Oral diagnosis and treatment planning: part 8. Reviews and maintenance of restorations

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IN BRIEF

- Suggests that continuous reviews increase the risk of overtreatment.
- This risk may be reduced by applying specific criteria before intervening, in particular to replace restorations.
- Highlights that a dental practitioner learns from experience to make a balanced clinical judgement on the most appropriate recall interval for each patient.

PRACTICE

The oral environment is hostile to dental materials and to dental treatments. Microorganisms, warmth, moisture and high stresses impose severe limitations on the ability to maintain the initial results of dental treatment. Therefore, continuous periodic reviews and maintenance of oral health are required to retain the restored dentition.

INTRODUCTION

Continuous reviews increase the risk of overtreatment, which may be reduced by applying specific criteria before intervening, in particular to replace restorations. When appropriate, refurbishments and repairs should be considered rather than restoration replacements, as the latter are larger and survive for shorter periods than

the original restorations. Preventive measures to reduce plaque are more appropriate than further restorative treatments, which fail to cure caries.

OBJECTIVES OF THE MAINTENANCE PHASE OF DENTAL TREATMENT

The principal objective of the maintenance phase of dental treatment is to review and maintain the long-term health of the masticatory system. Satisfactory dental or oral health may be defined in terms of: 'a masticatory system that is functionally adequate, aesthetically pleasing to the individual and free from discomfort and disease'. The need for regular reviews and maintenance should be emphasised as being in the best health interests of the patient. The practitioner also has the opportunity to evaluate his or her own treatments and treatment decisions over an extended time – a salutary experience. Broadly, patients are usually recalled for:

- The ongoing prevention or reduction in the progression of chronic dental diseases and conditions such as dental caries, periodontal disease and tooth surface loss
- The evaluation of asymptomatic oral conditions such as deteriorating restorations and prostheses, small periapical lesions, unerupted teeth and soft tissue changes
- Decisions regarding further elective dental treatments such as tooth bleaching, orthodontic treatment, the provision of an oral splint, crowning

of an endodontically treated molar tooth and the surgical removal of partly erupted impacted third molars.

The usual medical history and dental examination updates, including the need for further radiographs and other special tests are obtained as required. Patients should be questioned as to whether they have any ongoing dental problems or concerns. For dentate patients, routine care usually involves oral hygiene instruction and oral prophylaxis, scaling and root surface debridement, minor adjustments to restorations, teeth and prostheses and the application of topical fluorides. Any dental implants present should be debrided with plastic and not metal instruments. Removable dentures may require ultrasonic cleaning, tightening of 'loose' clasps, occlusal adjustments and relieving for soft tissue pressure spots.

RECALL INTERVALS FOR ROUTINE CHECK-UPS

The appropriate times for dental recalls depend very much on the individual circumstances of each patient. However, broad guidelines have been proposed in a report by the National Institute of Clinical Excellence (NICE).¹ Many factors are involved in deciding when the oral health status of a patient should next be reviewed. These include post-treatment assessments of dental disease activity and of systemic and oral risk factors, the compliance and co-operation of patients and financial and other considerations. Unfortunately, with

ORAL DIAGNOSIS AND TREATMENT PLANNING*

- Part 1. Introduction to oral diagnosis and treatment planning
- Part 2. Dental caries and assessment of risk
- Part 3. Periodontal disease and assessment of risk
- Part 4. Non-carious tooth surface loss and assessment of risk
- Part 5. Preventive and treatment planning for dental caries
- Part 6. Preventive and treatment planning for periodontal disease
- Part 7. Treatment planning for missing teeth
- Part 8. Reviews and maintenance of restorations**

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few exceptions, there is a general lack of good quality evidence available upon which to assign specific recall intervals for different oral diseases and conditions.

