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Effective Health Care

Bulletin on the effectiveness of health service interventions for decision makers

This bulletin reviews the evidence of the relative longevity and cost-effectiveness of routine dental restorations.

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Dental restoration: what type of filling?

- Tooth decay is one of the most common diseases and accounts for almost half of all tooth extractions. The treatment of tooth decay by the placement of simple, direct restorations (fillings) alone costs the NHS in England & Wales £173 million per year.
- Dental restorations do not last forever; over 60% of all restorative dentistry is for the replacement of restorations.
- New restorative materials are often marketed and introduced into practice with limited evidence on their long-term clinical performance.
- Overall, amalgam is the direct restorative material of choice unless aesthetics are important. It lasts longest and is the cheapest.
- The newer generation dentine bonding agents for composite restorations use some form of acidic primer and have better retention rates than earlier generations.
- The use of cermet cements, and the composite and glass ionomer sandwich technique in class II cavities, had high failure rates and cannot be recommended.
- There is significant variation in decision making between dentists. Appropriate criteria for replacement of restorations are needed and dental schools should train dentists in their use in order to reduce unnecessary procedures and improve quality.
- The longevity of restorations carried out in the better quality research studies suggests that routine clinical practice may be producing sub-optimal results. Work is needed to establish means of improving the quality of routine practice, putting in place incentives to promote cost-effective care and identifying the resource implications.

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A. Background

A.1. Tooth decay is a common problem: Dental caries (tooth decay) is one of the most common diseases with approximately 80% of the population in developed countries having experienced the condition. In England and Wales, dental caries accounts for almost half of all tooth extractions.[1]

A.2. Preventing and treating caries: The aim of prevention and treatment is to maintain a functioning set of teeth. Interventions can halt and even reverse the development of caries and its progression through enamel by reducing the frequency of exposure to sugar, and by exposure to fluoride either topically (e.g. in toothpaste) or systemically (e.g. in the water supply).

Through interventions at an individual level, caries can be managed by the use of topical and/or systemic fluoride, and the use of fissure sealants on the pits and fissures of back teeth to prevent them acting as stagnation areas for plaque.[2–7]

If decay has not been prevented, cavities develop and progression of caries into the dentine and dental pulp ('the nerve') allows the micro-organisms within lesions to produce acute inflammation which may lead to severe toothache, abscess formation and occasionally facial swelling. In order to prevent considerable pain and tooth loss it may be necessary to remove the diseased tissues and restore the cavities (a filling). The decision to restore will depend on the likely rate of progression of caries and the age of the child or adult. Restorations are also undertaken for other reasons such as trauma, wear and erosion.

Several restorative materials are available at different costs requiring varying amounts of expertise to prepare and complete a filling. Restorations have a limited life-span and once a tooth is restored, the filling is likely to be replaced several times in the patient's lifetime – the 'restorative cycle'.[8] Studies in the UK suggest that much of restorative dentistry is replacement of existing restorations, accounting for around 60% of all restorative work carried out.[9] Similar figures have been found in other parts of Europe[10,11] and the USA.[12,13]

The treatment of carious teeth by the placement of simple, direct restorations alone costs the NHS in England & Wales £173 million per year.[14] The provision of crowns costs an additional £156 million.[14] Restorations are also provided in the private sector, for which reliable data are unavailable.

The life of a restoration depends on factors such as the age of the patient, the properties of the filling and the rate of progression of caries in the filled tooth. Successive restorations of the sort which are placed inside the tooth (intra-coronal) tend to increase in size, leading to increased risk of subsequent tooth fracture. Replacement restorations tend to be more complex and sometimes more expensive than the initial restorations. They may have a shorter life-span and can have a detrimental effect on the pulp, occasionally leading to the need for root canal treatment involving further expense and also cost to the patient.

There is a large choice of materials which can be used for fillings. Many are introduced into the market place and used on patients with very limited evidence that they are more effective or efficient than existing materials. Consequently, one of the key questions is, all other things being equal, what type of filling is best?

