations in a practice in the North of England over a period of 20 years.




FIG. 4.—Progressive failure of amalgam and silicate restorations in a practice in the North of England over a period of 15 years.

**Results**

The results for the 20-year survey commencing in 1951 are shown in figure 3 and for the 15-year survey are shown in figure 4. In figure 3, half the amalgam restorations are lost in 8 years and nearly 90 per cent are lost in 20 years. With silicate, half of the restorations are lost in 8 years but nearly all are lost in 14 years. In figure 4 half the amalgam restorations are lost in 5 years and 90 per cent are lost in 15 years. The numbers of silicate fillings are small but all fail in 4 years.

"Given that these patients were regular attenders, one might assume that they were "better" patients than casual attenders".

"A filling was deemed to have failed because it was replaced"

# Onwards and upwards

# Paterson N. The longevity of restorations

Br.Dent.J.1984:157:23-25

## The Longevity of Restorations

A Study of 200 Regular Attenders in a General Dental Practice

NEIL PATERSON*, BDS, FDS, DRD

**In a retrospective study, a total of 3299 restorations placed in 200 regular patients in a large National Health Service practice in the north-east of England was followed over the period 1967–1983, and time-life survival tables constructed. The estimated 50% survival time for the selected group of patients was 8 years for occlusal amalgam restorations, 7 years for mesio-occlusal, disto-occlusal and mesio-occlusodistal amalgam restorations, 5½ years for silicate restorations, and 4½ years for composite restorations. A separate study of 62 children aged 6–12 years showed estimated 50% survival times of 6 years for occlusal amalgam restorations and less than 3 years for mesio-occlusal, disto-occlusal and mesio-occlusodistal amalgam restorations.**

Correct handling of any dental restorative material in ideal circumstances undoubtedly produces a restoration that can last for many years. However, the life of the restoration is dependent upon many factors, and in a typical clinical situation it is not always possible to attain perfection, owing to such constraints as patient cooperation, time, access, and operator's ability. It is therefore arguably of more relevance to assess the effectiveness of the treatment of the average practitioner for the average patient. In view of the very high cost of delivering restorative dentistry to the community, it is not unreasonable to wish to know the life expectancy of a filling and how often the community can expect to pay for its replacement.

Dental hospital patients,[1–3] patients attending single or limited operator practices,[3–5] RAF personnel[6] and patients attending many different practitioners[7] have already been assessed. Apart from the latter, there has been little work done on patients treated by a variety of operators in a general dental practice. Where a number of operators were involved, the effect of more able and less able dentists might be smoothed out and a truer picture of the average NHS practice arrived at. In this study the opportunity arose to do just that.

### Method

An NHS-only general dental practice in the north-east of England at which the author had worked was studied. One dental surgeon, the principal, worked throughout the period of the study, and a total of 16 full- and part-time associates and assistants with different training backgrounds worked there at various times during the same period. Most had recently qualified at the nearby Sutherland (later Newcastle upon Tyne) Dental School. Some were concurrently working as house officers or had recently done so. This may have had some influence on the results, but it was felt that their lack of experience might be compensated for by their slower approach. The average working time spent in the practice was approximately 2½ years.

The dental records of 200 patients who had attended the practice regularly were selected alphabetically from the practice records, yielding a total of 2344 amalgam, 546 silicate and 130 composite restorations. The age-range of the group at the beginning of the study was 13–73 years with a mean of 28·6 years. Apart from those mentioned below, all restorations placed in this time period were recorded. Thus the patients selected were all regular attenders; they were deemed so if they had attended at least yearly for ten years or more. All the restorations were placed during the period 1967–1983.

To allow all the restorations to be included in the study and to allow direct comparisons to be made with the work of Hunter[4] and Elderton,[3] time-life tables were constructed from the results. Robinson's[8] correction for successive occlusal restorations in $\frac{7|6|}{6|7}$ and $\frac{4|}{|4}$ was adopted. Where records of designation (mainly of molars) varied, commonsense reasoning of their true designation posed little problem. Where it was impossible to be sure, the teeth concerned were eliminated from the study; this involved only seven teeth. Buccal or lingual single-surface amalgam restorations were also excluded because they could not be distinguished as Class I or Class V restorations.

Hunter[4] showed that the failure pattern of restorations placed in children differed from that in adults, so 62 children, selected from within the group and aged 6–12 years inclusive at the time a restoration was placed in a permanent tooth, were recorded separately from those fillings placed in patients aged 13 years or over.

The fluoride level in the water of the practice catchment area fluctuated between 0·2 ppm and 0·8 ppm with a daily average of 0·5 ppm.[9] The amalgam used during the study period was Solila,* the silicate Achatit† or Petralit,‡ and the composite either Adaptic§ or Prismafil.‖

Failure of the restoration was deemed to have occurred (i) if all or part of a restoration was removed and/or replaced, (ii) if endodontic treatment was carried out necessitating removal and/or replacement of the restoration, (iii) if the tooth was crowned or extracted.

At no time were patients examined; all data were obtained purely by examination of the patient's records.

### Results

The time-life survival tables were calculated according to the method of Armitage.[1]

*Dentsply Division, Dentsply Ltd, Weybridge, Surrey.
†Vivadent, Schaan, Liechtenstein.
‡Howmedica International, Dental Fillings Division, London N16 0BP.
§Johnson & Johnson Dental Products Ltd, East Windsor, NJ 08520.
‖The L.D. Caulk Co, Division of Dentsply International Inc., Milford, Delaware.

*Newcastle upon Tyne Dental Hospital and School, Richardson Road, Newcastle upon Tyne NE2 4BW.*

Practice in NE England, where the author worked

Records of 200 patients who had attended regularly were selected “alphabetically”.
Followed for the period 1967 to 1983.

This yielded 2,344 amalgam, 546 silicate, & 130 composite restorations. Mean patient age = 29 years.

Patients were regular attenders (defined as annual attendance for the past 10 years)

“Robinson’s correction” followed for occlusal restorations in upper molars and lower 1st premolars

All data obtained from examination of patient records

# Paterson N. The longevity of restorations

Br.Dent.J.1984:157:23-25

Failure of the restoration was deemed to have occurred (i) if all or part of a restoration was removed and/or replaced, (ii) if endodontic treatment was carried out necessitating removal and/or replacement of the restoration, (iii) if the tooth was crowned or extracted.

# Paterson N. The longevity of restorations

Br.Dent.J.1984:157:23-25

***Amalgam restorations (Table I)***

From the sample of 854 occlusal amalgams an estimated 50% survival time of slightly over 8 years was calculated. From the sample of 1490 mesio-occlusal (MO), disto-occlusal (DO) and mesio-occlusodistal (MOD) survival time of approximately 7 years was calculated. There was a difference for all time-intervals between the two groups of restorations, but this was not statistically significant by the chi-squared test. Hence an estimated 50% survival time for all the above amalgam restorations of approximately 7½ years can be drawn.

***Composite restorations***

The composite restorations were mainly used in the last 6 years of the sample period (130 restorations). Little meaningful information could be gained from breaking down results into separate survival times for Class III, IV, and V. Overall 50% survival was around 4½ years.

“it is unrealistic to
expect controlled
longitudinal studies
to last more
than ten years”

**Mjor et al, 1990**

# Therefore, large scale administrative databases are of value

The big numbers game!

But some things are lost

# Large scale administrative databases

Elderton RJ. Br.Dent.J.1983:155:91-96

AUGUST 6 1983 91

## Longitudinal Study of Dental Treatment in the General Dental Service in Scotland

R. J. ELDERTON*, PhD, BDS

**This paper describes a continuing longitudinal follow-up study of the dental care provided in the general dental service for 720 dentate adults in Scotland who were subjects in the 1978 UK survey of adult dental health. The overall method is described, whereby the necessary linkage has been established to allow the details of a series of courses of treatment received by individual patients to be related to baseline data obtained in the national survey.**

**One thousand eight hundred and seventy four courses of treatment for 505 of the patients have been monitored to date. More than two-thirds of these courses involved active treatment, which included the placing of 3586 restorations. Preliminary life table analyses estimate the 50% survival time of routine amalgam and synthetic restorations to be less than 5 years. These findings help to strengthen the argument in favour of redeploying resources towards the preventive sphere.**

At a time when increasing emphasis is being placed upon the desirability of widening the scope for preventive dentistry in the general dental service (GDS), it is essential that the efficacy and benefits of standard treatments should also be evaluated.

This issue was brought into focus recently in the report of the Dental Strategy Review Group.[1] It was noted that much information is available about items of treatment carried out in the GDS, but that the methods of processing the data do not allow the record linkage which is needed to relate a series of courses of treatment to individual patients in order to investigate the effectiveness and durability of particular types of treatment. The report goes on to say that the establishment of any national centre with provision for such linkage of records over an extended period, however desirable, would be a massive and expensive undertaking, and that assessments of different forms of treatment are best done through special studies set up for the purpose. This paper describes such a study.

This project was established in response to the report of a dental advisory group set up by the Chief Scientist of the Scottish Home and Health Department in 1975 to examine dental health problems in Scotland. This advisory group noted that the dental health service is expensive and yet not always able to meet current demands effectively.[2] It also pointed out that there is little evidence that the procedures used in dental practice have been adequately evaluated, and that there is evidence that expensive treatments are provided which fall within a relatively short time. The advisory group concluded that dental health services research in both the treatment and preventive areas was clearly necessary, for dentistry falls far short of the kind of rigorous assessment now accepted as needed within medicine.

Restorative treatment in the GDS in England, Scotland and Wales in 1981 amounted to £268 million.[3,4] This represented 51·6% of the total fees paid to dental practitioners. The money was spread over 16 million courses of treatment and it bought in excess of 35 million fillings including 1·7 million crowns and 44 thousand bridges. In addition several million fillings were provided through the community dental service (CDS) and many would also have been undertaken in dental schools, the armed forces and privately.

Restorative dentistry is clearly very prevalent and it consumes a lot of money. In addition, it must inevitably be the cause of many millions of hours of absence from work or home, and people do not generally like having their teeth filled. Indeed, 46% of dentate adults questioned in the 1978 Adult Dental Health Survey[5] said that they put off going to the dentist because they did not like having fillings. Thus restorative dentistry is expensive from several viewpoints; yet there is little information available concerning the durability of restorations.

Allan,[6] Hunter[7] and Robinson[8] have all examined the durability of restorations in retrospective studies of the practice records of patients who had regularly attended single dentists over periods of 15 to 28 years. No details were reported concerning the conditions under which the restorations were placed, or the method of remuneration of the dentists. The studies of Allan and Robinson concerned 294 and 168 restorations respectively, which had been placed in the first year of the study periods.

Hunter adopted a method of analysis that was statistically more efficient—life table analysis. This enabled him to base his calculations upon a much larger sample of restorations, 5354 in 113 patients.

Gray[9] also used the life table analysis method in a retrospective study which was similar in size to Hunter's. But Gray's sample of 6731 restorations was spread among 513 Royal Air Force personnel who had been treated during the study period by a number of RAF dentists. In comparison to the single practice investigations mentioned above, bias introduced by any of the dentists in Gray's study would have been diluted by the pooled nature of the data. However, the very fact that the dentists were working under the salaried conditions of the armed forces may have influenced the findings. A similar comment applies to Crabb's study[10] of restorations undertaken by undergraduates and staff at the Dental Hospital at Leeds.

Since the great bulk of restorations are undertaken in the GDS, an investigation of their durability when placed

*Department of Periodontology and Community Dentistry, Dental School, Park Place, Dundee DD1 4HR, Scotland.

Patients were part of the Scottish cohort of the 1978 Adult Dental Health Survey (i.e. baseline data)

1,420 asked: 720 allowed their NHS dental records to be monitored.

# Large scale administrative databases

Elderton RJ. Br.Dent.J.1983:155:91-96

No significant difference in survival of 1-, 2- and 3-surface amalgams.

50% survival of “routine” amalgam & synthetic restorations = 4.5 – 5.0 years

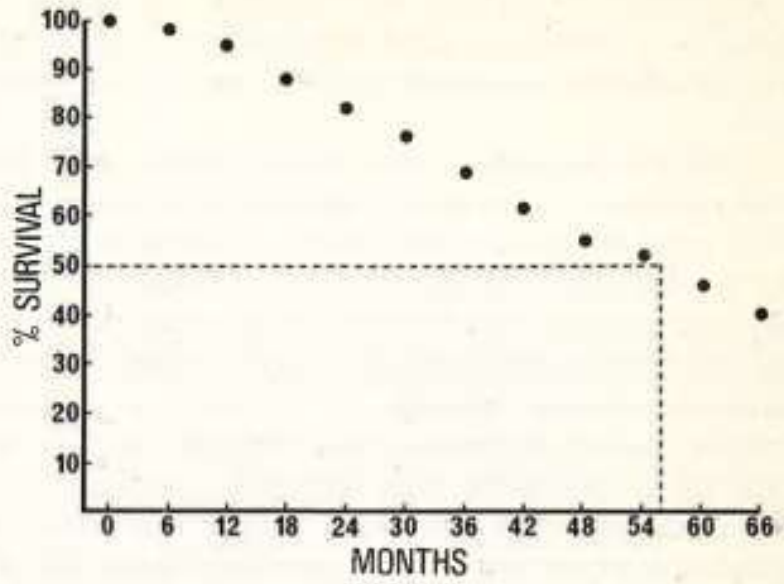



**Fig. 2.** Graph showing the proportion of amalgam restorations estimated to survive each six-month period up to 5·5 years. The median survival time of 56 months is indicated by broken lines.

The findings of the present study are clearly at the low end of the range. But these should be seen as preliminary results and longer term data are awaited with interest. However, they demonstrate the short lifespans that can be expected for the routine restorations which currently make up a large part of the dental service, and add fuel to the argument that redeployment of resources towards prevention should receive greater consideration than at present.

# The work of Richard Elderton challenged views on traditional cavity designs



## Restorative Dentistry: 1. Current Thinking on Cavity Design

R. J. Elderton

Cavity preparation and the restoration of teeth with amalgam and plastic tooth-coloured restorative materials has been a major preoccupation of dentists since the time of G.V. Black at the turn of the century. In their day, Black's[1] principles of cavity preparation provided a breakthrough in the conservation of teeth by imparting order to what was previously a somewhat haphazard process.

### Time to Review Cavity Design

As it is not only the turn of a new century that now looms, but also the turn of a new millennium, it is appropriate to review cavity design in order to ensure that modern dental practice is at the very forefront of current thinking in this area. If this is not done many widely-held beliefs, which should be relics of the past, stand to be perpetuated and therefore to become even more outdated.

It is hoped that this article will help the reader to grasp the logic behind current thinking on cavity design, while at the same time providing sufficient detail to enable the ideas to be applied in everyday clinical situations. Class I and II cavity designs for amalgam restorations are used to illustrate the most important changes in thinking that have occurred in recent years. The concepts described should, of course, also be applied to all other situations.

Textbooks and other literature to the present day are steeped in Black's original principles of cavity preparation[1] and the interpretations that have been placed upon them over the years have tended to become unbreakable laws which few clinicians or researchers have dared to challenge. Indeed, these principles have sometimes been taken to illogical limits in the belief that this is synonymous with high quality treatment. While few would disagree with Black's principles *per se*, the way in which they should be applied when preparing cavities is bound to change as dental disease changes, as preventive measures change, as dental materials and technology change and as understanding of the consequences of restorative dental treatment increases.[2]

*R. J. Elderton, BDS, PH.D. Professor of Preventive and Restorative Dentistry, University of Bristol Dental School*

### The Move Towards Smaller Cavities

Cavity preparation often involves the removal of large amounts of noncarious enamel and dentine in an endeavour to satisfy outdated interpretations of Black's principles. But, unfortunately, Black and generations of authors and teachers have to this day erroneously led their students to assume that the restorative procedures they describe will normally be successful in the long term. However, the poor durability of average restorations is an established fact.[3] If restorations commonly lasted a lifetime, there might be justification for large cavity preparations when small ones would do.

As cavities generally increase in size when restorations are replaced[4] and, as teeth become weaker as a result, it is clear that emphasis should be directed at keeping cavities as small as possible at every stage, commensurate with satisfying other requirements.

### Change in Current Teaching

An appreciation of this need was reflected recently in the response to a questionnaire sent out to dental schools in the United States, Canada and Puerto Rico. The results showed that cavity preparations considerably more conservative than those advocated by Black are widely taught in North America,[5] a finding which is in agreement with the consensus opinion expressed at the 1984 Annual Conference of the Association of Teachers of Conservative Dentistry in the UK.

This observation on both sides of the Atlantic summarises the main thrust of change in thinking on cavity design in recent years—a strong move towards smaller preparations. Indeed, most North American textbooks,





Where the cavity has to be extended to remove a fissure (for amalgam cannot be well adapted to a fissure which radiates from a cavity) a single sweep of a Jet 330 bur* produces a preparation that is just undercut and no more than 0.8 mm wide. This is about one-eighth or less of the intercusp width of a premolar (Figure 2c). As there is never any occlusal interference at the margins of these narrow parts of cavity preparations, the all-important high amalgam margin angles are produced (with room to spare) by carving the amalgam flat in these regions as shown in Figure 2c.