The dental practitioner learns from experience to make a balanced clinical judgement on the most appropriate recall interval for each patient, rather than routinely recommending blanket 6-month or 12-month periods. The times recommended between check-ups usually range from two months up to two years. Generally, the following patients should be recalled at the shorter rather than the longer time intervals:

- Children and adolescents
- Patients with medical conditions that put their general health at increased risk, for example, cardiovascular diseases, bleeding disorders, immunosuppression disorders, or that increase their risk of developing dental diseases, eg diabetes mellitus, hyposalivation
- Patients whose lifestyles place their oral health at increased risk, for example, excessive smoking, alcohol, cariogenic/acidic foods and gastric reflux, and psychological stress/anxiety with tooth grinding and hyposalivation
- Patients with physical and/or mental handicaps
- Patients with poorly controlled plaque removal and oral diseases, for example, active caries, periodontitis and tooth wear and persistent/recurrent mucosal 'white patch' lesions
- Patients with extensive fixed restorative work, removable prostheses, orthodontic appliances and dental implants.

CRITERIA FOR RESTORATION REPLACEMENT

Most of the practice and income of general dentistry consists of restoration placement and replacement where, from many studies, the latter may average approximately 50-70% of all restorative procedures. Considerable disagreements occur between dentists as to when dental restorations require repairing and replacement. The following guidelines have been proposed:²

'If a patient has problems associated with a marginal gap in a restoration, it will usually be appropriate to repair or

replace the restoration. However, the presence of a marginal gap alone, adjacent to either a newly-placed or an older restoration, is not a criterion for the restoration's replacement.

A restoration should be replaced when caries, which exists directly adjacent to the restoration and extends into the dentine, is judged to be active. At the same time the dentist should implement preventive measures aimed at shifting the patient to a low caries-risk category as part of the caries management plan.

Failed or defective restorations that are associated with a clinically significant loss of function, periodontal tissue inflammation, or pulpitis should be either adjusted or repaired if possible, or otherwise replaced; providing such treatment can be expected to overcome the problem. Surface quality deficiencies alone do not constitute an adequate reason for restoration replacement.

Restorations that appear to have caused a severe allergic response should be replaced with an appropriate alternative restorative material. Restorations apparently responsible for a mild hypersensitivity response should be closely followed for a period of two weeks or more, either to determine if the reaction is self-limiting or to identify other potential causes of such an inflammatory condition. Dermatologic consultation may be required when suspected allergens cannot be avoided.

Whenever the patient at his or her own volition requests the removal of restorations that have caused undue psychological stress as a result of poor aesthetics, inadequate function, and actual or perceived biological hazards, the restorations should be removed only after the advantages and deficiencies of alternative treatment have been fully explained to and accepted by the patient.'

REPLACEMENT OF INTRA-CORONAL RESTORATIONS

Generally, the quality and survival of dental restorations is dependent on the oral environment and habits of the patient, on the skills and experience of the dentist and on the physical properties of the restorative material. Placing a restoration does not confer immunity to caries for the tooth, and secondary (recurrent) caries may occur in the tooth tissue adjacent to the restorative

material if the oral environment remains unchanged. Many studies in general dental practice have found that approximately 50% of all plastic restorations, irrespective of material, continue to fail with the diagnosis of secondary caries (Fig. 1).

At the cavo-surface margin of a coronal restoration, the adjacent enamel may be considered in two planes, the outer surface enamel of the tooth and the enamel of the cavity wall. A secondary (recurrent) carious lesion has been described as occurring *in vitro* in two parts: an 'outer lesion' formed on the surface of the tooth adjacent to the restoration margin and an inner cavity 'wall lesion'. However, many if not all restorations exhibit marginal leakage to varying extents without secondary caries occurring, and a wall lesion will only occur *in vivo* when there is plaque retained within a marginal gap. In reality, there is no difference in the aetiology and the clinical and histologic appearances of primary and secondary caries. In a caries-prone mouth, any restoration may fail because of secondary caries, which emphasises the point that the best way of managing caries is by prevention and not by 'filling holes in teeth'. The diagnosis of secondary caries can be difficult. There are several visible signs for caries around a restoration:

- A white or brown spot on the tooth surface adjacent to a restoration (requires preventative management)
- A cavitated carious lesion adjacent to a restoration (requires operative and preventive management)
- Tooth discolouration around restorations: a small restoration with a large discoloured area is highly likely to be carious/a large amalgam restoration may discolour dentine without caries being present
- Major ditching at margins and poor oral hygiene (cautiously consider operative treatment)
- Carious lesions beneath or adjacent to radiopaque restorations are often visible on bitewing radiographs as radiolucencies. However, unless standardised serial radiographs are available it may not always be possible to distinguish between new carious lesions (recurrent or secondary caries), and caries left behind (residual caries) when the restorations were initially placed. Pooling of radiolucent bonding

Fig. 1 Percentage of amalgam, resin composite, and glass-ionomer cement restorations replaced with the diagnosis of secondary caries in an adult population. Based on data for secondary caries from Mjör I A, Moorhead J E, Dahl J F. Reasons for replacement of restorations in permanent teeth in general dental practice. *Int Dent J* 2000; 50: 361–366. Adapted 2008 with permission

Fig. 2 Reasons for the replacement of amalgams in dental practice**

agents beneath restorations may also simulate residual or recurrent caries.

Various clinical methods have been suggested to diagnose secondary caries in restored teeth:

- Vision, with good illumination
- Dental explorers
- Bitewing radiographs
- Transillumination
- Laser fluorescence, as with the DIAGNOdent/pen device (KaVo).

Specific diagnostic problems include:

- The difficulty of access to subgingival cavity margins
- Superimposition of the images of radiopaque restorations over the carious lesions
- Misleading laser fluorescence from resin-based materials, organic debris, prophylaxis pastes, enamel hypoplasia
- Whether the restoration with a defective margin is synonymous with recurrent caries
- Distinguishing recurrent from residual caries

- Distinguishing active from arrested caries.

The principal problem of diagnosing caries in restored teeth is in distinguishing between active carious lesions, which are likely to progress further, and chronic static lesions that are arrested. Currently, there are no absolute clinical criteria on which to base this judgement. Patient factors are important in determining treatment approaches, such as the dental and medical histories, diet, resting and stimulated salivary flow rates and buffering capacity.

DENTAL AMALGAM

The replacement of various restorative materials currently represents a major part (50–70%) of the restorative work performed in dental practices. Therefore, it is important to define the criteria for the replacement of restorations and critically assess the need for their replacement. Clinical investigations, based on many general practice reports, have shown that approximately 50–60% of all replacements

of amalgam restorations are because of recurrent caries. Around two-thirds of all marginal deficiencies in amalgam restorations are located at the cervical margins and approximately 50% of the revisions are accounted for by restorations placed in Class II cavity preparations. The high failure rates at the cervical margins indicate the importance of careful cavity design, good access and correct packing and burrishing procedures. The reasons for amalgam restoration replacements from one study are shown in Figure 2.

The principle of ‘extension for prevention’ for cavity preparations has been abandoned in favour of a reduced cavity size, in particular for amalgam restorations. The benefits are the removal of less sound tooth structure, resulting in improved aesthetics and the likelihood of fewer tooth fractures. A reduced caries activity, a prophylactic attitude and technological improvements in instruments and materials have made this reduction in cavity size possible. However, the more precise technique required is technically difficult, and adequate visual access is essential to avoid problems arising from ‘keyhole surgery’. A well-finished and smooth restoration surface is easier to keep clean than a rough surface. Correct finishing of the set restoration provides for better surface contours and anatomy to avoid interproximal food impaction, and a smooth surface provides for better comfort and gingival tissue health. However, there is no evidence that polishing amalgam restorations to achieve a high lustre will result in increased restoration longevity.