This issue of *Effective Health Care* summarises the results of a systematic review of the relative longevity and cost-effectiveness of routine intra-coronal dental restorations.[15] The bulletin aims to provide information which can be used to improve the cost-effectiveness of restorations and is of use to dentists, patients, policy makers and industry. A summary of the research methods used is given in Appendix A. A glossary of terms is provided in Appendix B.

B. Replacing restorations

The reasons for replacing a restoration are numerous, and vary with tooth type and restorative material.[16] Once inserted, restorations may fail at variable rates due to a number of 'objective' factors affecting both the failure of the filling material and further decay of the tooth around the filling. These factors include the characteristics of the filling material and effect modifiers related to operator skill and technique, patients' dental characteristics, and the environment around the tooth (Table 1).

The decision to replace a restoration is also influenced by more subjective factors such as dentists' interpretation of the restoration's condition and the health of the tooth, the criteria used to define failure and patient demand. These decisions are subject to a great deal of variation.[8,17] There is a lack of standardisation and no generally agreed criteria are used to decide when a restoration requires replacement.[18]

Whilst it is likely in routine practice that subjective factors have a greater impact on longevity than the physical properties and biocompatibility of a material, there are limited data on the relative importance of objective and subjective factors.

C. Types of restoration

Tooth restorations may be classified as *intra-coronal*, when they are placed within a cavity prepared in the crown of a tooth,

Table 1 Factors influencing the decision to restore

a) Possible objective influences

General patient factors
• Exposure to fluoride • Caries status • General health • Parafunction • Age (particularly child/adult) • Xerostomia • Socio-economic status • Diet
Tooth factors
• Tooth location/type/size • Cavity design/type • Dentition • Occlusal load • Tooth quality e.g. hypoplasia
Operator and restoration process factors
• Material type • Physical properties • Quality of finish • Moisture control • Anaesthesia during restoration • Expertise • Training

b) Subjective factors

• Incentives (payment structure: salaried, government funded, private, insurance) • Clinical setting (university, private practice, general dental practice, specialist practice, field trial) • Country (local treatment fashions) • Clinician's diagnostic, treatment and maintenance philosophy (influenced by training) • Patient preferences

or *extra-coronal*, when they are placed around (outside) the tooth as in the case of a crown. Intra-coronal restorations are usually placed *directly* into the tooth cavity and normally consist of a mouldable material that sets and becomes rigid; the material is retained by the surrounding walls of the remaining tooth tissue. An alternative intra-coronal restoration uses an *indirect* technique: here an impression of the cavity is taken and a laboratory constructed inlay is produced and subsequently cemented into the prepared cavity.

The materials currently used to restore intra-coronal preparations are: dental amalgam, composite resins, glass ionomer cements, resin-modified glass ionomer cements, compomers and cermets, cast gold and other alloys, and porcelain.

C.1. Dental amalgam: Dental amalgam is an alloy of mercury with silver and other metals such as tin and copper to give a set material that does not adhere to tooth tissue and is not tooth coloured. It has been available for over 100 years, but the original formulation of the material has been modified considerably; in particular, the addition of copper and zinc to the alloy powder has enhanced its physical properties. The choice of alloy will have a bearing on the way the material is handled clinically and may influence its long-term performance.

There have been concerns over the safety of amalgam, most of which appear to be unjustified. The British Dental Association have recently concluded that:

> 'To date, extensive research has failed to establish any links between amalgam use and general ill health. Those countries which are limiting the use of amalgam are doing so to lower environmental mercury levels.'[19]

The Department of Health's Committee on Toxicity reviewed the evidence on the safety of amalgam in response to an expert report from the European Commission and concluded that dental amalgam is free from risk of systemic toxicity and only a very few cases of hypersensitivity occur.[20]

C.2. Composite resin: There are several groups of composite materials that can be classified on the basis of their resin and filler components. All are tooth coloured and are essentially a mixture of filler particles, consisting of various types of translucent glass, embedded in a matrix of resin that binds the filler particles together. The original generation of materials that set by a chemical reaction have been largely superseded by composites that set on the application of a bright light. These light-cured materials contract (shrink) during the curing process. The loading of the material with filler particles and the size of the particles as well as other factors have a bearing on the physical properties of the material and may influence its long-term performance. Composite resins have also been used for inlay restorations.