These principles apply to all Class I cavities for amalgam, irrespective of the teeth or surfaces involved, providing the caries does not undermine a cusp tip, a matter outside the scope of this article.

### Outdated Class II Cavity Design

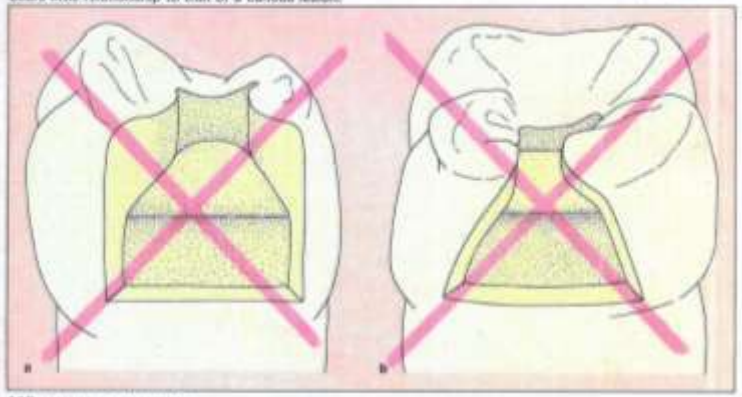
The major problem with the old thinking on Class II cavity designs has been the perceived need for big angular approximal boxes, yet these are both destructive and unnecessary. Certainly, they are not consistent with the shape of a Class II carious lesion. Figure 3 illustrates the sort of diagrams that have appeared in undergraduate textbooks over the years. The authors of the book from which Figure 3b has been redrawn* must, by most accounts, be considered progressive, yet there can be no case for preparing a cavity with such sharp corners at the gingival margin. No carious lesion is ever this shape and the mind boggles at the difficulties of condensing amalgam into these regions, especially after a matrix band has been applied and the corners have become truly three-dimensional point-angles. In the accompanying text, the authors ill-advisedly state:

> "The gingival wall is perpendicular to the long axis of the root and must extend apically far enough to be below the contact area and to provide a clearance of at least 0.5 mm from the adjacent tooth; 0.5 mm clearance will generally result in the gingival wall extending below the free gingival margin except in cases of gingival recession."

While the extension of a Class II cavity to clear its margins from the adjacent tooth is normally sound practice, extending the gingival margin of a cavity into

* Cotrell & Co. 16-17 Charlotte St. London W1P 2AA

**Figure 3.** *Examples of inappropriate Class II cavity designs for amalgam. (a) Rather square-cut design based upon the original Black cavity, which is still being taught in many quarters. (b) More progressive design in that there is less destruction of sound tooth tissue. However it is still far too mechanistic and the shape produced bears little relationship to that of a carious lesion.*







the gingival crevice is an irrational procedure, for such areas are no longer believed to be immune from caries, and gingival irritation is likely to be caused. Subgingival margins are also less easy to manage clinically and they are less amenable to subsequent re-evaluation. Owing to the curvature of the teeth, the buccal and lingual corners of the cavity in Figure 3b will, in any case, be considerably more than 0.5 mm from the adjacent tooth, so the case for preparing the gingival floor flat in the buccolingual plane cannot be justified on this account. So why is it flat in this plane? No answer is forthcoming.

### Extension for Prevention

The argument in favour of 'extending for prevention' the buccal and lingual embrasure walls of Class II cavities was based upon the somewhat erroneous concept of 'self-cleansing' areas at the corners or axial angles of the tooth. However, these so-called self-cleansing areas are virtually non-existent, as can be demonstrated readily by means of disclosing solution. Plaque is either present on the tooth or it is not, and if it is, the fall-off in quantity tends to occur from the gingival regions towards the occlusal, rather than from the approximal towards the buccal and lingual sides. And how often is recurrent caries found relating to a buccal or lingual embrasure margin? Rarely; so the position of the margin cannot be very important from this viewpoint. When recurrent caries occurs in relation to a Class II restoration it is usually at the gingival margin, which means that it is particularly important to keep this part of the cavity preparation as short and precise as possible, as in Figure 4, which shows a modern optimum Class II cavity design for amalgam.

### Other Problems with Class II Cavities

In addition to the over-cutting of sound tooth tissue in an endeavour to produce an old-fashioned outline form, for whatever reason, damage to the adjacent tooth and inadequate finishing of the gingival margin have also been noted as particular problem areas in connection with Class II cavity preparations. A method of overcoming these shortcomings has been suggested.[7]

### Modern Class II Cavity Design

As the caries commences in the region of the contact area, but to the gingival aspect of it, the removal of the carious tissue through an approach from the marginal ridge will inevitably involve removal of the contact area in most cases, leaving the cavity margins clear of the adjacent tooth. By forgetting any ingrained ideas about

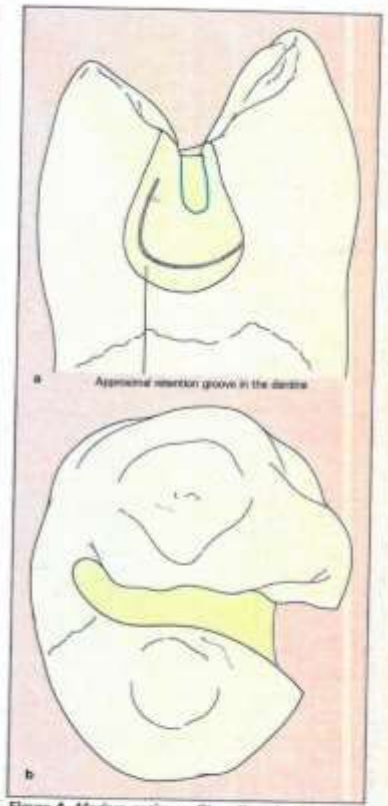



**Figure 4.** *Modern optimum Class II cavity design for amalgam in an upper premolar where there is a moderately-sized approximal carious lesion but minimal occlusal caries. As far as possible the cavity is prepared according to the shape and extent of the carious lesion. (a) Approximal view showing an approximal retention groove. (b) Occlusal view. Note that where fissure removal can be minimal, as here, the preparation takes the same form as the narrow part of a Class I cavity.*

# Twenty-two years on, I rediscovered those papers!

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Trevor Burke

# The genesis of minimal cavity design

Cavity design is an important consideration in direct restorative dentistry: readers will be aware from their own clinical experience that large cavities fail more readily than small and that large cavities, especially in premolar teeth, may predispose to cusp fracture. Readers will also be aware that minimal non-retentive cavity design is really only possible using adhesive techniques and that recent improvements in dentine bonding agents have facilitated this.[1]

However, readers may not be aware of the work of a pioneer in minimal cavity design, Professor Richard Elderton, who first proposed a new look at cavity design[2] in a paper published in 1979.[3] This was long before the era of adhesive dentistry, yet Elderton proposed serious deviations from GV Black's cavity designs and was roundly criticized for so doing in some quarters, as I recall. Yet his arguments had a basis in truth, as he stated that 'a sizeable proportion of restorations at that time were found to fail in a few years', adding that 'Black and generations of authors have erroneously led their readers to assume that the treatment that they prescribe would be successful in the long term'. He added that 'teeth are small and their treatment requires attention to detail'.[3]

Ten years on, in a special themed issue of *Dental Update* on 'Dentistry in the year 2000', Elderton published a paper on novel cavity designs.[4] The first section of his paper was titled 'Time to review cavity design', the second 'The move towards smaller cavities'. Readers can guess the premise for the article, minimally interventive cavities! He also added that there was no justification for extension for prevention. Among the cavity designs which he published were those illustrated in Figure 1 (published as in the original publication).[4] These are undoubtedly minimal, but I have reservations with regard to whether the very narrow isthmus and occlusal design would actually work with amalgam. It required approximal grooves in the dentine of a Class II for retention. It would work with an adhesive resin composite, as was noted towards the end of the paper.

This paper, which should remain prescribed reading for all modern dentists but was published too early for the *Dental Update* web site (which extends back 20 years) paved the way to a new look at cavity design.[5] The message was clear – we should always be thinking of ways to reduce loss of tooth substance during cavity preparation (even if still using amalgam). In that regard, amalgam bonding could be considered, but the placement of grooves or slots within the interproximal box will help retain a minimal amalgam Class II in a maxillary



Figure 1.



## Comment

**Figure 2.** Conventional cavity design maxillary first premolar, minimal cavity design second premolar, with the arrows indicating the potential position of slots in the interproximal box.

second premolar tooth, as it did for one of my patients for 15 years (Figure 2). The interproximal grooves, however, present a risk of pulpal exposure if too deep, a risk that adhesive dentistry does not pose.

The Minimata Agreement, with its ban on amalgam in the under 15s, should embrace the concept of minimal cavity design for Class I and II restorations, because this can only really be done using adhesive techniques. Despite the work, 20 years ago, of Nordbo and colleagues,[4] there remains a need for high quality cohort studies in the survival/success of restorations placed in mini Class II cavity designs. Only then will we know if the work of Richard Elderton, on the dangers of unnecessarily cutting extensive cavities, can produce successful, contemporary-design, minimal restorations in posterior teeth. However, even without such research, all readers will sense that keeping cavities as small as possible in 'small teeth' is bound to be a good thing, with an example of such a cavity being exhibited in a recent *Dental Update* publication.[5] And, for those readers still wedded to amalgam for reasons of funding or personal preference (which results of a recent publication have indicated applies to circa 50% of restorations in posterior teeth in the UK[6]), there is always the minimal option illustrated in Figure 2 which does not destroy the strength of a premolar tooth in the way that a conventional cavity might.

Richard Elderton's work was 20 years ahead of its time, given that few embraced the concepts at the time of publication. His cavity concepts are an example to all of us who are faced with cutting cavities in teeth – keep the cavity as small as possible, whatever the material! Or better still, embrace prevention, then we might not have to cut the cavity at all!

Finally, readers will, I hope, have read the first pages on *Dental Update*'s efforts to have readers advise other readers of events, good and bad, in the feature 'I learnt about dentistry from that', the concept being similar to the open reporting culture of the airline industry. I would be grateful for others to respond to this anonymous reporting of events so that we can all learn from them.

## References


1. Burke FJT, Lawson A, Green DJB, Mackenzie L. What's new in dentine bonding?: universal adhesives. *Dent Update* 2017; **44**: 328–340.
2. Elderton RJ. A new look at cavity design. *Proc Br Paedontics Soc* 1979; **9**: 25–30.
3. Elderton RJ. Restorative dentistry 1: Current thinking on cavity design. *Dent Update* 1986; **13**: 113–121.
4. Nordbo H, Leirskar J, von der Fehr FR. Saucer-shaped cavity preparations for posterior approximal resin composite restorations: Observations up to 10 years. *Quintessence Int* 1998; **29**: 5–11.
5. Burke FJT, Mackenzie L, Shortall ACC. Survival rates of resin composite restorations in loadbearing situations in posterior teeth. *Dent Update* 2019; **46**: 523–535.
6. Wilson NHF, Burke FJT, Brunton PA, Hosey M-T, Mannocci F. Dental Practice in the UK 2015/2016, Part 2: Aspects of direct restoration, bleaching, endodontics and paediatric dentistry. *Br Dent J* 2019; **226**: 110–114.

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Journal of Dentistry

journal homepage: www.elsevier.com/locate/jdent

# Longevity of 2- and 3-surface restorations in posterior teeth of 25- to 30-year-olds attending Public Dental Service—A 13-year observation

Ulla Palotie[a,*], Anna K. Eronen[b], Kimmo Vehkalahti[c], Miira M. Vehkalahti[d]

[a] City of Helsinki, Department of Social Services and Health Care, Metropolitan Area Department of Oral Special Care, P.O. BOX 6670, FI-00099 Helsinki, Finland
[b] Social Statistics, Department of Social Research, Faculty of Social Sciences, University of Helsinki, P.O. BOX 18, FI-00014 Helsinki, Finland
[c] Centre for Research Methods, Faculty of Social Sciences, University of Helsinki, P.O. BOX 18, FI-00014 Helsinki, Finland
[d] Department of Oral and Maxillofacial Diseases, Faculty of Medicine, University of Helsinki, P.O. BOX 41, FI-00014 Helsinki, Finland

*Methods:* Data were extracted from electronic patient files of the Helsinki City Public Dental Servic
Finland. A total of 5542 2- and 3-surface posterior composite and amalgam restorations were followed i
from 2002 to 2015. Longevity of restorations was illustrated using Kaplan-Meier curves. Annual failure rates (AFRs) of the restorations were calculated separately by type of tooth, size, and material. Differences in longevity were statistically tested with log-rank tests.

*Results:* Composite restorations formed the majority (93%). The longest median survival times and the smallest failure rates were found for teeth in the upper jaw, for premolars, and for 2-surface restorations. Median survival time of all restorations was 9.9 years (95% CI 9.6, 10.2) and re-intervention of restorations occurred less often in the maxilla (AFR 4.0%) than in the mandible (AFR 4.7%). Median survival time of composite restorations was greater for 2-surface than for 3-surface restorations: in premolars 12.3 vs. 9.6 years ($p < 0.001$) and in molars, 9.2 vs. 6.3 years ($p < 0.001$); for molar amalgams the difference (8.0 vs. 6.3 years) was non-significant ($p = 0.38$). Median survival time of 2- and 3-surface restorations in premolars exceeded that in molars (12.0 vs. 8.7 years; $p < 0.001$).

*Conclusions:* Longevity of posterior composite multisurface restoration is comparable to amalgam longevity.

*Clinical significance:* Regarding material choices for posterior multisurface restorations, composite and amalgam perform quite similarly in molars, 3-surface restoration being challenge for both materials.

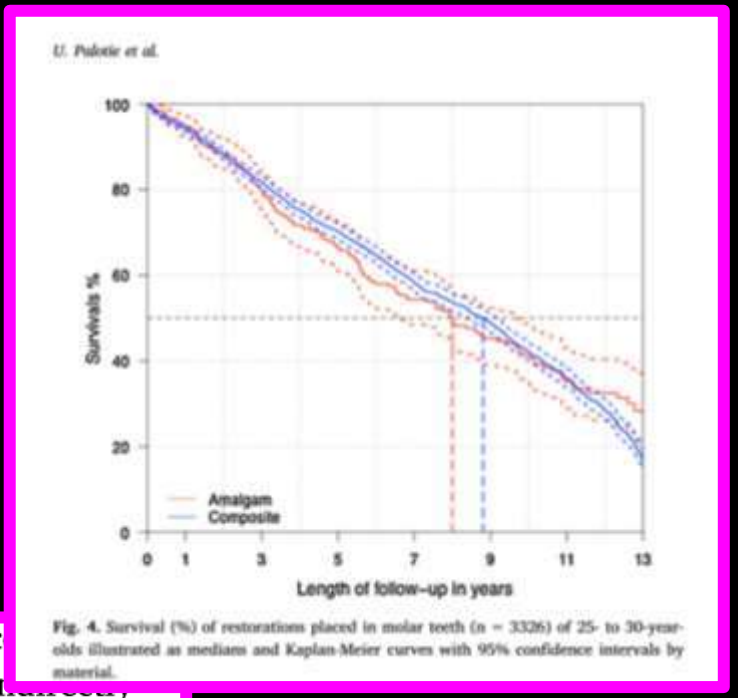



Fig. 4. Survival (%) of restorations placed in molar teeth (n = 3326) of 25- to 30-year-olds illustrated as medians and Kaplan-Meier curves with 95% confidence intervals by material.

# Large scale administrative databases

Gilthorpe MS et al. Community Dent.Health.2002:19:3-11.

*Community Dental Health* (2002) **19**, 3–11
Received 31 August 2000; Accepted 24 April 2001



**Multilevel survival analysis of amalgam restorations amongst RAF personnel**

Mark S. Gilthorpe[1], Martin T. Mayhew[2] and John S. Bulman[3]

[1]*Biostatistics Unit;* [2]*Transcultural Oral Health, Eastman Dental Institute for Oral Health Care Sciences, University College London;* [3]*Defence Dental Agency, RAF Halton, UK.*

***Objective*** To introduce the concepts of multilevel survival analysis through an investigation into the longevity of amalgam restorations. ***Basic research design*** The multilevel Cox proportional hazard model is illustrated using amalgam restoration data comprising three levels: repeated restorations at level-1, teeth at level-2, and subjects at level-3. The outcome was duration of amalgam restoration survival. Single-level and multilevel Cox methods are contrasted. ***Participants*** The data were from a survey of amalgam restorations (reported elsewhere), involving 200 RAF personnel aged between 16 and 37 years at enlistment between 1947 and 1979, having served continuously for a minimum of 16 years prior to 1994. ***Results*** Differences existed between single-level and multilevel methods; the latter being the method of choice. Initial caries experience was a good predictor of longevity. Molar teeth fared worse than pre-molars and MOD & B, MOD & L, and MOD & BL restorations experienced considerably greater risk of failure than did MOD, MO, DO and MO/DO ext types, which in turn fared worse than occlusal restorations. Root treated and pinned teeth also experienced an elevated risk of premature failure. There was a moderate but significant increase in restoration failure amongst subjects who were seen by more dentists throughout their service. ***Conclusions*** The application of multilevel modelling to survival analysis provides an appropriate and powerful solution to the problem of lack of independence amongst dental restorations. It is beneficial that studies undertake a multilevel analysis in preference to ignoring hierarchy or omitting swathes of information in order to perform a single-level analysis.