The future for dental amalgam

Dental amalgam as a restorative material has a number of disadvantages. It is a metal alloy, and looks nothing like tooth structure. It readily conducts temperature changes and does not bond micromechanically to tooth tissue. It may tarnish, and the corrosion of older low copper-content alloys caused tooth discolouration. It contains silver, which is expensive, and mercury, which worries some people because of unfounded fears of its toxicity when used in restorations. The future for dental amalgam is perceived to be in jeopardy because of a number of factors, including:

- An increased anxiety over mercury hazards, though it has yet to be shown

that a significant clinical risk exists for the vast majority of patients. The publicity of this issue is not unconnected with: the desire of certain groups of practitioners to encourage patients to have all of their existing restorations replaced, in the absence of alternative remunerative procedures/ the political activities of environmental lobbies in Scandinavia and Germany in particular/ the marketing activities of some dental and chemical companies who produce tooth-coloured restorative materials

- Economic considerations related to silver prices and metal availability though, since the development of the electronics industry, mercury is less used for instruments such as thermometers and rectifiers, and is in plentiful supply
- Environmental concerns, which are important from an industrial waste viewpoint, though the contribution of amalgam waste is negligible and can be eliminated by the use of amalgam scavenging equipment.

Given all of the above, it is surprising that amalgam has performed as well as it has for so long, and it is still used extensively worldwide despite repeated claims over the past 25 years of its immediate demise. When all factors are considered, dental amalgam can be used to provide relatively inexpensive and serviceable restorations over many years. Until relatively recently, except for the far more expensive indirect cast gold alloys and high-strength ceramic materials, there have been few alternative direct placement materials to amalgam as a posterior restorative material in large cavities. Alternative materials such as resin composite, polyacid-modified resin composite ('compomer') and resin-modified glass-ionomer cement have their own clinical problems, and numerous studies over many years continue to demonstrate the superior longevity and cost-effectiveness of posterior amalgam restorations placed in general dental practice, in both the primary and the permanent dentitions.

Longevity of amalgam restorations

From many studies, data indicate that the median survival times of posterior amalgam restorations in general dental practice

range from approximately 8–12 years (Table 1). But, some persons have satisfactory amalgam restorations that are 40–50 years old and even older.

Some patients believe that their restorations should last for their lifetime. However, evidence from NHS general dental practices in the UK in particular suggests that many amalgam restorations may last on average for only five to ten years. Studies from general dental practices in other developed countries suggest higher median survivals of from 12–15 years and even much longer. There is considerable evidence to show that restoration longevity, as with other restorative materials, is far less in children than in adults.

Many dentists believe that when a restoration of dubious marginal integrity is seen, the patient is best served by replacing the restoration with a 'better' one. However, there is evidence that the replacement restoration may incorporate many, or even more, of the intrinsic faults of the original restoration. In replacing the restoration, a considerable amount of sound tooth structure may be cut away and the tooth further weakened. Little is known about the reliability of the criteria used to categorise and thus predict a restoration to become either a likely 'failure' or 'success'. Very considerable inter-observer and intra-observer variations have also been reported for deciding whether restorations have failed. The 'premature' failure or short life-span of many restorations cannot be blamed solely on the deficiencies of the material itself, but more commonly on the misuse of it in inappropriate cavity designs or by improper handling. One of the most predictable causes of marginal failure is when sharp angles (less than 70°) of amalgam material are produced at the cavo-surface cavity margins, as they commonly are on occlusal cusp slopes and with the deep carving of occlusal anatomy. Here, marginal fracture and ditching, which may predispose to secondary caries if the gaps are wider than approximately 300–400 µm and contain plaque, are invited from the moment the amalgam is carved. The treatment options available when confronted with a restoration of dubious marginal integrity are:

- Do nothing, but review periodically
- Recontour or refinish (refurbish) the restoration, but don't leave thin flashes of material at the cavity margins

Table 1 Longevities of plastic restorative materials in general practice

Material	Range (years)
Amalgam	8–12
Anterior resin composite	7–10
Posterior resin composite	5–8
Glass-ionomer cement	5–8
Resin pit and fissure sealant	5–7

- Seal the margins with either a fissure sealant or a low-viscosity flowable resin composite
- Repair, or replace, the restoration.