The use of composite materials has been supplemented with pre-treatment of tooth tissue prior to placement. Thus, the enamel surrounding the preparation is usually treated with a mild acid and coated with a thin resin wetting agent to improve the marginal seal and aid retention. More recently, application of acids and other agents to dentine has been advocated to reduce leakage and further improve retention. These dentine bonding agents are rapidly evolving.

C.3. Glass ionomer cements: Glass ionomer cements are tooth coloured and adhere chemically to tooth tissue. They are similar to composite resins in that they consist of a matrix and embedded filler particles; however, their formulation and setting reaction differ.

C.4. Resin-modified glass ionomer cement and compomers: New generations of materials are essentially glass ionomer cements that contain resin. The resin-modified materials are more akin to glass ionomer cements, whilst the compomers are more like composite. Again, these materials are tooth coloured and are available in a variety of different formulations.

C.5. Cast gold and other alloys: Cast gold or alloy restorations are called inlays and are made outside the mouth in an indirect technique that requires laboratory facilities. The advantage of cast inlays is their strength in thin sections; they can be used to protect weak tooth tissue. Cast restorations are inherently more expensive because of the cost of the alloy and the laboratory involvement. They are cemented in place with either traditional dental cements or can be used with more modern bonding systems.

C.6. Porcelain: Porcelain crowns have been made for many years for the anterior part of the mouth. With the introduction of new and stronger porcelains, and the development of cementing systems, it is now possible to construct inlays from porcelain that can be cemented into the prepared cavity. A variety of porcelains are available along with a variety of production processes, all of which can be used with a number of cementing agents.

D. Direct methods

This section reports on the longevity of directly placed materials: amalgam, composite and others materials such as glass ionomer cements (GIC).

The findings from the review, presented below, report longevity from studies generally carried out under optimal conditions. These are reported in order to make sensible comparisons of the longevity of different materials. The longevity reported from these studies is unlikely to be achieved in the conditions of routine general dental practice (see Section G).

D.1. Amalgam restorations: The studies of amalgam show good rates of survival compared with most of the other materials examined in this review.[15] At three years, no study showed failure and at 10 years, less than 10% of restorations had been replaced (Fig 1), although by this time there were no data on 52% of restorations. In addition, these results may shed the most favourable light on amalgam because patients were often pre-selected before entry into the study on criteria such as intact dentition, good oral hygiene and absence of active periodontal disease.

The longevity was also affected by the skill of the operator in placing the restoration and by the level of agreement on whether to replace a restoration.[27,38,61]

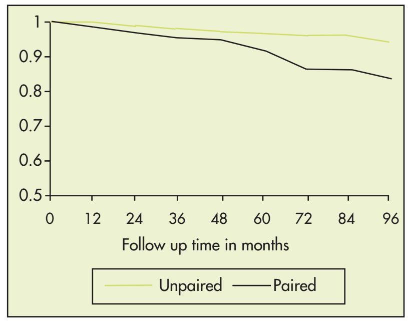

Fig 1 Survival of amalgam restorations for permanent teeth (paired and unpaired studies) [22–63]

There appeared to be no greater reduction in survival of larger amalgam restorations than smaller ones.[33,63,64] The evidence that two surface restorations survive longer than three surface restorations was inconclusive.[27,65,66] There were no differences in survival between polished and unpolished amalgams over the 36 months of follow-up, but this is a relatively short time to assess this factor.[50,67–69]

There was some evidence to suggest that dispersed phase, high copper alloy amalgams were associated with greater survival than other amalgams.[27,30,38,53,60,65,66]

D.2. Composite restorations: Forty-eight studies involved composite restorations but without use of dentine adhesives.[15] Twenty-five studies involved dentine bonding systems. In the vast majority of cases, these studies investigated cervical cavities where retention of the restoration relied exclusively on the bonding mechanism to resist loss. These studies rarely reported the site of the filling and thus it is impossible to assess whether survival is different for composites placed in the front or back teeth.