*Key words: dental public health; hierarchical linear models; multilevel modelling; survival analysis.*

**Introduction**

This article forms part of a series which introduces multilevel modelling (MLM) to dental research (Gilthorpe and Cunningham, 2000; Gilthorpe *et al.*, 2000; 2000a; 2000b; 2001; Lewsey *et al.*, 2000; 2001; Maddick and Gilthorpe, 2000;). This particular study was concerned with the longevity of amalgam restorations amongst subjects with several restored teeth, some of which will have undergone repeated restoration. The analysis seeks to determine which factors affect overall survival. To address this research question properly, certain methodological issues need to be considered. The problem that arises in this and similar studies is that hitherto standard statistical techniques fail to deal with the clustered nature of the study data, i.e. the grouping of successive restorations within the same tooth and multiple teeth nested within the same subject. Natural hierarchy requires special attention because the observations of interest are not strictly independent, a property required by most statistical procedures. In this instance, restored teeth and their successive restorations share a common environment within each subject; hence the assumption of independence is violated.

Wong and Day (1989) intimated that the current use of life tables is incorrect as teeth or restorations, and not the person, are taken as the experimental unit. They went on to reanalyse their results using a restoration randomly selected from each patient in the study and achieved a 13% increase in longevity compared to the non-independent study. However, they encountered a greatly increased standard error due to the decrease in sample size. Osborn (1987) questioned the independence of observations in clinical periodontal research, concluding that any strategy that examined only the sites of disease and ignored the patients should not be used, as this tactic assumed that all patients were the same, a most unlikely situation in practice. Bulman and Osborn (1989) later stated that a statistical analysis of dental disease using teeth as the units would be invalid because teeth are not independent units.

Dental research data often exhibit inherent hierarchy (Macfarlane and Worthington, 1999). Previously, the issue of data hierarchy has either been overlooked or else worked around (e.g. selecting only one restoration per subject). The first of these options is in error and the second suffers from the loss of data and a commensurate reduction in statistical power, as well as potential bias from inappropriate sub-sample selection. This article introduces the more sophisticated methodology of MLM, with which clustered survival data may be analysed. MLM can be used in any number of instances where the research data are inherently hierarchical (Goldstein, 1995), overcoming the constraint that observations are not independent. Within this study, a multilevel extension of Cox's proportional hazards model (Cox, 1972) was adopted.

Correspondence to: Dr. M.S. Gilthorpe, Biostatistics Unit, Eastman Dental Institute for Oral Health Care Sciences, 256 Gray's Inn Road, London WC1X 8LD, UK. Email: m.gilthorpe@eastman.ucl.ac.uk.

Gilthorpe et al. analysed amalgam restorations in 200 RAF personnel at 16 yrs.

4,712 restorations in 200 subjects (24 restorations per subject!)

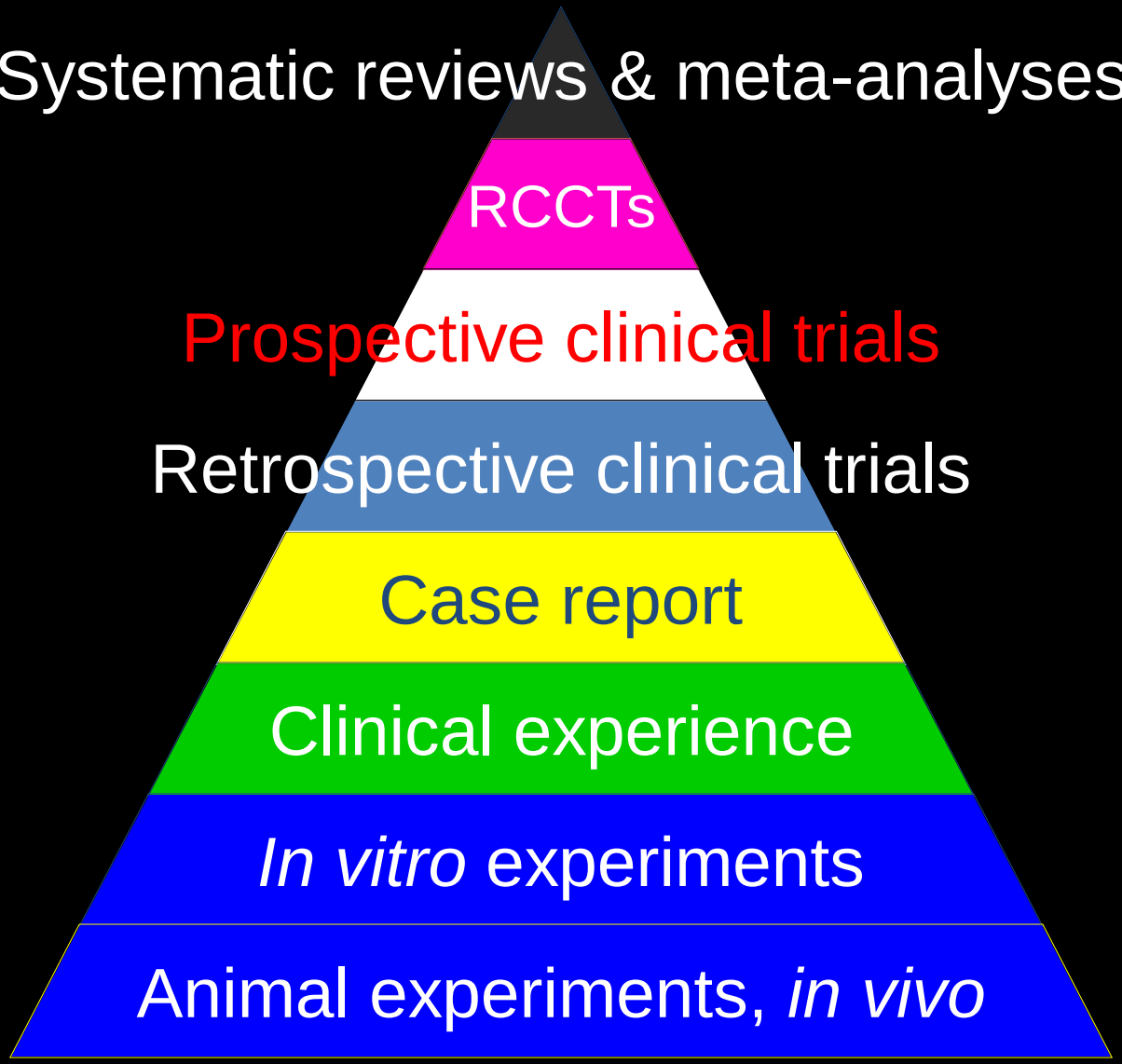
Cox Regression models used

Higher risk of failure associated with molars compared with premolars, large restorations *cf* small, presence of root fillings or pins.

Patients who had seen different dentists had more restoration failures.

Patients with high DMFT subsequently experienced increased risk of failure.

Successive restorations fare worse than previous ones.




# The hierarchy of evidence in dental research

Comment

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# End of the road for the randomized controlled trial in restorative dentistry?

Trevor Burke

Satisfactory survival of restorations is central to good practice, not only because unfulfilled patient expectations may lead to adverse medicolegal circumstances, but also because third party funders, managers and governments may also be inquisitive as to the performance of clinicians in their pay. However, there seems to be an obsession among researchers with the Randomized Controlled Clinical Trial (RCCT), and, ok, it is the internationally recognized gold standard. The problem is that the RCCT was designed for medicine and the pharmaceutical industry and not specifically for dentistry, where funding is less and the prescription of a drug or treatment is not so often a matter of life or death, as it may be in medicine, surgery or pharmacy. Another problem is that RCCTs are necessarily expensive, given that these should generally continue for a minimum of five years, with sufficient numbers of patients to satisfy a power calculation.

Manufacturers of dental materials and other funders generally appear reluctant to fund RCCTs into the applied performance of dental materials and restorations. Why? Firstly, as mentioned above, they are expensive and the income from the life of a given dental material is not likely to bring in the profits accrued from a lifetime of (comparatively higher) sales of a successful new drug being marketed in the pharmaceutical industry. Add to that the difficulties and time in recruiting suitable patients, and then placing the restorations, plus the time spent in actually commissioning and organizing the programme.[1] All of this means, according to Cunningham, that it might be well over six years before a 5-year date is ready for analysis.[1]

Arguably, the most well-known RCCT in restorative [illegible] first dedicated posterior composite [illegible] Dental Pu[illegible]

[illegible] risk of bias' (aesthetic [illegible] the lack of evidence' (only one study on bonded vs non-bonded amalgams); 4. No trials met the inclusion criteria – there is a need for well-designed and appropriately conducted clinical trials on this topic' (best therapies for post-extraction haemorrhage); 5. 'Insufficient evidence' (only one study included on BRONJ), 'insufficient evidence to support or refute use of any particular intervention for management of BMS'.

One cannot underestimate the amount of work which has gone into the original studies and their reviews, so it seems disappointing that more robust conclusions were not always possible. Perhaps the bar was set too high? Not all of the above studies related to restorative dentistry, but the same conclusion may be seen in Cochrane studies on restorative dentistry. Two, in particular, spring to mind. Firstly, the most recent Cochrane

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ABC
DU ISSN 0305-5000

Given the paucity of RCCTs in restorative dentistry, might well designed cohort studies provide good quality "evidence"?

Not only should the research be sound, but it should also be based in the real world of dental practice

# What is practice-based research?

“ strategy for conducting clinical dental research using general dental practitioners as investigators, and their practices as laboratories to investigate questions related to general dental practice”

Tom Hilton, IADR, 2006

considered not only as the silent partner in dental practice, but should be the very scaffolding on which a dental practice is built and sustained”

Mandel ID. Clinical research – the silent partner in dental practice.
Quintessence Int.1993:24:453-463

# Practice based research: Summary

## Advantages

- Uncontrolled
- Real life - real dentists, real patients
- Big numbers
- Enhanced patient image
- Dentist interest

## Disadvantages

- Uncontrolled - lack of calibration
- Time costs
- ? Lack of training

Trevor's view

Advantages > Disadvantages

# More plus points for practice-based research

- ✓For the dental practitioner - pushing back the comfort zone
- ✓Potentially uncontrolled nature of the research
- ✓Different “angle” from academics
- ✓Additional interest for the staff in the practice

I’ve been banging this drum for a long time!

The busy practitioner is ideally placed to observe trends in treatment need, the life-span of restorations, and whether caries activity is increasing or decreasing within the practice patient base. Some practition-

Burke F.J.T., Crisp R.J. McCord J.F. Research in dental practice:SWOT analysis. Dent.Update 2002:**29**:80-87.

Burke F.J.T. and McCord J.F Research in general dental practice – Problems and solutions. Br.Dent.J.1993:**175**; 396-398.

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COMMENT

# Practice-based Research?

The busy practitioner is ideally placed to observe trends in treatment need, the life-span of restorations, and whether caries activity is increasing or decreasing within the practice patient base. Some practitioners may store this information on disk, but others may simply store it as an anecdotal or subjective memory. For example, at recent meetings, I asked GDPs the question: "What is the greatest predisposing factor to tooth fracture?" An obvious response may be sticky toffee or a boiled sweet, but a substantial proportion of the audience replied: "An MOD restoration", which was precisely the result that a research project had demonstrated.[1] Similarly, on being asked which glove was most at risk of puncture during a surgical operation and at what point of the operation was the risk greatest, the practitioner audience responded "the left (non-working) hand, during suturing." This subjective observation has been confirmed by the results of a research project.[2]

These examples demonstrate that while practitioners have an excellent awareness of their everyday clinical situations, the majority do not analyse their observations scientifically. This has been demonstrated by the low volume of research which has been carried out in general dental practice.[3] This is not a criticism of general practice or practitioners; simply a reflection of the difficulties of practice-based research. Difficulties include cost — practices are designed for patient treatment, and time equals money, and GDPs may consider themselves ill-trained in research methodology.[4] There may be other perceived difficulties such as lack of calibration of operative diagnoses, problems of validation and other uncontrolled variables, but these are the making of real-world decisions and outcomes.[5]

Why bother confirming anecdotal observations with research? Surely our profession is founded upon scientific principles and there can be no place for anecdote and subjectivity in a science, particularly when patient treatment is involved.

Many difficulties associated with practice-based research can be overcome, and 1997 sees a massive boost for such research in the UK. The NHD R & D initiative is discussed on page 75; a project in which dental practitioners will be encouraged to put forward ideas and proposals. Clinically-related research has not been considered to be an exact science, but rather a scientifically-based approach to the investigation and quantification of the effects, behaviour and performance of therapies in patients with disorders and disease.[5] For the enlightened, it may be possible to turn observations into robust, clinically-related research projects based in the real world of general practice, which may ultimately provide the evidence to confirm that what we are doing is correct, or alternatively, to alter thinking.

A survey of papers published in three journals in 1991 showed that 21.9% were related to clinical techniques, and less than 10% of these papers involved general dental practice or practitioners.[3] It is hoped that new initiatives will change this emphasis and raise awareness of practice-based research. General dental practice is, to a large extent, where the dental health of our public stands or falls. While there are many areas from which dental research may originate, a substantial proportion of dental research projects should have a firm practice base.

**F.J. Trevor Burke**

**References**
1. Patel DK and Burke FJT. Fractures of posterior teeth: a review and analysis of predisposing factors. *Primary Dental Care* 1995; **26**: 10.
2. Burke FJT, Baggett FJ and Lomax M. Assessment of the risk of glove puncture during oral surgery procedures. *Oral Surg Oral Med Oral Path Oral Rad Endod* 1996; **82**: 18-21.
3. Monroe LA, Burke FJT and McCord JF. Trends in publications on clinical techniques/materials 1971-1991. *Int Dent J* 1995; **45**: 163-165.
4. Burke FJT and McCord JF. Research in general dental practice. Problems and solutions. *Br Dent J* 1993; **175**: 396-398.
5. Wilson NHF and Mjor IA. Practice-based research: importance, challenges and prospects. A personal view. *Primary Dental Care* 1997; **4**: 5-6.

Dental Update:1997

# Trevor's view:

Well-designed cohort studies from general dental practice can provide good evidence for survival of restorations.

# What I plan to talk about

- Sustainability and dental restorations
- History of restoration survival research in the UK
- Factors influencing restoration survival (materials, dentists, patients)
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making

# What I plan to talk about

- Sustainability and dental restorations
- History of restoration survival research in the UK
- Factors influencing restoration survival (materials, dentists, patients)
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making

The choice
of dental
materials
is vast

…*but* choosing a material is a fundamentally important decision, and should be evidence based

# 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

You can
save £40 by
buying  a
5ml bottle of
“own label”
bonding
agent,
but……

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.



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

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


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

Journal of Dentistry 56 (2017) 84–98

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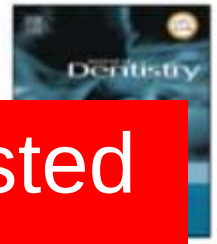



Two own brand label (OBL) materials tested against 3M Z250

# Own brand label restorative materials—A false bargain?

Gaute Floer Johnsen[a], Minh Khai Le Thieu[a], Badra Hussain[a], Elzbieta Pamuła[b], Janne Elin Reseland[a], Ståle Petter Lyngstadaas[a], Håvard Haugen[a,*]

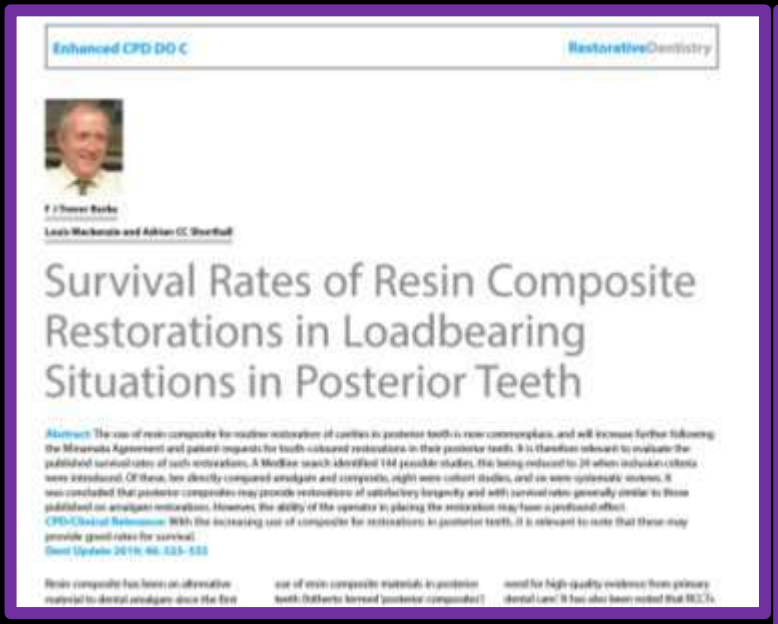
[a] University of Oslo, Department of Biomaterials, Institute of Clinical Dentistry, Faculty of Dentistry, Geitmyrsveien 71, Oslo, NO 0455, Norway
[b] AGH University of Science and Technology in Kraków, Kraków, Małopolska, Poland

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

*Conclusions:* The OBLs were in general outdone by the conventional composite.
*Clinical significance:* OBLs restorative materials have become pervasive in the dental market. Manufacturers often promise equal or better characteristics than existing brand-name composites, but at a lower price. Dentists are highly recommended to reconsider utilization of OBLs lacking sound scientific scrutiny, and our findings underscore this recommendation.