Often, a less-than-ideal restoration may remain perfectly serviceable for many years, and to review it in cases of doubt is a sensible decision. Recontouring or refurbishing is quicker, easier, cheaper and more conservative of tooth structure than repairing or replacing the restoration. Avoid creating over-steep cuspal inclines and deep occlusal fissures, as these will result in sharp amalgam cavo-surface cavity margin angles and predispose to failure. Repairing a restoration is recommended when a small isolated problem is found in one area of an otherwise satisfactory restoration. Provided that the retention and appearance of the original restoration is not compromised, this rules out the possibility of introducing defects into those areas of the restoration where none existed previously. Replacement of the entire restoration is the treatment of choice when there is clear evidence of active caries or a fault that compromises the survival of the restoration or the tooth, or damage to the periodontal tissues as in the case of a large overhanging margin. Several prospective clinical studies are underway to determine the long-term outcomes of refurbishing, repairing or replacing amalgam and resin composite restorations. The increased restoration longevities for marginal sealing, refurbishments and repairs are very encouraging.

RESIN COMPOSITE (RESIN-BASED COMPOSITE)

Resin composite restorations fail and are replaced for reasons such as recurrent caries and pulpal sensitivity, bulk

Fig. 3 Reasons for the replacement of resin composites in dental practice**

fracture, marginal degradation, loss of anatomic form, discolouration and various mechanical deficiencies. Recurrent or secondary caries, bulk fracture and the loss of restorations are the predominant causes of replacement in Class II cavity preparations, whereas secondary caries accounts for most failures in Class V preparations. These failures illustrate the variety of challenges in optimising clinical procedures for resin composites placed in posterior teeth. The reasons for resin composite restoration replacements from one study are shown in Figure 3. For aesthetic reasons, resin composites are the most widely chosen restorative material for anterior teeth. Several controlled clinical trials undertaken in institutions also have shown that resin composites are suitable as a substitute material for amalgam when restoring small proximal carious lesions in posterior teeth. These restorations were generally placed by a few selected operators in selected carious lesions in relatively few selected patients. In these controlled trials, there was no significant difference between amalgam and posterior resin composites in the incidence of isthmus fracture and recurrent caries. However, this result has not been confirmed by most clinical studies in general dental practices or in 'the real world'. In one large long-term controlled trial involving many dentists, secondary caries was by far the most frequent reason for the failure of all sizes of posterior resin composite restorations, but especially for large restorations. The failures were much higher than for all comparable amalgam restorations.

Resin composites are usually placed in posterior teeth when preservation of tooth structure, improved appearance and concerns regarding mercury in amalgam restorations are a primary consideration. The

relatively low fracture strengths and wear resistance of many so-called 'universal' resin composites, and the much increased risk of secondary caries at proximal gingival cavity margins when compared with amalgam, usually result in resin composite being less successful for larger restorations. Bacterial adherence of *Streptococcus mutans* is less on amalgam than on resin composite, and the spread of secondary caries with resin composites is often fast and quickly involves the pulp. By comparison, the breakdown products of amalgam tend to corrode and fill any voids, which probably retards the rate of caries spread.

In general dental practice, from the findings of many studies, the median survival times for resin composite placement in posterior teeth are shorter than those for amalgam, and range from approximately five to eight years (Table 1). It is expected that these survival times will increase substantially following the improved training of general practitioners and greater clinical experience with placing larger posterior Class II resin composite restorations. However, there is scant evidence that such an increase has been achieved, even after more than 30 years of posterior resin composite and dentine bonding developments and clinical use in general practice.