Composite without dentine bonding

Many studies poorly catalogued the numbers of subjects, teeth, the tooth types, the materials and types of cavities and also failed to describe correctly and simply the survival data.

Overall, the studies demonstrated good short-term survival (two and three years).[31,32,70–72] Studies showing poor results were explained on the grounds of poor technique or unconventional cavity design.[73–76] However, the few studies with at least five years follow-up showed signs of significant failure, particularly the multi-centre studies.[77,78]

Survival of composite was influenced significantly by material type, with light-cured microfilled and densified filled materials being more successful between 6.5 years and 8.5 years, while the older autopolymerising macrofilled composites were most successful up to 6.5 years. The studies did not present data needed to analyse the impact of operator factors and other effect modifiers.

Composite with dentine bonding

In the systematic review, dentine bonding agents were classified into three main groups:[79] those evolved from the earliest resin materials which simply impregnated the smear layer (group 3), those modified to enhance impregnation and to alter the smear layer (group 2), and the more modern materials which use an acidic primer (group 1). Dentine bonding materials have often been tested in cervical cavities and in this situation the failure of these materials is rapid, beginning within one year (Fig 2).[80–83] This figure is based on a combination of included studies of cervical restorations by the type of dentine bonding agent used. Unfortunately it is not possible to present additional figures showing other variables because of the lack of data reported.

More recent materials that use some form of acidic primer (groups 1a and 1b) demonstrate improved survival compared to groups 2 and 3. There appeared to be little difference between materials classed in group 1a (those which use phosphoric acid) and group 1b (those using other acids). Studies of group 1a have shorter follow-up. The reason for the enhanced performance of group 1 compared to the other groups may be the improvements in the dentine bonding system but could also be the etching of enamel that may be a side effect of using acids.

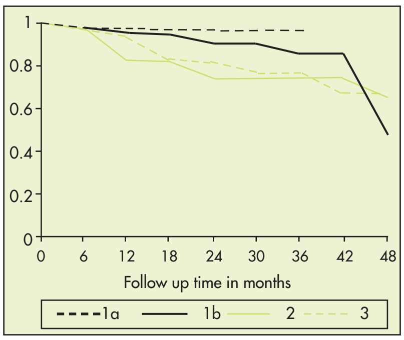

Fig 2 Survival of composites in cervical cavities by type of bonding agent [48,80–110]

The results of these studies suggest that enamel etching (with or without enamel bevel) is clinically effective for long-term retention.[81,111] Mechanical retention is also effective for the retention of restorations.[112] Newer materials (group 1) appear to perform better than older materials (groups 2/3).[92,102] Use of all dentine bonding systems reduced patient pain after placement.

Significant problems of inter-pretation have been encountered because of poorly designed studies, the appreciation that occlusal factors may have an influence on retention, and lack of detail in papers, especially relating to losses to recall and technique used.

D.3. Comparison of amalgam with composite: Twenty-six studies in this review compared amalgam and composite restorations.[15] In studies comparing the two materials in an unpaired design (teeth from different patients), amalgam was superior, always having greater survival. In similar studies using a paired design (teeth in the same person) the differences in favour of amalgam were less but still statistically significant.

D.4. Other materials: Forty-four studies which compared a number of different materials were included in the review.[15] Many of these studies were of small size and short duration. Only the key findings are summarised in this bulletin.