# The “evidence” for Own Label Brands

# Evidence for materials in posterior teeth



Enhanced CPD DO C

RestorativeDentistry



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

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

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

Dent.Update. 2019:46: 523-535

# 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.

# 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.

*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.*

## 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.

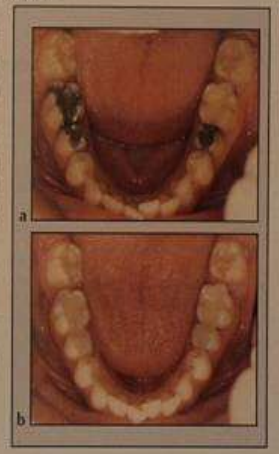
Studies are available which show satisfactory behaviour of these materials in clinical use.[9-11] From further studies, it can be seen that Occlusin restorations performed their intended purpose satisfactorily for periods of at least five years.[12]

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.*






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

Dent.Update.1989: 16.114-116

# Trevor’s view:

Once a patient has received one tooth-coloured restoration in a back tooth, they are unlikely to return to amalgam.

…there is now some new, positive information on GICs in posterior teeth

Oper Dent. 2020 May/Jun;45(3):243-254. doi: 10.2341/18-282-C. Epub 2019 Oct 29.

# Clinical Performance of a Glass Hybrid Restorative in Extended Size Class II Cavities

S Gurgan, Z B Kutuk, C Ozturk, R Soleimani, F Y Cakir

PMID: 31661352 DOI: 10.2341/18-282-C

## Abstract

**Objective:** To evaluate the clinical performance of a glass hybrid restorative compared with a resin composite in the restoration of large and deep Class II cavities after 24 months.

**Methods and materials:** A total of 108 extended size, with the width of the proximal box not interfering with the peak of the cusps and the proximal box in occlusion, 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 the six-, 12-, 18-, and 24-month recalls according to the modified US Public Health Service criteria. Negative replicas at each recall were observed under scanning electron microscopy (SEM) to examine surface characteristics. Data were analyzed statistically.

**Results:** After 24 months, 90 restorations were evaluated in 32 patients (recall rate: 86.5%). Four glass hybrid restorations were missing; three were due to bulk and one was due to proximal fracture at 12 months. Only six restorations were scored as bravo at baseline and at the six-, 12-, 18-, and 24-month recalls for color ($p<0.05$). 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 at 24 months.

**Conclusions:** Although glass hybrid restorations showed significant mismatch in color, both restorative materials exhibited successful performance for the restoration of large Class II cavities after 24 months.

- Two-year evaluation of 108 extended-size class II restorations (width of the proximal box not interfering with the peak of the cusps and the proximal box in occlusion) in 37 patients.
- Half of the restorations were restored with EQUIA Forte, the others with composite.
- Two independent examiners

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**Conclusions:** Although glass hybrid restorations showed significant mismatch in color, both restorative materials exhibited successful performance for the restoration of large Class II cavities after 24 months.

Despite this conclusion, four of the restorations, of 90, had fractured.
WARNING! large interproximal box widths employed in this study may be best avoided and the manufacturer's indications for use should be followed. The other message might be – use a resin composite for such wide boxes.

- At 2 years, 90 restorations in 32 patients examined (recall 86.5%). Four glass hybrid restorations were "missing", three due to bulk fractures and one due to proximal fracture, but no significant differences were noted between the two materials.
- CONCLUSION "although the glass hybrid materials showed a significant mismatch in colour, both materials exhibited successful performance for the restoration of large class II cavities at 24 months".

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

IADR
International Association for Dental Research

## 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, 1was 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

***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.

Received: 31 May 2022 | Revised: 5 December 2022 | Accepted: 8 December 2022
DOI: 10.1111/jerd.13000

RESEARCH ARTICLE

WILEY

# Five-year randomized clinical trial to evaluate the clinical performance of high-viscosity glass ionomer restorative systems in small class II restorations

Ramy Ahmed Wafaie BDS, MDS, PhD[1] | Ashraf Ibrahim Ali BDS, MDS, PhD[2] | Salwa Abd El-Raof El-Negoly BDS, MDS, PhD[3] | Salah Hasab Mahmoud BDS, MDS, PhD[2]

[1]Operative Dentistry Department, Faculty of Oral and Dental Medicine, Delta University for Science and Technology, Gamasa, Egypt
[2]Operative Dentistry Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt
[3]Dental Biomaterials Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt

**Correspondence**
Salah Hasab Mahmoud, Operative Dentistry Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt.
Email: salahmahmoud2010@mans.edu.eg

**Abstract**

**Objective:** Evaluate and compare the 5-year clinical performance of three high-viscosity glass ionomer restorative materials in small class II restorations.

**Materials and Methods:** Forty patients, each with four class II restorations, were enrolled in this trial. A total of 160 restorations were placed, 25% for each material, as follows: three high-viscosity conventional glass ionomer restorative systems (Ketac Universal Aplicap, EQUIA Forte and Riva Self Cure HV) and a microhybrid resin composite system (Filtek Z250). Clinical evaluation was performed at baseline and after 1, 3, and 5 years by two independent examiners using FDI criteria. Epoxy resin replicas were observed under scanning electron microscope (SEM) to examine surface characteristics. Data were analyzed with Kruskal-Wallis, Mann–Whitney *U*, Friedman, and Wilcoxon signed-rank tests ($p < 0.05$).

**Results:** The success rates were 100% for resin composite, 97.4% for Ketac Universal, and 94.9% for both EQUIA Forte and Riva HV restorations. Statistically significant differences were observed between all groups in terms of surface luster and color match criteria ($p < 0.05$). Statistically significant changes were found over time for all criteria except for fracture of material, postoperative hypersensitivity, recurrence of caries, tooth integrity, periodontal response, adjacent mucosa, and oral health criteria ($p > 0.05$). SEM evaluations were in accordance with the clinical findings.

**Conclusions:** Although drawbacks in surface luster and color match appeared over the 5-year evaluation period, the three high-viscosity glass ionomer restorative materials provided successful clinical performance in small to medium sized class II cavities compared to microhybrid resin composite.

**Clinical Significance:** Glass ionomer restorations exhibited clinical performance similar to that of microhybrid resin composite restorations in small class II cavities subsequent to 5-year evaluation.

KEYWORDS
class II restorations, clinical performance, clinical trial, glass ionomer, resin composite

- Well-constructed, independent randomised trial in Egypt.
- Three high-viscosity glass ionomer materials in small class II cavities after five years. Ketac Universal Applicap (3M), EQUIA Forte (GC) and Riva self-cure (SDI), *vs* a hybrid resin composite system, Filtek Z250 (3M), as control.
- Patients were between 20 and 40 years of age, with each needing *four or more* restorations.
- 160 restorations in 40 patients. Isthmus width of the cavities was not more than 1/3 of the intercuspal distance
- Isolation by cotton rolls & high-volume saliva ejector. Restorations examined by two independent examiners, epoxy resin replicas of the restorations observed.

- 39 patients examined at five years
- 100% success for the resin composite restorations,
- 5 failed class II glass ionomer restorations (one Ketac Universal (2.6% failure), two EQUIA Forte (5.1%), and two Riva HV (5.1%).
- *AFR of 0.5% for Ketac Universal and 1% for both EQUIA Forte and Riva HV groups.*
- Reason for failure - fracture of class II glass ionomer restorations, while one Riva HV restoration failed because of “partial looseness *in situ*”.
- *CONCLUSION:* Although differences in surface lustre and colour match at 5 years, the three high-viscosity glass ionomer materials provided successful clinical performance in small to medium class II cavities.

# 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.

# Trevor's view:

The study by Wafaie *et al* also indicated good results at 5 years for Ketac Universal (3M), which doesn't need a coating or a cavity conditioner.

Enhanced CPD DO C

FJ. 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

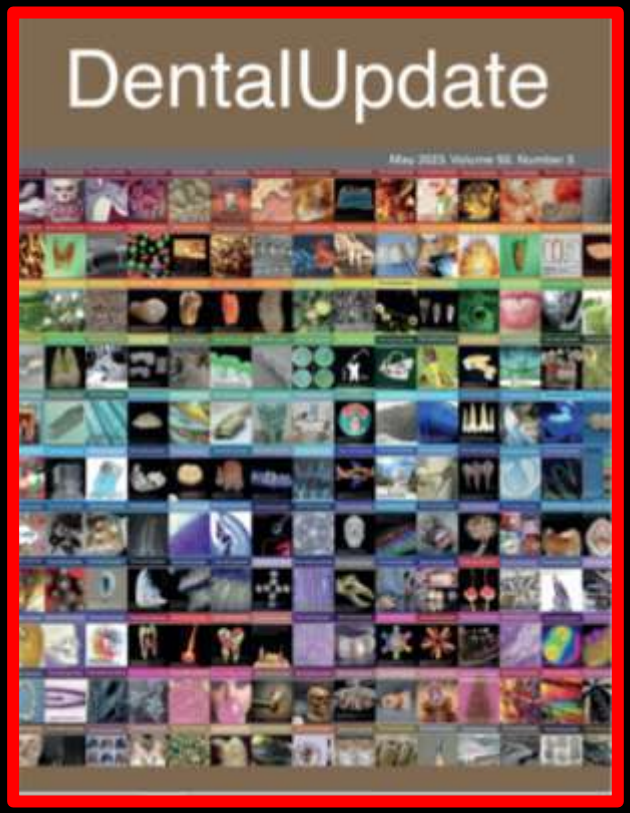
Glass ionomer materials were first described in a patent in 1969,[1] with the first publication being in 1972 by Wilson and Kent.[2] They were originally considered to be a development of silicate cement,[3] which comprised a fluoro-alumina-silicate (FAS) glass, mixed with phosphoric acid. The mixed 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, MGDS, 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 RCPS, FCGDent, 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



Read the paper for complete information!




Dent.Update
2023:50:437-443

# For anterior teeth…

- Resin composite
- Resin composite
- Resin composite
- Resin composite
- Resin composite
- Resin composite

…is the outright winner:

- Aesthetically good
- Can be used in a minimally invasive manner
- Physical properties excellent
- Bonding agents have improved

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,[7] 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



# Conclusion from this publication:

New Universal bonding agents are an advance in bonding

Dent.Update.2017:44:328-340

# More recently!

Bonding to Dentine: An Update on Universal Adhesives

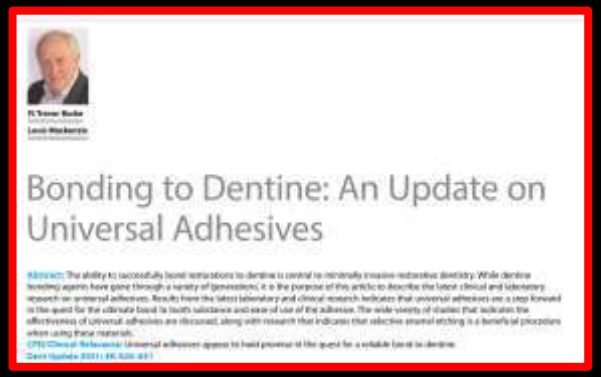
In summary therefore, there is a strong body of evidence that indicates that recently developed UAs provide clinical effectiveness as good as, or better, than previous 'gold standard' adhesives, and that selective etching of the enamel is desirable, given that the results presented above indicate improved 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[21,22]), 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.

**10 laboratory studies & 11 clinical studies included**

Finally, recent laboratory studies include the work by Lago and co-workers[39] 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.

Dent.Update.2021: 620-631



Bonding to Dentine: An Update on Universal Adhesives

Dent.Update.2021: 620-631

## Conclusions

In summary, universal adhesives hold promise and:

- Can be used in total etch, self-etch, selective enamel etch modes, depending on the clinician's choice. The need to selectively etch the enamel has been demonstrated to be beneficial in many of the studies quoted in this review, both from the point of view of retaining class V restorations, but also because marginal staining and defects will be reduced;
- In addition, in view of the potential to cause post-operative sensitivity as a result of (over) etching dentine, particularly in posterior teeth, it is the authors' view that this is not necessary or desirable and that selective enamel etching is the method of choice;

# More recently!

## Conclusions

- Some are compatible with direct and indirect procedures, when used with a designated resin luting material from the same manufacturer as the bonding agent because this will contain a separate activator;
- May be suitable primers for silica and zirconia;
- Can bond to different substrates, such as metal.

However, as with any new material or technique, more long-term clinical evaluations (alongside those referenced above) are needed to adequately demonstrate the value of these universal adhesives.

# Trevor’s view:

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

# Scotchbond Universal Plus: What's different?

It bonds to caries affected dentine

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

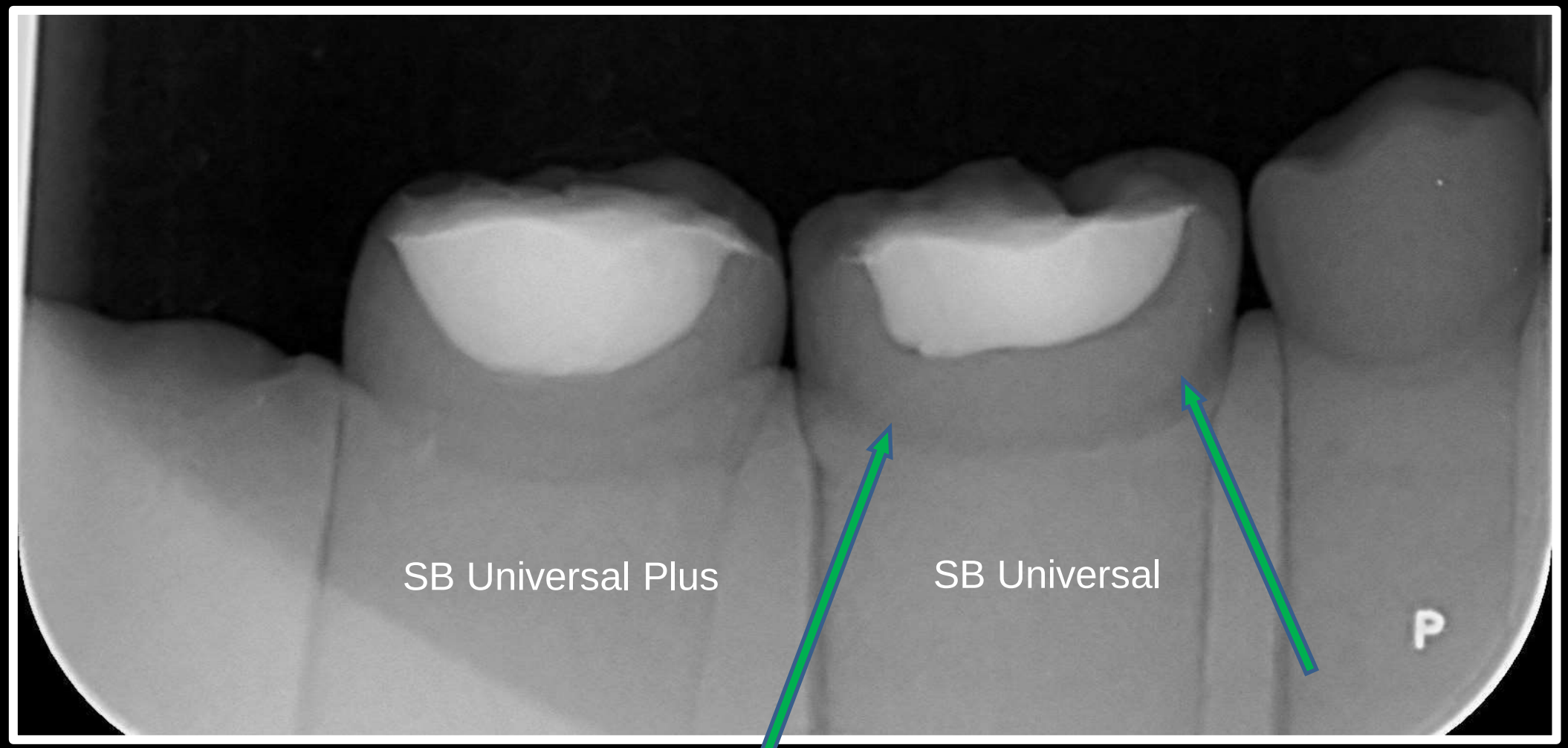
Improved silane

BPA free

The gamechanger

# A longstanding question

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




Filtek Universal Pink Opaque

Amalgam
V
RBC

In terms of
“sustainability”



# The environmental impact of dental amalgam and resin-based composite materials

S. Mulligan,[1]* G. Kakonyi,[2] K. Moharamzadeh,[1] S. F. Thornton[2] and N. Martin[1]

**Key points**

An overview of commonly used dental materials and the impacts of their use on the environment is presented.