For patients wishing to replace their clinically satisfactory posterior amalgam restorations with tooth-coloured materials, the reasons must first be clearly determined. There is no scientific evidence of any sustained improved general health outcomes from replacing amalgam restorations and very rarely is there any evidence of local oral tissue allergy or sensitivity responses to the components of amalgam restorations. However, the patient's concerns should be listened to carefully and not dismissed. They may arise because of

either misinformation or the patient is desperate to try anything that may improve his or her health. It is unethical to replace satisfactory amalgam restorations with other materials in the expectation, or with the promise, of improved general health. The use of so-called 'electrodiagnostic' devices or galvanometers to measure electric currents either between amalgam restorations or between amalgam restorations and the oral mucosa as a basis for determining damage to the nervous system and to specific body organs linked to specific teeth is to be deprecated. The patient should be informed of the lower long-term cost-effectiveness of resin-based composites before his or her fully informed consent is obtained for the replacement of any satisfactory posterior amalgam restorations, either for psychological medical reasons or because of aesthetic concerns.

Resin composite in Class II cavity preparations

Great care must be taken to ensure correct interproximal contour and gingival margin adaptation of the restoration since modification of the set material is very difficult, if not impossible. Unlike amalgam, resin composite cannot be condensed to ensure a tight proximal contact during placement. Positive pressure from the matrix band retainer and/or wedge is, therefore, essential to push the teeth apart and to compensate for the thickness of an anatomic matrix band. During placement of the resin composite it is imperative that there is no moisture contamination and that no voids be incorporated between the cavity margins and the restoration. This may be difficult to ensure, since the stickiness of some resin composites to instruments tends to pull them away from the cavity walls. The use of resins injected from compules reduces porosities and voids, and is essential for highly filled stiff materials in particular which, however, may not be able to be placed effectively in small preparations.

GLASS-IONOMER CEMENTS (GLASS POLYALKENOATE CEMENTS)

The development of glass-ionomer cements (GICs) has made possible cavity preparations without macromechanical retention. The long-term ionic bond strength to dentine is responsible for the longevity of

GIC restorations in low-stress situations. In adults, GICs are best suited for Class III and V cavity preparations, and for restoring non-carious cervical lesions. GICs lack the mechanical properties needed for the long-term survival of large occlusal and multisurface restorations, and for the restoration of incisal tooth edges. However, high-viscosity GICs may be used successfully as large interim/temporary restorations in posterior teeth provided that they are subject to minimal occlusal forces.

Newer conventional GICs have improved mechanical and optical properties and shade matching, and faster initial setting times. Several of the most recent restorative GICs also release increased, sustained amounts of fluoride ions. Resin-modified GIC restoratives combine some of the advantages of resin-based composites and GICs.

Dissolution and erosion

Deficient techniques while preparing and placing conventional GIC restorations, such as moisture contamination before the cement has set and desiccation before the cement has fully matured, may lead to rapid surface dissolution and increased opacity of the restorations. Even fast-setting conventional GICs are vulnerable to moisture for several minutes after their initial setting. Signs of early contamination by moisture are the subsequent loss of surface material with roughening and impaired translucency. Being also vulnerable to desiccation, the best setting environment for the GIC is one that is high in humidity (80% relative humidity), but not wet. The durability of conventional GIC restorations is highly dependent upon the care devoted to them during the first few minutes of placement. An effective surface seal is essential to protect the glass-ionomer cement after it initially sets. Thirty minutes should suffice to prevent damage by moisture, but the restoration may remain vulnerable to desiccation for a much longer period of several weeks. This was especially critical with earlier aesthetic conventional GICs.

Acids produced by microorganisms in dental plaque, acids contained in many foods and beverages, gastric refluxate and 1.23% acidulated phosphate fluoride (APF) gels may lead to surface erosion of earlier aesthetic GIC restorations in particular.

Fig. 4 Reasons for the replacement of glass-ionomer cement restorations in adults**

Table 2 Rating system for restorations

Rating code	Operational explanation
Satisfactory	
Range of excellence Code: R Call: Romeo (Alfa)	The restoration is of satisfactory quality and is expected to protect the tooth and the surrounding tissues.
Or	Or
Range of acceptability Code: S Call: Sierra (Bravo)	The restoration is of acceptable quality but exhibits one or more features which deviate from ideal conditions.
Not Acceptable	
Replace or correct for prevention Code: T Call: tango (Charlie)	The restoration is not of acceptable quality. Future damage to the tooth and/or its surrounding tissues is likely to occur.
Or	Or
Replace immediately Code: V Call: Victor (Delta)	The restoration is not of acceptable quality. Damage to the tooth and/or its surrounding tissues is now occurring.