Overall it appears that in developing countries, glass ionomer cement inserted with a technique which removes caries using hand instruments (ART) has reasonable retention rates but other factors have yet to be assessed. Conditioning of dentine prior to placement of glass ionomer cement does not seem to affect longevity (although this is based on only two studies).[113–115]

Several restorative materials were reported as having low survival rates. These include cermet cement when used to restore either deciduous or permanent teeth [116–118] and GIC when used in the composite/GIC sandwich technique.[75,119] Improvements in the physical properties of GIC may improve the potential for the success of this type of restoration. Gallium also had high failure rates and cannot be recommended.[120]

E. Indirect methods: inlays

Twenty-seven studies were included which examined the longevity of inlays using ceramics, gold and composites.[15] These studies often had few patients and were of a weaker design. In addition, few undertook any form of comparison.

Overall, there is no important difference between porcelain and composite inlays (see Fig 3). However, these studies (one of which compares both materials)[121,122] suggested that some types of porcelain inlays were significantly better than composite inlays.

There is limited evidence to support the use of a resin compared with a GIC as luting cements.[123–126] There is some evidence, although limited, to support the use of heat cure in addition to light cure in composite inlays.[127] There are some reports of post-operative pain, for example, with inlays and these need further investigation.[128–131]

One small study compared porcelain inlays with amalgam and found identical survival at two years.[47] There are no long-term data.

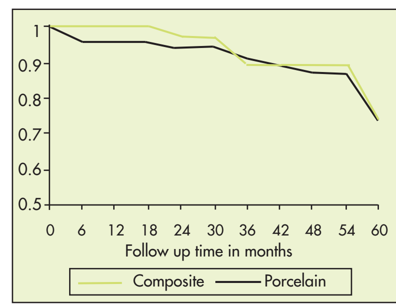

Fig 3 Survival of porcelain and composite inlays [47,123,125, 126, 130–150]

F. Cost-effectiveness

The 30 economic studies that were identified were of poor quality[15] and did not provide sufficient information to enable the cost of restorations to be constructed with any degree of confidence. The data were, therefore, supplemented by information provided by dentists on the time taken to carry out restorations in order to undertake a cost-effectiveness comparison of the filling materials (see Appendix A). A summary of the results is shown in Table 2.

Whilst these results are approximate and should be treated with caution, amalgam clearly dominates composite and inlays across all time periods considered because it is cheaper and has better survival, and this dominance was robust to a wide range of changes in the assumptions. Composite was between 1.7 and 3.5 times more expensive than amalgam to generate one tooth year, a finding

Table 2 Cost per tooth year of three main classes of restoration (discounted at 5%)

	5-year time period			10-year time period		
	Tooth years	£	Cost per tooth year	Tooth years	£	Cost per tooth year
Amalgam	4.85	21.56	4.44	9.31	32.93	3.54
			(5.05)			(3.92)
Composite	4.37	33.01	7.54	7.35	91.66	12.47
			(8.19)			(11.87)
Inlay	3.30	130.00	39.39	-	-	-
			(41.26)			

Tooth year = the average number of years a restoration survives before failure over 5 or 10 years

£ = cost of initial restoration + cost of replacement at time of failure with the same material

which is in line with previous estimates from better quality economic evaluations[149,150]

Composite would provide more 'value for money' than amalgam over the first five years only if patients valued tooth years with composite nearly twice as highly as with amalgam for aesthetic reasons. However, the studies included in the review did not measure patients' quality of life or valuations of tooth years with different restorations.

G. General applicability of findings

The majority of studies of sufficiently high quality to be included in this review were undertaken in dental schools, whereas virtually all restorations are treated in a primary dental care setting. This affects the extent to which individual studies can be generalised to the wider population. The advantage of the academic setting is that it is easier to control the study as well as train and calibrate operators and examiners. In addition, many of the financial and time factors that beset practitioners are removed. The data on the relative longevity are likely, therefore, to be more valid. However, using a setting that is quite different from that under which most patients are treated has disadvantages. It may result in different types of patients being included, different amounts of time being taken, different expertise and payment systems etc. Any one or combination of these factors may affect longevity to a greater or lesser extent.