Environmental pollution pathways are considered for both amalgam and resin-based composite.

Microplastic pollution from dental resin-based composite applications is highlighted.

Direct-placement dental restorative materials include dental amalgam, glass ionomer, resin-modified glass ionomer, compomer and resin-based composite (RBC). The choice of restorative material is determined by its ability to restore the structure and/or the aesthetic appearance of the dentition and to impart a net therapeutic value. In this way, the most appropriate material system is chosen to manage each particular clinical situation in the most effective manner. The most commonly used direct-placement materials in everyday modern dentistry are dental amalgam and resin-based composites. To date, concerns about the environmental impact from the use of dental materials has focused on dental amalgam and mercury release. It is now evident that the continued use of dental amalgam is time-limited on the basis of environmental pollution as recommended by the Minamata Treaty. The recommendations include a planned phase-down of use of dental amalgam with an anticipated complete phase-out by 2030. The environmental impact of other restorative dental materials deserves further consideration. This article provides a detailed overview of the environmental issues associated with the use of dental amalgam, the potential environmental issues associated with the alternative resin-based composite restorative materials and to consider recommendations for further research.

## Introduction

The decision-making process for the clinical use of a dental restorative material is made in accordance with the material's ability to restore the structure and/or the aesthetic appearance of the teeth and in doing so, impart a net therapeutic effect. Subjective parameters such as the clinician's personal choice, skill base and the cost of the material are also considerations made in this decision-making process. The potential impact upon the environment from the use of dental materials has been a minor consideration to date, with much of the focus centred on the use of dental amalgam.[1] Dental amalgam is a direct-placement restorative material with other materials in this category being calcium silicate, glass ionomer, resin-modified glass ionomer, compomer and resin-based composite (RBC).[2] Currently, dental amalgam remains a popular restorative material that is used throughout the world in large quantities with approximately 75 tonnes per year being used within the EU alone.[3] Worldwide, dental amalgam and RBC are the most commonly used direct-placement dental restorative materials. The decision to use amalgam instead of RBC to restore a tooth is often based on the perceived disadvantages of RBC. These disadvantages include a requirement for adjunct technologies and equipment (eg dental dam and light curing units), longer placement time, higher material costs and a less predictable functional longevity compared with dental amalgam.[4–7] Notwithstanding, in light of the advice of the Minamata Treaty and regardless of the restorative credentials of dental amalgam, its environmental impact due to mercury release means ongoing use is time-limited. An eventual cessation of use of dental amalgam is in the foreseeable future, with a predicted increase in use of the obvious alternative, RBC. This raises an important question; what are the environmental credentials of the alternative direct placement restorative materials and RBCs in particular?

The reality is that, as per any manufactured item, all dental restorative materials have a potential pollutant effect on the environment. This will be associated with the fabrication process, transportation, clinical use and disposal of waste material. In addition following the death of a person who has these restorative materials in their dentition, constituents are released into the soil or atmosphere, following interment or cremation respectively.

As stated, to date dental amalgam has received the most attention as a source of environmental pollution from dentistry on account of the mercury content of this material. Resin-based composites, by contrast, have not been considered in this context. This is possibly due to a focus on mercury release from amalgam, the knowledge that heavy metal pollution is a serious, recognised issue, and perhaps a perception that RBCs are inert plastic materials and as such not considered to be an environmental hazard. This view is possibly reinforced by virtue of the natural tooth-like appearance of RBC,

[1]The University of Sheffield, Academic Unit of Restorative Dentistry, Sheffield, United Kingdom; [2]Department of Civil and Structural Engineering, Sheffield, United Kingdom
*Correspondence to: Steven Mulligan
Email: s.mulligan@sheffield.ac.uk

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## Conclusion

In conclusion, environmental pollution from the release of mercury from dental amalgam is a major concern, but one that is currently being addressed at an international level, with an expected phase-out of this material in the foreseeable future. RBCs have been identified as a clear environmental pollutant, with an impact arising from both the chemicals that leach out in the form of complex eluted resin components and the microparticles arising from everyday use during clinical placement, removal and CADCAM fabrication. The impact of RBCs is difficult to quantify due to their complex chemical nature. There is a need for a comprehensive research programme that sets out to investigate the nature, magnitude and effect of pollution caused by the release of eluates and micro-particulates in to the environment arising from common RBCs.

# What I plan to talk about

- Sustainability and dental restorations
- History of restoration survival research in the UK
- Factors influencing restoration survival
  (materials, *dentists*, patients)
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making

# Dentist factors relating to restoration longevity

- Correct diagnosis, correct choice of technique /material
- Optimum technique

This can only be achieved by keeping up to date, using the literature to indicate what works where

Lord Moynihan (1928), President of the Royal College of Surgeons: “Give me the surgeon who does the right operation competently, rather than the surgeon who does the wrong operation beautifully”.

# Dentist factors relating to restoration longevity

- Correct diagnosis, correct choice of technique /material
- Optimum technique

- For materials, follow the instructions, handle correctly
- Obtain good isolation (rubber dam if necessary)
- Take time

# The literature:
# Are dentists consistent in their treatment planning?

Variation among dentists in planning treatment
Elderton RJ,Nuttall NM.
Br.Dent.J.1983:154:201-206.

The nature of restorative dental treatment decisions
Nuttall NM, Elderton RJ.
Br.Dent.J.1983:154:363-365

An in vitro study of restorative dental treatment decisions Merrett MCW, Elderton RJ. Br.Dent.J.1984:157:128-133.

Relationship between epidemiologic coronal caries assessments and practitioners' treatment recommendations in adults.
Bader JD, Shugars DA, Rozier RG.
Community Dent.Oral Epidemiol.1993:21:96-101

Factors influencing variation in dentist service rates
Grembowski D, Milgrom P, Fiset L. J.Public Health Dent.1990:50:244-250

Understanding dentists' restorative treatment decisions. Bader JD, Shugars DA. J.Public Health Dent.1992:52:102-110.

Bader JD, Shugars DA. Agreement among dentists' recommendations for restorative treatment. J.Dent.Res. 1993:72:891-896.

Variation in dentists' clinical decisions. Bader JD, Shugars DA. J.Public Health Dent.1995:55:181-188

Cost implications of differences in dentists' restorative treatment decisions
Shugars DA, Bader JD J.Pub.Health Dent.1996:56:219-222.

Factors influencing the likelihood of successful decisions to treat dentin caries from bitewing radiographs. Community Dent.Oral Epidemiol.1992:20:175-180.

Dentists' stated restorative treatment thresholds & their restorative and caries depth decisions
Lewis DW, Kay EJ, et al. J.Public Health Dent.1996:56:176-181.

Dentists' variability in restorative decisions, microscopic & radiographic caries depth
Lewis DW, Kay EJ, et al. Community Dent.Oral Epidemiol.1996:24:106-111.

# The literature: Are dentists consistent in their treatment planning?

There is quite a lot in the literature: A few (notorious) examples:

# Variation among dentists in planning treatment

**Elderton & Nuttall Br.Dent.J.1983:154:201-206.**

- 18 1st year dental students
- 7 gdps and 8 hospital dentists
- The dentists examined the 18 “patients” and recorded proposed treatment over a period of 5 months
- Number of tooth surfaces planned for restoration varied from 20 to 153
- Treatment of 184 tooth surfaces resulted from only 2 dentists

# Variation among dentists in planning treatment

**Elderton & Nuttall Br.Dent.J.1983:154:201-206.**

- Only 41% of treatment decisions were agreed upon by more than half of the dentists
- Dentists who worked in the GDS planned more restorative treatment than dentists who worked in the hospital
- But… there was greater agreement among GDS dentists as to which surfaces needed treatment

# Factors influencing variation in dentist service rates

Grembowski D, Milgrom P, Fiset L. J.Public Health Dent.1990:50:244-250

- Dental claims from the Washington Education Association (Insurance scheme for teachers) examined
- 200 dentists in Washington State, USA
- Rates calculated for diagnostic, preventive, restorative and prosthodontic, endodontic treatment
- Compared with 8 practice variables such as practice busyness, practice size, age of practice etc.

# Factors influencing variation in dentist service rates

Grembowski D, Milgrom P, Fiset L. J.Public Health Dent.1990:50:244-250

**RESULTS**

- Non-price competition (e.g. practice amenities, office waiting time) influenced treatment given to patients
- More restorative treatment provided for patients in busy practices
- Practice characteristics such as practice age were related to variation
- As dentists and their practices aged, fewer services were provided per patient
- Services and expenditure per patient were largest in big practices with high fees
- Wide variation detected across dental practices

## Agreement among dentists' recommendations for restorative treatment

Relationship between epidemiologic coronal caries assessments and practitioners' treatment recommendations in adults. Bader JD, Shugars DA, Rozier RG. Community Dent.Oral Epidemiol.1993:21:96-101

- 283 patient examinations – 51 dentists and 43 patients
- Perfect agreement obtained for 59% of teeth
- Among restored teeth, reliability of dentists' recommendations for treatment was little better than poor

**CONCLUSIONS**

- "it is easy to criticise dentists for failing to achieve perfect agreement on 4 of every 10 teeth examined"
- "in the absence of clearly defined, widely accepted criteria for recommending treatment, this level of agreement may represent a reasonable performance"

Therefore: Should we have clearly defined criteria for every dental transaction (like the airline industry?)

The literature:
Are dentists consistent in diagnosis & planning treatment?

**Not very!**

# What I plan to talk about

- Sustainability and dental restorations
- History of restoration survival research in the UK
- Factors influencing restoration survival (materials, dentists, patients)
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making

# First, a brief lesson in Kaplan Meier

The goal is to estimate a population survival curve from a sample.

If every patient is followed until death, the curve may be estimated simply by computing the fraction surviving at each time.

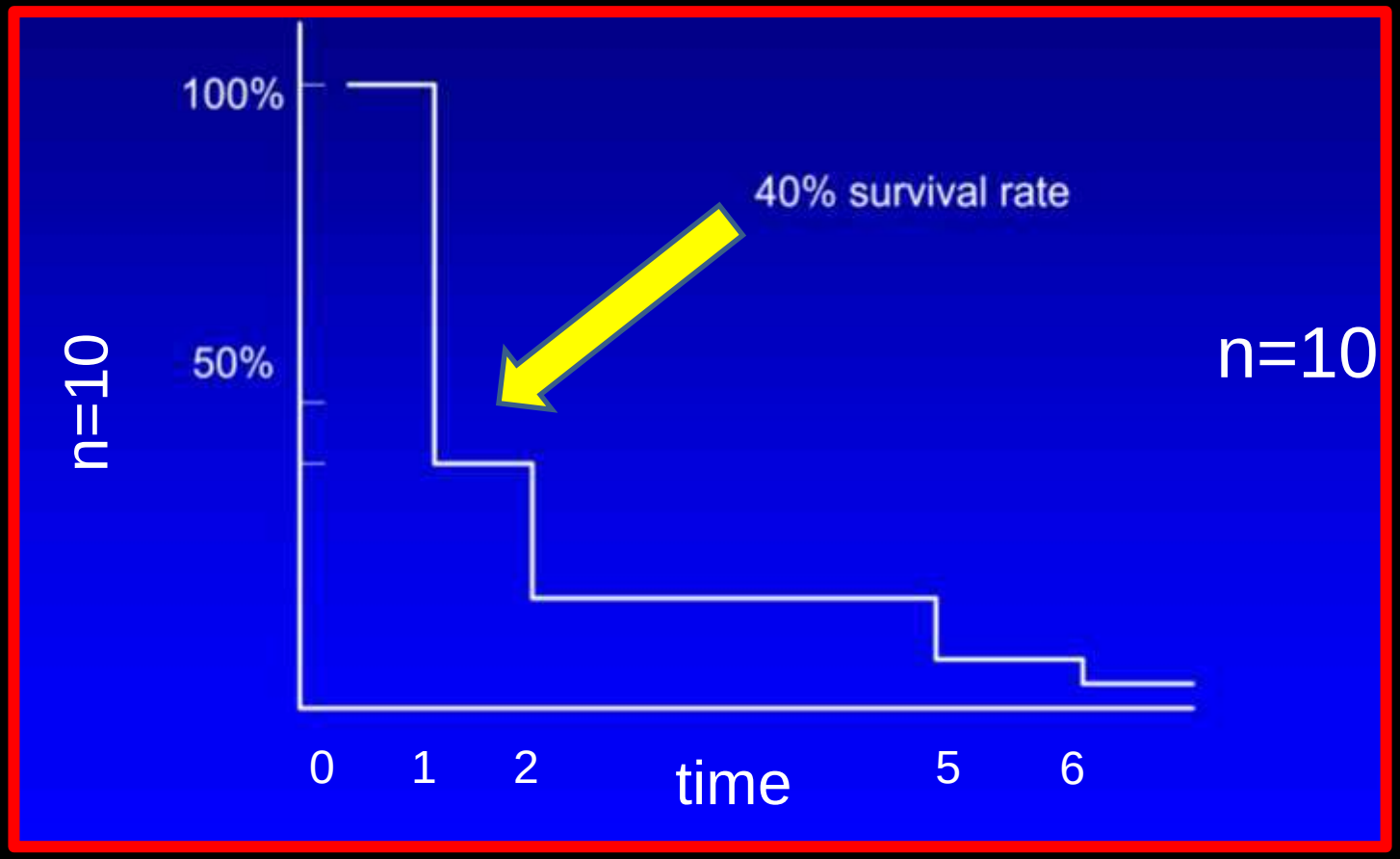
However, in most studies patients tend to drop out, become lost to follow up, move away, etc.

A Kaplan-Meier analysis allows estimation of survival over time, even when patients drop out or are studied for different periods of time.

# First, a brief lesson in Kaplan Meier

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

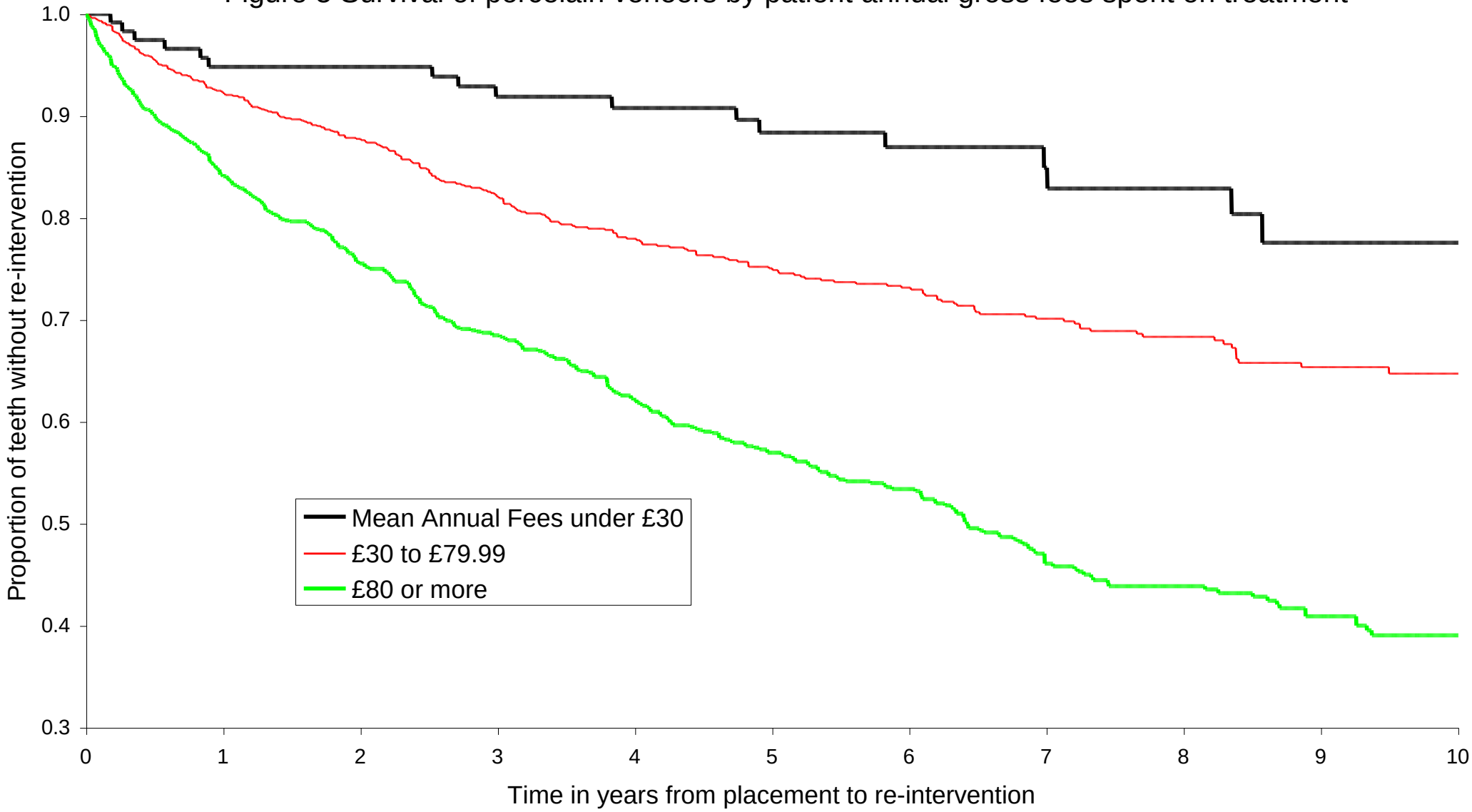
# Kaplan Meier statistical analysis




n=10 hypothetically

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

Figure 5 Survival of porcelain veneers by patient annual gross fees spent on treatment



# Experts in the field consider Kaplan Meier to be the method of choice for assessing restoration survival

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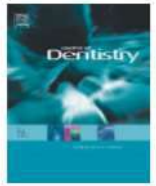
available at www.sciencedirect.com

ScienceDirect

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



## Age of failed restorations: A deceptive longevity parameter

**Conclusion:** In absence of all dates of placement and failure for a series of restorations a reliable measure of restoration longevity is not yet available. Kaplan–Meier statistics remains the preferred method of calculating longevity of a group of dental restorations.