NB: Table 2 from Ryge G. Clinical criteria. *Int Dent J* 1980; 30: 347–378. Reprinted 2008 by permission.

The carboxylate groups are connected by covalent linkages, which are impervious to acid attack. However, the cross-links are ionic and many of these may break. Non-matrix elements such as sodium and fluoride ions and silica are then leached from the GIC. Newer, mature GIC restorative materials on exposed tooth surfaces are relatively resistant to acid attack from most sources. However, long-term surface dissolution of GIC restored proximal tooth surfaces in posterior permanent teeth may cause extensive losses of cement with resulting unsupported marginal ridge fracture or chipping of the GIC restorations. The localised dissolution appears to be the result of acids from dental plaque present immediately below the proximal contact area. This region is largely isolated from the protective effects of saliva and the mechanical removal of plaque by tooth brushing.

Colour stability and staining

Clinical studies have shown that relatively few conventional GIC restorations discolour significantly in the mouth. However, marginal staining may occur following the fracture of thin flashes of GIC material extended beyond the cavity margins. There are considerable variations in median longevities reported for GICs. Because of their sustained low levels of fluoride ion release and their ability to be 'recharged' by topical fluorides, GIC restorations are often placed in patients at high risk of active caries. Therefore, median survivals may be relatively low (Table 1). However, in optimal situations median survival times in adults may be approximately 10–12 years, but little long-term data are available from general practice. The reasons for GIC restoration replacements from one earlier study are shown in Fig. 4. Other studies have reported relatively more failures in posterior teeth from bulk fracture.

PREVENTIVE *VERSUS* RESTORATIVE TREATMENT PHILOSOPHIES

The strategy used for the management of clinical problems depends upon the dentist's knowledge, training and confidence in providing the various alternative treatments available, as well as upon a host of economic and personal considerations. A dentist can opt to be preventive-biased, which is what we are recommending, or restorative-biased, which we do not recommend. In cases of doubt, the preventive-biased operator will attempt to prevent the carious lesion from progressing and will review the patient to ensure that the lesion does not progress. The restorative-biased dentist will 'cut and fill' immediately in the same doubtful instance of a carious lesion being present.

Preventive strategies

These recognise that a small, incipient or early carious lesion will not necessarily progress to a large more severe lesion. Non-progression or arrest can be promoted by various preventive treatments such as fluoride application, plaque removal and modification of diet. It is also important to realise that the sticky fissure is not a reliable indicator of caries on its own. The finding of this sign should not lead to the automatic restoration of the tooth. 'Extension for prevention' also is an outdated concept in most respects. 'Prevention instead of extension' is more appropriate. It must be appreciated that merely cutting out the carious tissue and replacing it with a reasonably inert restoration does not cure caries or modify any of the causative factors. In fact, the restored tooth is more susceptible to caries than the sound tooth, due to the imperfect tooth/restoration margins. If secondary caries occurs, restoring the tooth a second or third time inevitably involves the cutting away of more tooth structure. There are a finite number of times that this process can be repeated.

Preventive strategies aim to remove or modify the aetiological agents of caries to prevent its recurrence as well as restoring the damage the disease has caused. For proximal lesions, monitoring the size of radiolucencies is a practical early way of assessing the success or otherwise of the arrest of caries. When a posterior bitewing radiograph taken for a new patient reveals a proximal radiolucency, the behaviour of the lesion cannot be assessed just by the

size of the radiolucency. Two identically positioned radiographs taken at similar exposures and X-ray beam angles, and separated by a reasonable time interval, are required if an assessment of lesion progression is to be made. A relatively large radiolucency seen for the first time may have been present for many years, and represent an arrested or very slowly progressive lesion. Conversely, a small radiolucency may be progressing very rapidly.