Studies not included in the systematic review which used subjective criteria, and are more representative of the situation prevailing in general dental practice, make it clear that the longevity of amalgams[151–153] and composite[152] is considerably less than that achieved in the prospective studies included in the systematic review. Glass ionomer restorations have been in use for a much shorter time but they, too, have a high replacement rate in cross-sectional studies.[150]

Wide variation both within and between dentists' treatment decisions has been reported, and is obviously an important issue when trying to identify the point at which a restoration is replaced.[8,17,154,155] This is an issue that could be appropriately addressed by dental schools.[18] There is a difference between identifying how long a restoration could last if objective outcome measures were used, and how long it is allowed to last when individual practitioners use their own criteria. It is claimed that the likelihood of having a restoration replaced is more than doubled when a patient changes practitioner.[156]

H. Implications

H.1. Implications for policy and practice:

- The dental manufacturing industry is constantly promoting the use of new materials. These are marketed and introduced into practice typically without reliable and comprehensive trials involving people in everyday situations. This has created a high level of uncertainty about the absolute and relative merits of different materials. Mechanisms should be sought to ensure that the introduction of dental materials into clinical practice is incorporated into any new NHS regulatory structures designed to promote the quality of health care.[157]
- The good results in terms of longevity of restorations achieved in the optimally designed studies demonstrate that routine clinical practice may be producing sub-optimal results. This raises the issue of how clinical practice can be improved so that restoration longevity in all settings approaches the best that can be achieved and what the resource implications of this may be.
- Appropriate incentives (including the fee structure) which reward cost-effective practice should be explored and evaluated. This is an area that might be worth considering for inclusion in the National Performance Framework.
- There is insufficient information to be able to assess the likely impact of better training, more care when carrying out a restoration, protocols to ensure the optimal process of restoration, the impact of the time spent, and remuneration systems etc.

- Currently, variations between dentists in the way they judge existing restorations increases the probability of replacement restorations when patients change dentists. In order to reduce unjustified variation in the diagnostic level at which restorations are replaced there is a need for clarification of appropriate criteria for replacement of restorations. Dental schools should train dentists in using standardised definitions of what constitutes a failed restoration and to adopt appropriate maintenance policies. This would protect the public against unnecessary procedures, reduce costs and improve the quality of professional decision-making.
- Dental amalgam is the direct restorative material with the longest duration and from the perspective of the NHS is of lower cost. Unless there is a contra-indication (which is usually aesthetics or pregnancy), it is recommended for routine use wherever possible. All NHS dental treatment provided by general dental practitioners in England and Wales is reported to the Dental Practice Board. Whilst this database provides a record of actual patterns of practice, it is of limited use for comparing the longevity of different restorative and other influences because subjective criteria are used which vary between practitioners.

H.2. Implications for research:

- Co-ordinated research in primary dental care is needed to assess the effects of clinicians' skill, tooth type, cavity type and material type on restoration survival, taking into account the evolving disease patterns.
- This requires the establishment of multi-centre, multi-operator studies with stratification of tooth type, cavity type and other effect modifiers (such as fluoride availability and oral hygiene), for assessment periods of greater than 10 years. It has been suggested that "pragmatic clinical studies" using a representative group of practitioners, on a large sample of their patients, may be one way to obtain the internal validity of a randomised controlled trial and the generalisability of purely observational clinical studies which this review has largely ignored because of their subjective nature![158] With appropriate clinical and economic evaluation such studies would allow an overview of a material's spectrum of performance in different clinical environments.
- In order to obtain more reliable cost and relevant outcome estimates, a long-term prospective cohort study is needed across different dental settings. The cost profile for each material type for different types of restorations could be constructed and used in conjunction with the evidence relating to the longevity of each restorative material.

Appendix A – Research methods

This bulletin is based on a systematic review[15] which used a wide search for studies in any language using a large number of general and specialist databases, hand searching of key dental journals and searching of abstracts from conference proceedings.[21] Of the 652 relevant papers, 253 (representing 195 studies) had the minimum core of data required for inclusion.