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8 December 2010
Accepted 10 December 2010

*Keywords:*
Longevity
Survival
Median
Dental restoration
Cross-sectional

There is pressing need to enhance evidence base in respect of longevity of restorations. Currently, there is lack of appreciation of differences between survival data based on the age of failed restorations as compared to gold standard Kaplan–Meier statistics.

*Objectives:* This study was undertaken to compare and contrast longevity data for a number of data sets. It investigated if restoration longevity, as calculated by the Kaplan–Meier method, is different from longevity according to the median survival time of failed restorations.

*Methods:* Existing clinical datasets of dental restorations and an artificial dataset were used to calculate longevity according to Kaplan–Meier statistics and by means of calculation of median age of failed restorations.

*Results:* The findings indicate that median age of failed restorations may be considered as a deceptive measure of restoration longevity. Specially extending the duration of longitudinal studies of restorations apparently leads to higher values for median age of failed restorations. Restorations of materials that tend to exhibit early failures may have lower values for median age of failed restorations, compared to restorations of different materials which tend to exhibit failures later in clinical service, and thereby not giving a true measure of overall restoration longevity.

*Conclusion:* In absence of all dates of placement and failure for a series of restorations a reliable measure of restoration longevity is not yet available. Kaplan–Meier statistics remains the preferred method of calculating longevity of a group of dental restorations.



If you don't believe Trevor!

# Eastbourne, home of The Dental Practice Board: now, The Dental Services Division of the Business Services Authority (Newcastle)

# 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

# ….later: the database

- SN7024, available from UKDataService.ac.uk, contains anonymized longitudinal data on a large sample of patients (chosen by random date of birth within each possible year of birth) 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!

| Type of Treatment | Survival (%) at 1 year | 5 years | 10 years | 15 years | n |
|---|---|---|---|---|---|
| Amalgam | 91 | 66 | 51 | 41 | 7,[illegible]64 |
| Composite Resin | 87 | 59 | 43 | [illegible] | [illegible]25 |
| Glass-ionomer | 84 | [illegible] | [illegible] | [illegible] | [illegible],566 |
| Crown | [illegible] | [illegible] | [illegible] | 53 | 1,202,005 |
| Inl[illegible] | [illegible] | [illegible] | 49 | 37 | 86,189 |
| Ve[illegible] | 90 | 69 | 52 | 42 | 66,509 |
| Multiple types | 88 | 59 | 41 | 30 | 151,990 |
| All Restorations | 89 | 64 | 48 | 39 | 13,896,048 |

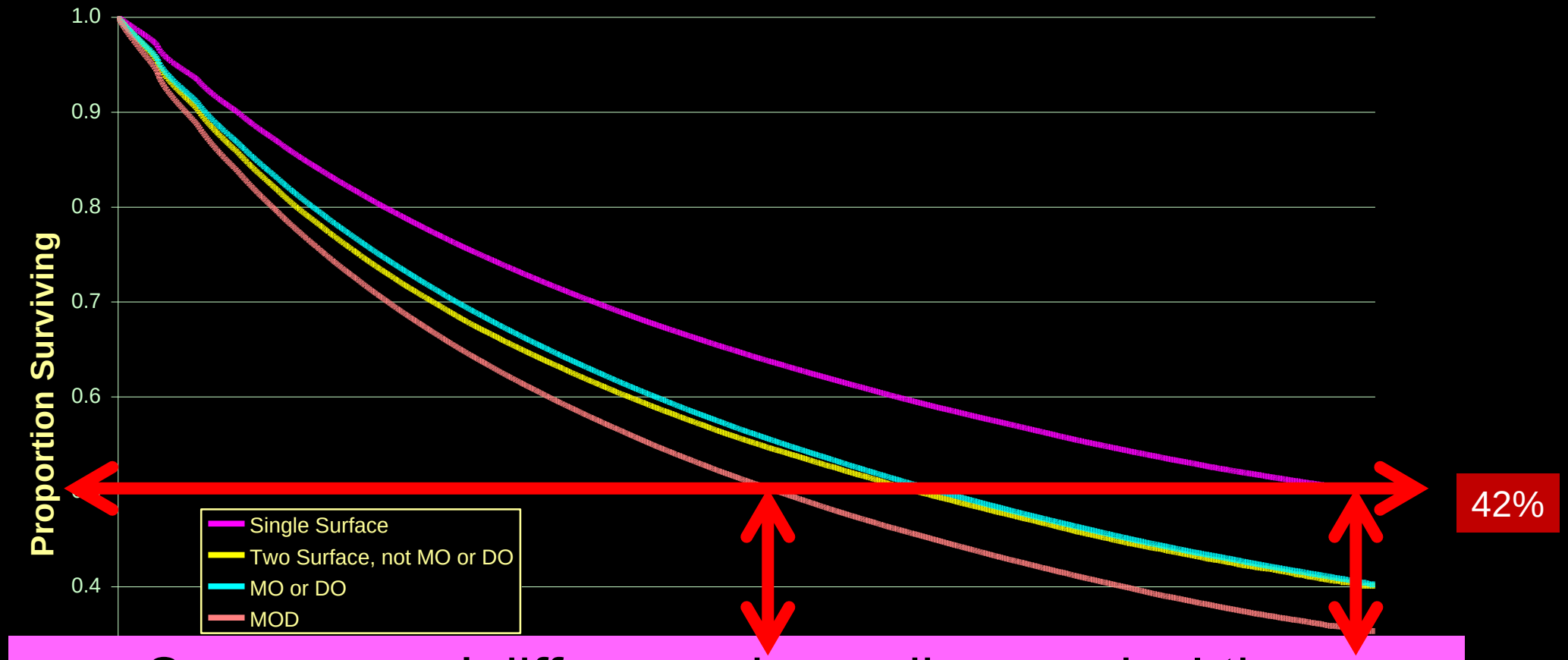
But I don't want you to swich off now!

a total of 13,896,048 tooth restorations

# Direct placement restorations: amalgam

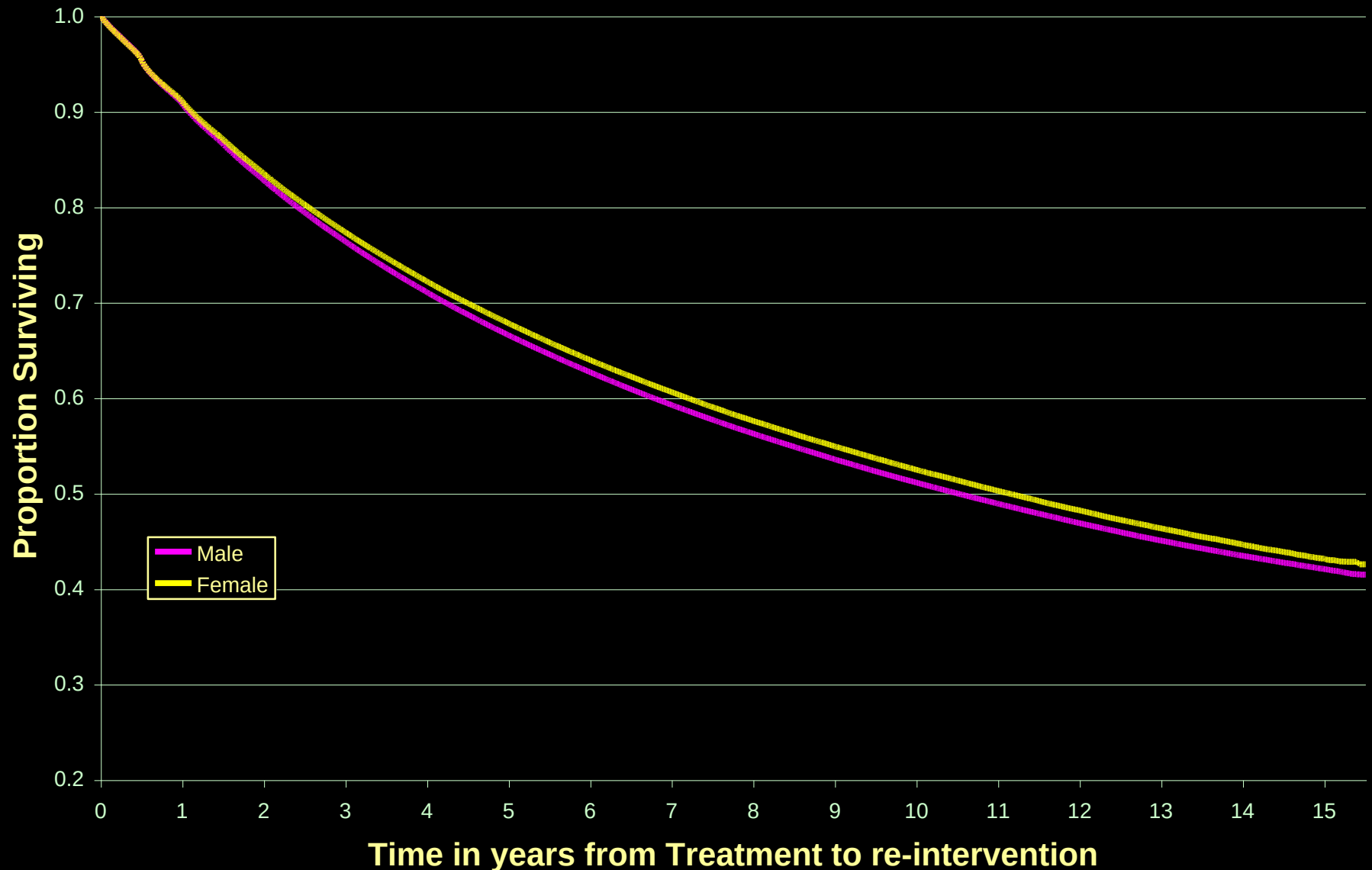
7,425,049 amalgam cases included, of which 2,537,331, of which had a re-intervention

# Amalgam Restoration Survival by Type of Cavity

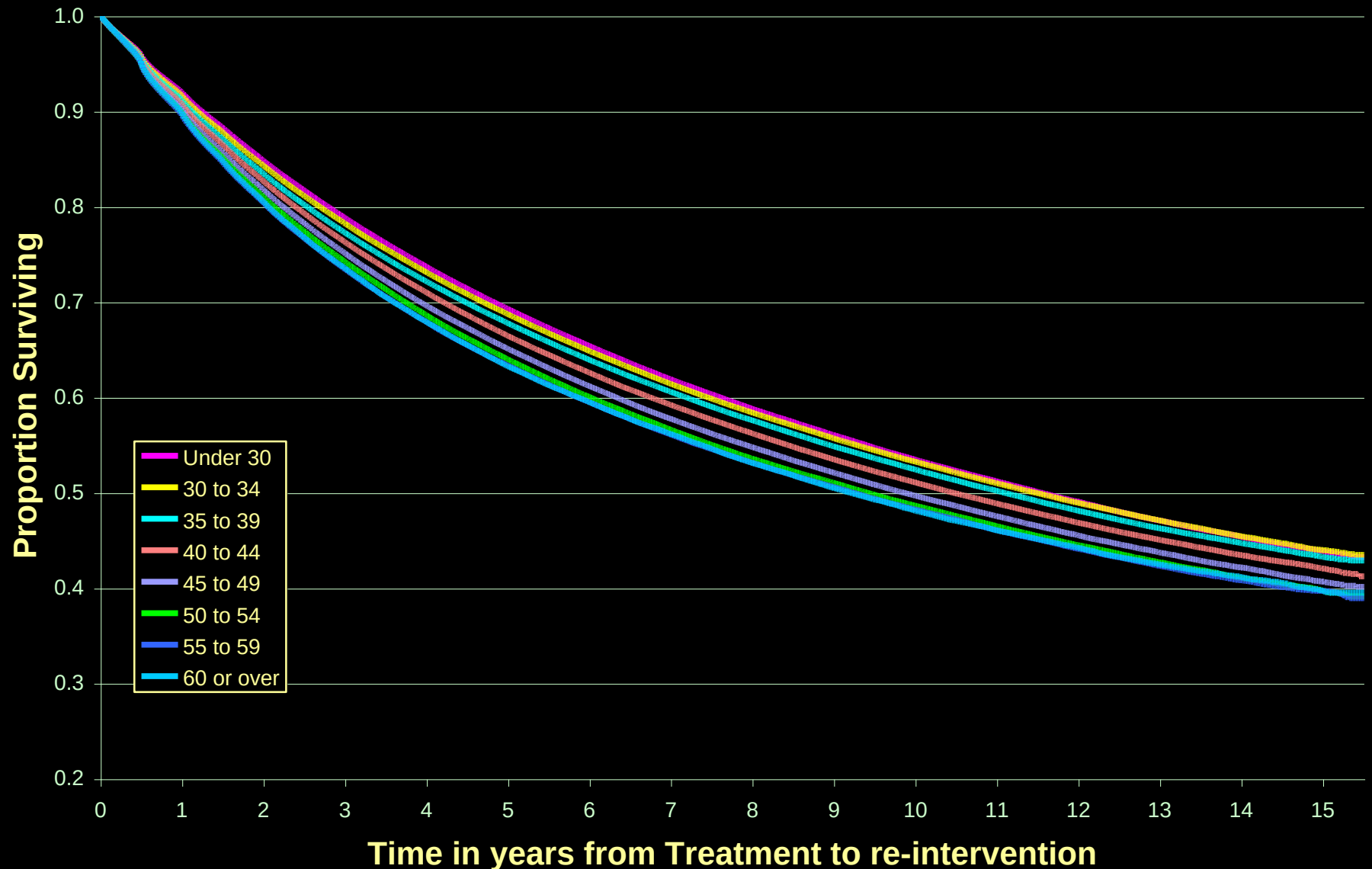



Seven years' difference in median survival time between MOD restorations and class I restorations

# We can also determine survival of direct restorations according to dentist gender



# We can also determine restoration survival according to dentist age



# Trevor's view:

There are a number of dentist variables which influence restoration survival

# What I plan to talk about

- Sustainability and dental restorations
- History of restoration survival research in the UK
- Factors influencing restoration survival (materials, dentists, *patients*)
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making

# Patient factors relating to restoration longevity

- Diet
- Oral health awareness, oral hygiene
- Smoker or not

These will all affect the success/survival of restorations

# Patient factors relating to restoration longevity

- Diet
- Oral health awareness, oral hygiene
- Smoker or not, perio disease or not
- Patient pays for treatment or not
- Age

The literature is clear with respect to the adverse effects of smoking on periodontal and implant health