Most enamel lesions in permanent teeth progress slowly, and remineralised areas can be more resistant to new acid attacks than sound enamel.

To restore all approximal radiolucencies immediately, irrespective of their size, is illogical and represents overtreatment. Review the lesions, apply preventive measures, and institute restorative treatment only if continuing progression is seen or if the radiolucency extends past the enamel-dentinal junction more than one-third to one-half of the thickness of the dentine.

Restorative strategies

Merely restoring every suspect tooth surface promptly, in the hope that the restoration will provide a lasting cure to dental caries, has been shown to be an optimistic approach, doomed to failure. However, prompt restorative care is needed when preventive treatments fail in the caries-susceptible or high risk individual. Dentists should be constantly alert for these patients who are a minority group with a particularly rapid, destructive form of caries. Patients need continued intensive preventive treatment, as well as restorations for cavitated teeth, if widespread rapid primary and secondary caries is to be avoided. Restorations should be placed to a high technical standard to minimise iatrogenic damage. Factors to consider in identifying high risk individuals include their age, past caries experience (filled teeth, extracted teeth), present carious lesions and their distribution (particularly involving mandibular incisors), oral hygiene, diet, fluoride history, salivary flows.

The timing of recall or review appointments must be determined individually for each patient if the correct balance between preventive and restorative care is to be maintained. How best to motivate individual patients to attend recalls, and how to assess whether the patient will actually

comply with your recommendations are further very important factors to consider.

No known dental material has yet to achieve all of the requirements of an ideal restorative material. However, provided that an appropriate material is selected and there is appropriate cavity preparation and careful handling of the material by the dentist the success or otherwise and good oral hygiene practices by the patient, without bruxing or hyposalivation present, then intra-coronal restorations can last for a very long time. The advantages of repair of localised defects include the saving of tooth structure, and extending the longevity of restorations at low financial cost. Restorations only require repair or replacement if they are causing biological, functional or aesthetic problems for the patient.

QUALITY ASSESSMENTS IN OPERATIVE DENTISTRY

The clinical characteristics most commonly considered to assess the quality of restorations are surface texture and colour, anatomic form and marginal integrity. To aid the dentist in his or her assessments, specific criteria have been developed for each of these characteristics, to match the four categories of the rating system shown in Table 2.

From this table, replacing 'not acceptable' restorations for 'prevention' reasons has the potential to lead to overtreatment, as many such designated restorations may not actually fail until many years later, when they are often either repaired or replaced for reasons completely unrelated to the original (Tango/Charlie) assessment reason. Based on the need for improved restoration assessment and treatment decisions, modifications to both the original, and to the expanded complex Ryge-type criteria, have been proposed. However, these modifications unfortunately still usually include criteria for 'replace or repair for prevention reasons', thus continuing to promote overtreatment and the potential 'death spiral' for restored teeth. Restorations should only be repaired or replaced if there is actual evidence of biological, functional, or aesthetic (as determined by the patient in many instances) problems present. Belated recognition of these three parameters for determining clinical criteria has now been recognised, and approved recently by the FDI World Dental Federation.

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****Figures 2–4 are based on data from: Wilson N H, Burke F J, Mjör I A. Reasons for placement and replacement of restorations of direct restorative materials by a selected group of practitioners in the United Kingdom. Quintessence International 1997; 28: 245–248. Adapted 2008 with permission. Also, Anusavice K J (ed). Quality evaluation of dental restorations. Criteria for placement and replacement. Chicago: Quintessence Publishing, 1989. Material quoted with permission**

Corrigendum

Research article (*BDJ* 2012; **213**: E8)

'The effects of NICE guidelines on the management of third molar teeth'

In the above research article, an error appears in the text relating to the age range of patients. The actual mean age range throughout is between 25 and 32 for the years from 1990 to 2010.