Inclusion criteria

Use of objective outcome measures

Many authors did not state or use criteria for deciding when a restoration had failed and needed to be replaced. In these studies it is therefore impossible to distinguish between the objective factors influencing longevity (the main aim of the review) and subjective influences. In other words it is not possible to establish whether a restoration was replaced because it had failed or because a clinician subjectively deemed it to have failed. For example, one clinician may have decided to replace an old corroded amalgam filling while another may have polished it. For these reasons studies were required to have measured outcome (the decision to replace a restoration) using stated criteria. For example, the criterion "failure due to secondary caries" was not accepted unless the paper clearly stated how secondary caries was diagnosed.

Study design

Whilst new restorative materials are tested using laboratory-based studies and animal experiments to examine the chemical, physical and biological properties of materials, these studies cannot be used to predict their performance in practice. Thus, only studies which looked at performance in either experimental or clinical settings were included. The review included randomised controlled trials (RCTs), quasi-experimental designs and non-experimental studies which surveyed the longevity of restorations in a cohort of patients with good follow-up.

Cost-effectiveness

In order to compare the cost-effectiveness of different filling materials a review of the economic literature was undertaken. This was supplemented by information from nine general dental practitioners in Wales who provided data on the time taken to place a restoration and subsequent replacements. These times were multiplied by the estimated average hourly cost of dental staff (£62.50) preparing and completing a restoration. The cost of a filling was calculated by adding staff costs to the different material costs. Thus the costs used in the economic model were developed from the bottom up rather than by using the fee schedules. The costs for the initial filling were combined in an economic model with estimates of the number of years a restoration survives (tooth years) based on survival probabilities derived from the systematic review. The economic evaluation was undertaken from the perspective of the NHS and used *tooth years* as the outcome measure for each material type and the cost per tooth year as the cost-effectiveness ratio.[15]

Table 2 also presents the discounted cost per tooth year which takes into account the fact that benefits and costs are spread over time.

Appendix B – Glossary

Carious – describes a tooth affected by caries (decay).

Cavity – carious lesion or area of destruction in a tooth.

Cervical (Class V) – concerning the neck of the tooth, near the gum.

Dental caries (tooth decay) – disease resulting in the demineralisation, cavitation and breakdown of calcified dental tissue by microbial activity.

Direct inlay – method of construction of an inlay using a wax pattern taken directly from a tooth preparation and not from a model.

Direct intra-coronal restoration – involves a direct insertion of a pliable material (such as dental amalgam, composites and glass ionomer cement) into the preparation which subsequently becomes rigid and is retained by the surrounding walls.

Dispersed phase – a specific formulation of amalgam alloy powder.

Effect modifier – factor which modifies the effect of an intervention.

Enamel bevel – a sloping surface, at a cavity margin.

Etching – partial demineralisation of a selected area of tooth substance.

Erosion – irreversible loss of tooth substance by a chemical process that does not involve bacterial action.

Extra-coronal restoration – a crown.

Fissure – a small groove or trough in the enamel of the tooth.

GIC lute – a cement used in the placement of an inlay.

Indirect inlay – method of construction of an inlay by using an impression of the tooth. Indirect technique is more suitable for complex cavities, preparations with veneers, and full crowns.

Occlusal load – the load on a tooth or filling due to the forces of biting or clenching.

Parafunction – abnormal occlusal loads placed on teeth because of habits or function of a patient.

Pit – a small depression in the enamel of a tooth.

Recurrent caries – dental caries that extends either beneath or beyond the margins of a restoration.

Resin – a low viscosity liquid monomer that is applied to the cavity usually to improve adaptation of the material.

Root canal (or endodontic) treatment – the treatment of a damaged necrotic pulp in a tooth to allow the tooth to remain functional in the dental arch.

Secondary caries – see recurrent caries.

Smear layer – the loosely attached mineral and organic debris left on the surface, particularly of dentine, after it has been mechanically instrumented.

Xerostomia – dryness of the mouth due to a lack of saliva.

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Effective Health Care

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