# Patient factors relating to restoration longevity

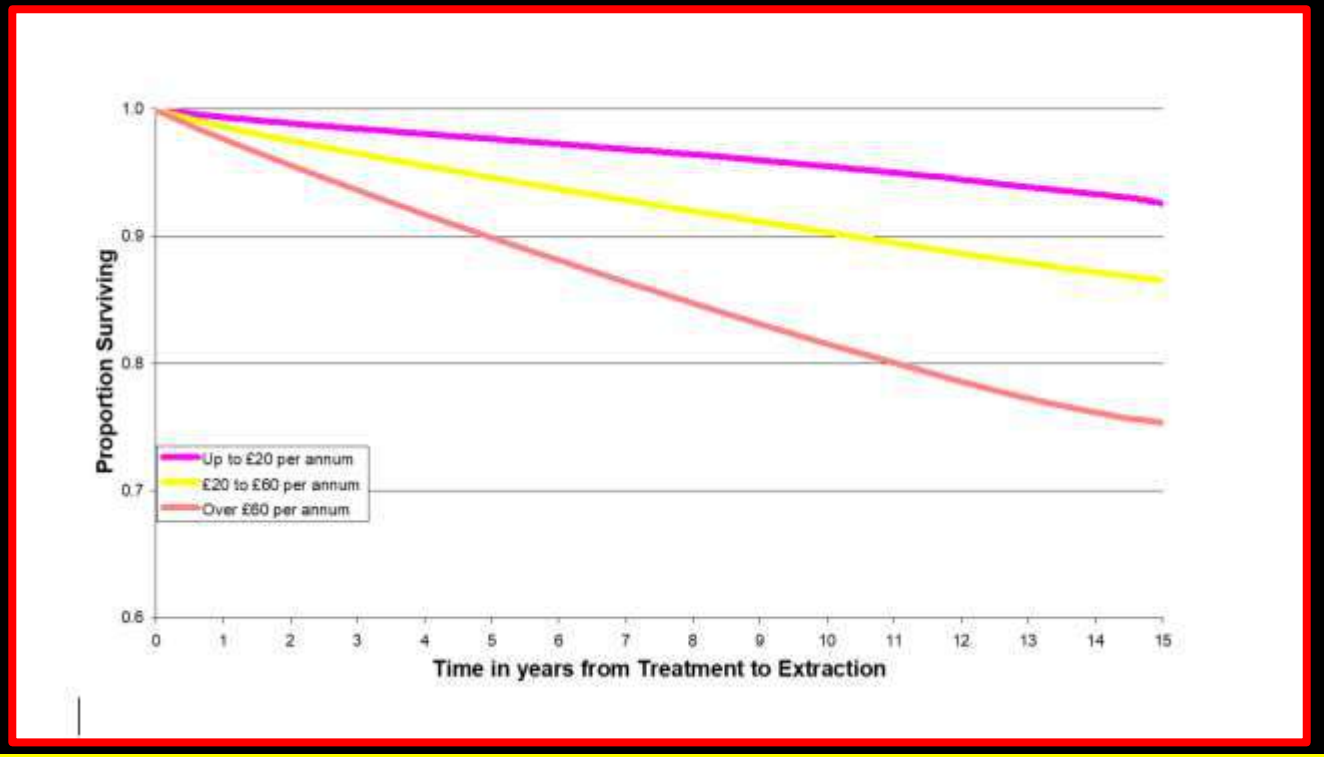
- Diet
- Oral health awareness, oral hygiene
- Smoker or not
- Patient pays for treatment, or not
- Age

# There are two different proxies for the patient's state of oral health:

the annual average cost of GDS dental treatment for the patient, and,

the median interval between courses of treatment for the patient.

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




We must therefore be careful what we promise to a patient with history of high treatment need!

# Confirmed by further analysis

Patient history as a predictor of future treatment need? Considerations from a dataset containing over nine million courses of treatment

P. Steve K. Lucarotti[1] and F. J. Trevor Burke*[1]

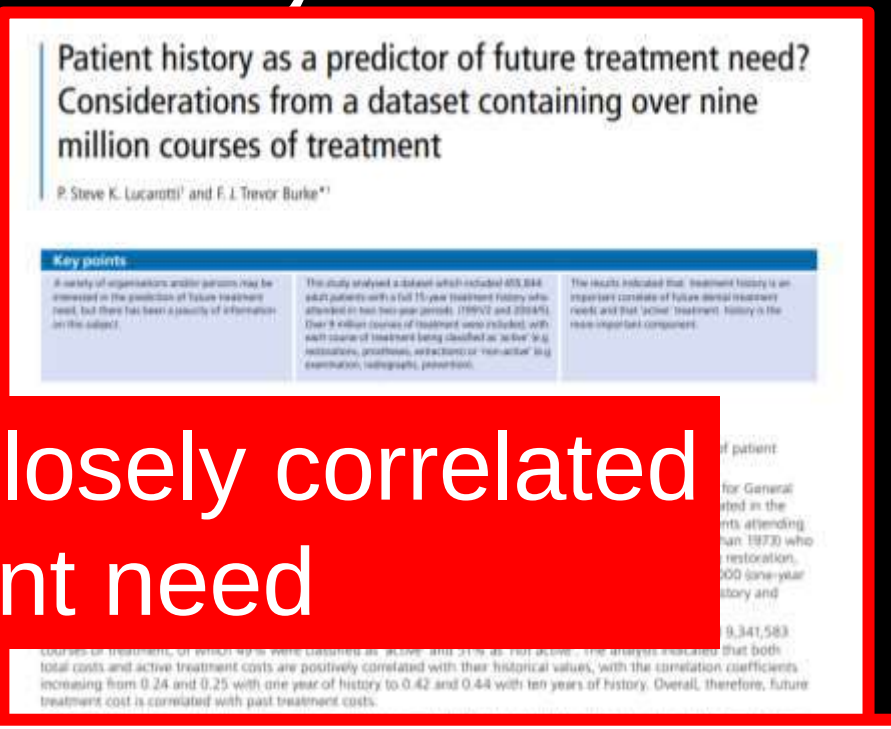
Key points

Abstract

Aim It is the aim of this paper to con... history, matters in predicting future t...

Methods This study used a data set (... Dental Services' (GDS) patients, this b... GDS of England and Wales between ... in 2003 was restricted to adult patien... attended in both two-year periods 19... extraction, prosthesis) or 'not active' ... history), 1999–2000 (two-year history ... outcome correlated.

Results A total of 455,844 patients ... courses of treatment, of which 49% were classified as 'active' and 51% as 'not active'. The analysis indicated that both total costs and active treatment costs are positively correlated with their historical values, with the correlation coefficients increasing from 0.24 and 0.25 with one year of history to 0.42 and 0.44 with ten years of history. Overall, therefore, future ...



Patient history as a predictor of future treatment need? Considerations from a dataset containing over nine million courses of treatment

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Key points

... patient ... for General ... ated in the ... nts attending ... han 1973) who ... restoration, ... 000 (one-year ... story and ... 9,341,583 ... total costs and active treatment costs are positively correlated with their historical values, with the correlation coefficients increasing from 0.24 and 0.25 with one year of history to 0.42 and 0.44 with ten years of history. Overall, therefore, future treatment cost is correlated with past treatment costs.

**Future treatment need is closely correlated with past treatment need**

**Results** A total of 455,844 patients met the inclusion criteria, namely adults with a full history. They received 9,341,583 courses of treatment, of which 49% were classified as 'active' and 51% as 'not active'. The analysis indicated that both total costs and active treatment costs are positively correlated with their historical values, with the correlation coefficients increasing from 0.24 and 0.25 with one year of history to 0.42 and 0.44 with ten years of history. Overall, therefore, future treatment cost is correlated with past treatment costs.

**Conclusions** Treatment history may provide an important correlate of future dental treatment needs and the more history the better, at least up to five years. However, active treatment is the important component and should be distinguished from preventive and diagnostic treatments.

# Patient factors relating to restoration longevity

- Diet
- Oral health awareness, oral hygiene
- Smoker or not
- Patient pays for treatment, or not
- Age

# The effect of patient age on ***survival of restorations***

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

We must be careful what we promise when restoring teeth for older patients

# The effect of patient age on survival of restored teeth: other factors

- 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

# Trevor's view:

There is a wide range of patient variables which may influence restoration survival

…also

# Patients care more than we suspected!

## A practice-based assessment of patients' knowledge of dental materials

F. J. T. Burke*[1,2] and R. J. Crisp[1,2]

RESEARCH

IN BRIEF

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

**Aims** It is the aim of this study to determine, by means of a questionnaire completed by patients attending ten UK dental practices, patients' level of knowledge on dental materials and techniques. **Materials and methods** Members of The PREP (Product Research and Evaluation by Practitioners) Panel were asked to recruit patients to participate in a questionnaire-based assessment of their knowledge of dental materials. **Results** Two hundred and forty-nine patients took part in the questionnaire. Sixty-three percent (n = 157) of the respondents were female and 92% (n = 229) of the respondents stated they were regular attenders at the dental practice. The respondents were asked how important the quality of dental materials used in their mouth was, and on a Visual Analogue Scale (VAS) where 1 = not important and 10 = very important, the result was 9.6. The same score was recorded when they were asked how important it was that the materials used in their mouth were supported with relevant clinical research evidence and long term data of the success of the material. They were also questioned on the subjects of price, manufacturer, source or material and type of filling material. A significant amount of respondents demonstrated that they had concerns over the use of amalgam. **Conclusions** Respondents expressed strong views that the materials used on their teeth should have a robust evidence base and they care about the materials that are used in their mouths.

Refereed Paper
Accepted 9 November 2015
DOI: 10.1038/sj.bdj.2015.956
*British Dental Journal 2015; 219: 577-582

A practice-based assessment of patients' knowledge of dental materials

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BRITISH DENTAL JOURNAL VOLUME 219 NO. 12 DEC 18 2015

## CONCLUSIONS:

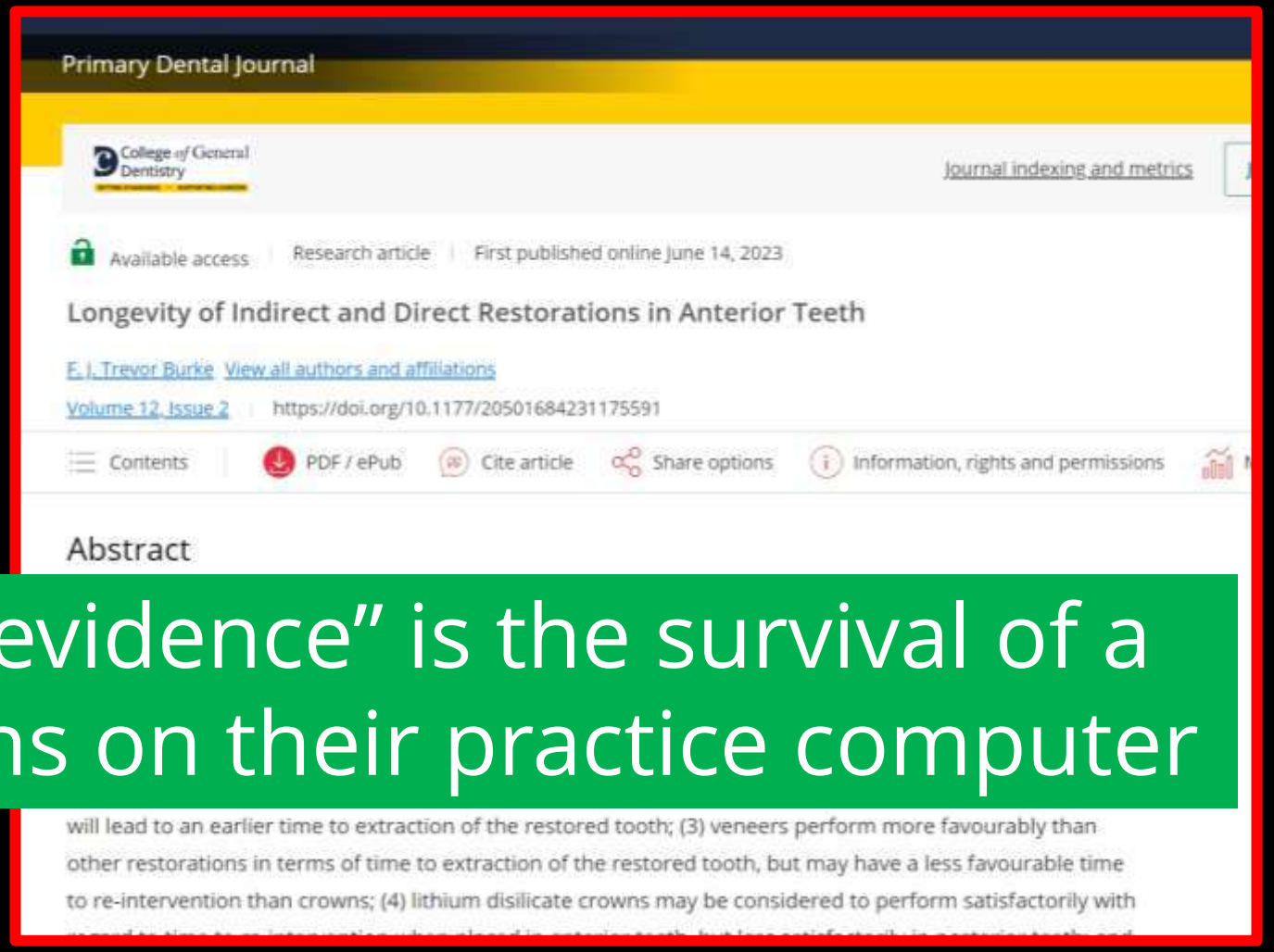
- Patients feel that materials should have a robust evidence base, produced by manufacturers with experience in the field
- Patients care about the materials that we use
- Almost half did not wish “own label” materials to be used in their mouths
- One third expressed anxieties regarding the use of amalgam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

# What I plan to talk about

- Sustainability and dental restorations
- History of restoration survival research in the UK
- Factors influencing restoration survival (materials, dentists, patients)
- A brief Kaplan Meier statistical analysis lesson
- Applying that to clinical decision making
- Survival of restorations in the dental literature

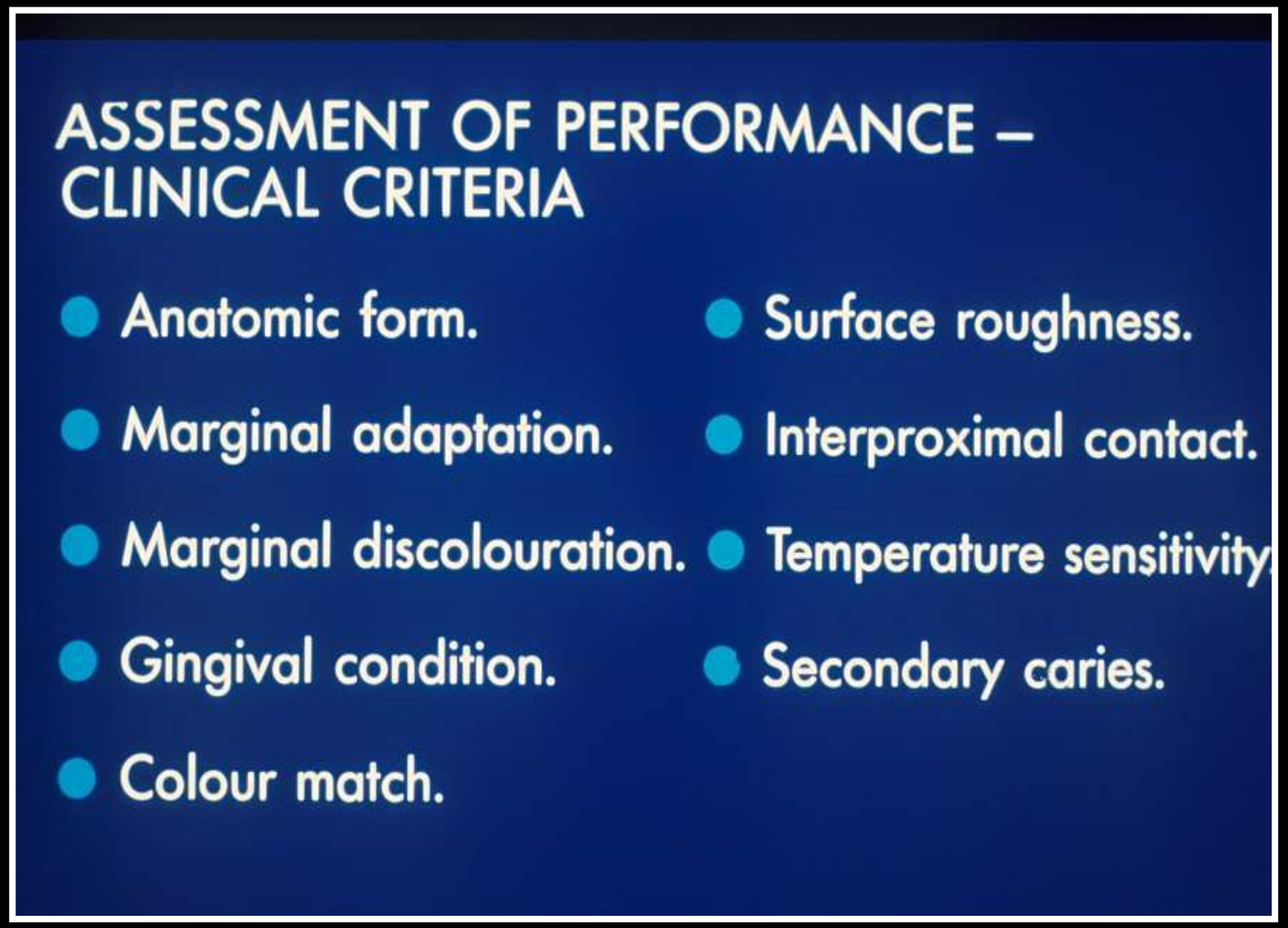
# Longevity of restorations in the “aesthetic zone”

If you are looking for actual figures, don’t go away!




The most powerful “evidence” is the survival of a clinician’s restorations on their practice computer

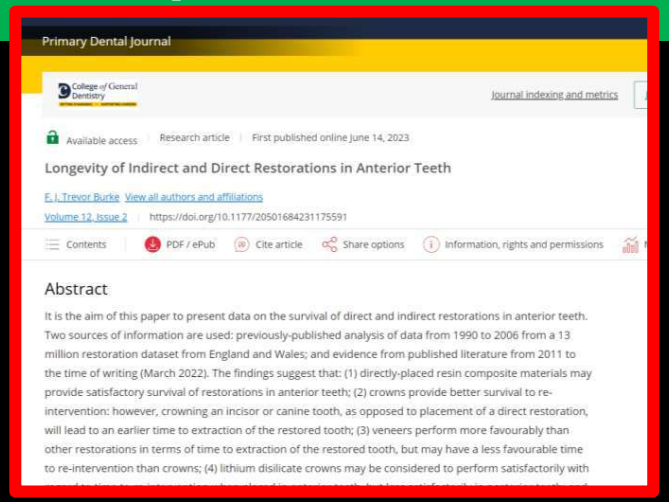
# Cohort studies generally use criteria such as:



# Anterior teeth (results from 13m dataset)

- 34% of Class III composite restorations survived at 15 years, Class IV 7% less
- 48% of crowns survived at 15 years

BUT, when we look at time to extraction, crowns do not provide as good a time to extraction as direct resin composite restorations



# Anterior teeth (results from systematic reviews and cohort studies)

- Demarco and colleagues carried out a systematic review of the survival of anterior composite restorations in 2015, eventually including 17 studies and 1,821 restorations
- AFRs of class III restorations 0 to 4.1% at 3 years
- Results mainly from dental hospitals

# Anterior teeth (results from systematic reviews and cohort studies)

- Heintze et al. carried out the first meta-analysis on resin composite restorations in anterior teeth.They included 21 prospective clinical trials.
- Median success rate for class III resin composite restorations was 95% at 10 years and, for class IV restorations, 90%.

# Anterior teeth (results from systematic reviews and cohort studies)

- Smales and Berekally, retrospective study, resin composite restorations were placed for 17 patients and metal-ceramic crowns for eight patients, with the mean age of the patients being 64.9 years. Results indicated that 58.9% of resin composite restorations survived for ten years, compared with 70.3% of crowns in anterior teeth, with the authors stating that the resin composite restorations were “usually replaced or repaired”, while the crowned teeth “often required root canal treatment or extraction”.

# Anterior teeth (Indirect restorations)

## SUMMARY FROM SEVEN STUDIES

- Lithium disilicate crowns perform well in anterior teeth
- The improving aesthetics that can be achieved using modern zirconia materials means that, if occlusal demands on the restoration are high, this may be a viable alternative.

# Anterior teeth (Indirect restorations)

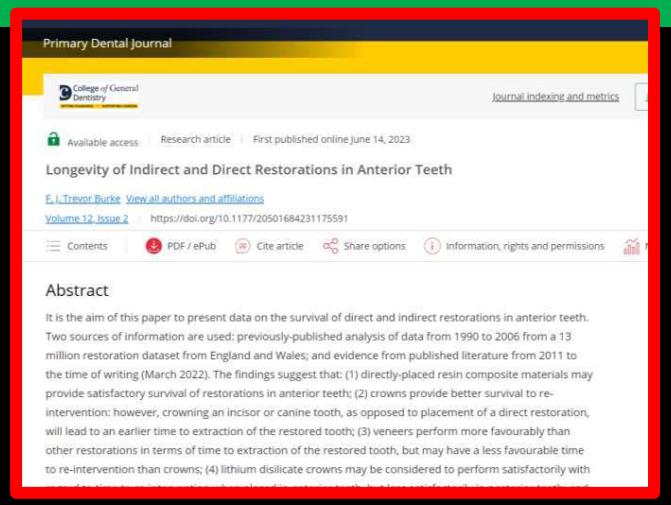
SUMMARY

- Directly-placed resin composite restorations may provide satisfactory clinical service and do not challenge the survival of the restored tooth in the same way as a full coverage crown.
- This therefore represents the challenge for the clinician of “keeping anterior teeth going” with direct placement resin composite restorations rather than a crown if survival of the tooth is the key criterion.
- If that is not the case (e.g. for a patient who does not want repeated interventions on a failing direct-placement restoration in an anterior tooth), then a full coverage restoration in lithium disilicate may provide good aesthetics, or zirconia for those patients with a “heavy occlusion” or a bruxist habit.

# Anterior teeth (Indirect restorations)

## POORER PERFORANCE OF CROWNS

- Reduced volume of tooth substance following crown preparation (which Edelhoff and Sorensen estimated as the removal of around 70% of coronal tooth structure)
- Or, the potential for pulp death, given that Bergenholtz has considered that “iatrogenic dentistogenic” injury to the dental pulp during crown preparation to be *“not an insignificant problem in clinical dentistry”*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Longevity of Indirect and Direct Restorations in Anterior Teeth

E. J. Trevor Burke View all authors and affiliations

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Abstract

It is the aim of this paper to present data on the survival of direct and indirect restorations in anterior teeth. Two sources of information are used: previously-published analysis of data from 1990 to 2006 from a 13 million restoration dataset from England and Wales; and evidence from published literature from 2011 to the time of writing (March 2022). The findings suggest that: (1) directly-placed resin composite materials may provide satisfactory survival of restorations in anterior teeth; (2) crowns provide better survival to re-intervention: however, crowning an incisor or canine tooth, as opposed to placement of a direct restoration, will lead to an earlier time to extraction of the restored tooth; (3) veneers perform more favourably than other restorations in terms of time to extraction of the restored tooth, but may have a less favourable time to re-intervention than crowns; (4) lithium disilicate crowns may be considered to perform satisfactorily with

# Trevor’s view:

Resin composite restorations perform well in anterior teeth. If a tooth needs a crown, lithium disilicate performs well, but.. Use zirconia if high occlusal load or on posterior teeth

# What does all of this mean?

- Nothing lasts forever, therefore, prevention is important
- Have firm rules for replacement of restorations
- Consider repair rather than replacement
- A variety of dentist factors & patient factors influence restoration survival
- Correct choice of material and technique influences restoration survival
- Crowning a tooth reduces survival of the tooth, therefore avoid if possible
- Resin composite restorations provide good survival in anterior teeth

# Patient –centred care will remain important

Jeremy Bagg

subsequent 'perspective' articles from a range of relevant stakeholders and care-providers. The overriding message is that in all areas of healthcare, dentistry included, the quality of patient care, especially patient safety, must be placed above all other aims.

**Clinical Relevance:** The overriding importance of patient-centredness and quality of care, above all other aims, is the key message of clinical relevance from the Francis Report.

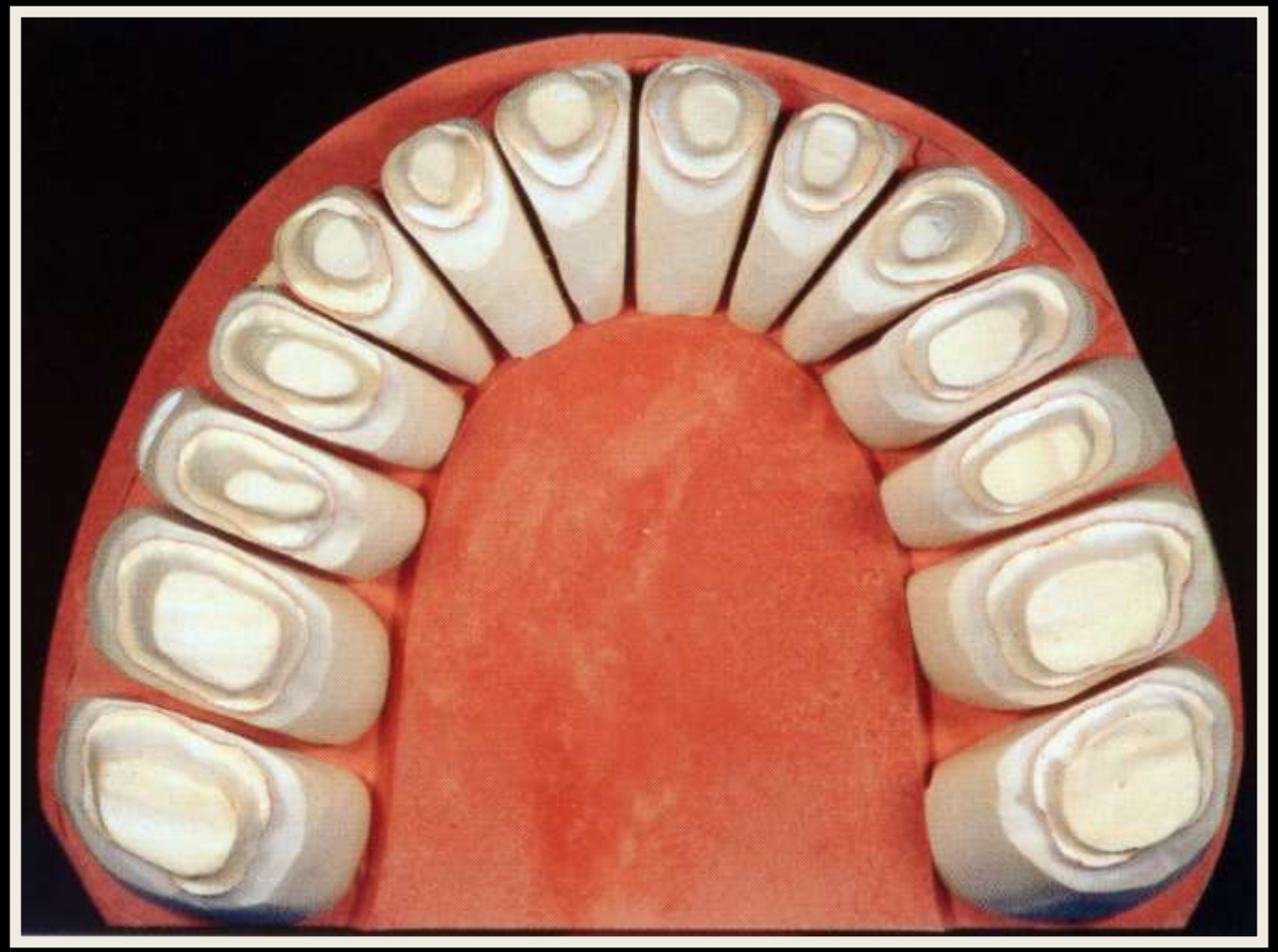
to the Dental Team

**Abstract:** The Francis Report into the deaths at Mid-Staffordshire NHS Trust highlighted the problems facing the NHS when patients, families, clinicians and nurses are not heard, and where the management, leadership and ensuing culture are focused on the system's business, not patient care. This paper, the first in a series based on the implications of the Francis Report, provides the background and context for the subsequent 'perspective' articles from a range of relevant stakeholders and care-providers. The overriding message is that in all areas of healthcare, dentistry included, the quality of patient care, especially patient safety, must be placed above all other aims.

**Clinical Relevance:** The overriding importance of patient-centredness and quality of care, above all other aims, is the key message of clinical relevance from the Francis Report.

**Dent Update 2015; 42: 206-209**

# ..more of this and we won't have a dental profession



Hopefully we will continue to be healthcare professionals rather than beauticians

# The biggest threat to dentistry in 2023 and beyond?

Dentists
who are only
in it for the money

# 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[1] 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[2] and later by Dahl.[3] 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".[4] 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."[5] Many preparations that we see, originating from the United States, involve dentine, with the potentially deleterious effects on longevity of the restoration.[6] 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.

Burke FJT, Kelleher MGD J.Esthet.Restor.Dent.2009:21:143-145

Similar advice from 2000 years ago.

“Whatsoever you would that men should do to you, do ye even so onto them”
The Bible: Matthew chap 7 verse 11

“In everything,
do unto others what you
would have them do to you.”
New International Version,
1980, New York Int. Bible Society

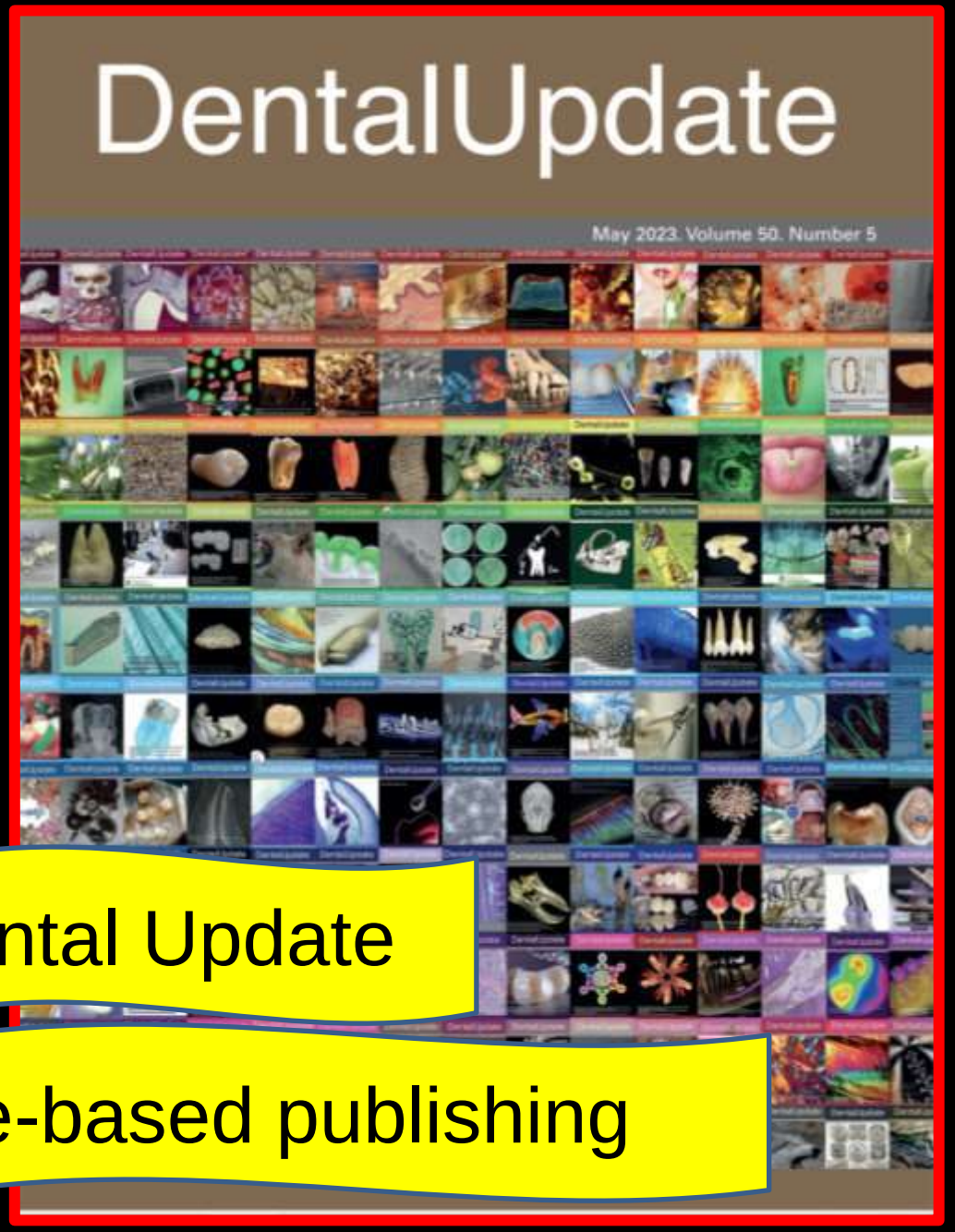

The best treatment is the simplest treatment that adequately meets the patient’s needs
Adhesive dentistry can do this!

That's measuring restoration longevity

It’s easier to talk rubbish
than to listen to it!

**Oscar Wilde, 1895**

# Thank you for listening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