Australian Dental Journal 1998;43:(3):153-9

A new cavity classification

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Abstract

With the development of adhesive restorative materials and a far better understanding of the action of the fluoride ion it is suggested that the time has arrived for a reassessment of the traditional cavity classification as set out by G. V. Black over one hundred years ago. When preventive measures and remineralization fail and a carious lesion has progressed through the enamel into the dentine there is a need to remove the infected dentine, and possibly some of the affected dentine as well, to eliminate cavitation and avoid further accumulation of plaque. In most situations this will involve removal of enamel to achieve access to the infected dentine but, in the presence of fluoride, both enamel and dentine are capable of being remineralized and therefore conserved, at least to a degree.

The principle of minimal extension must be encouraged to allow maximum preservation of natural tooth structure. A new cavity classification is proposed which is designed to make the most of the potential for healing which is inherent in both enamel and dentine. However, it must be accepted that a considerable proportion of restorative dentistry is carried out to replace failed restorations and, in this case, cavity design will be complicated by existing loss of tooth structure.

Key words: New cavity classification, cavity design, fluoride ion, preservation and restoration of tooth structure.

(Received for publication March 1997. Revised June 1997. Accepted June 1997.)

Clinical relevance

The proposed classification allows the operator to define the extent and complexity of a cavity and at the same time encourages a conservative approach to the preservation of natural tooth structure. It is also compatible with computerization and will therefore facilitate both record keeping and communication within the profession.

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Introduction

Until recent times cavities were designed without the present understanding of the action of the fluoride ion[1] and, in the presence of restorative materials which had no inherent therapeutic properties, were subject to microleakage and were often not aesthetic. Also, in the absence of adhesive restorative materials, it was regarded as essential to remove all unsupported enamel regardless of its location. More importantly, it was often necessary to remove additional sound tooth structure just to make room for the restorative material thus defeating one of the prime purposes of restoration – the preservation of remaining tooth structure.

It is very difficult indeed to reproduce the anatomy and appearance of the original tooth with any of the direct plastic restorative materials, for example, amalgam, composite resin and glass ionomer. However, now that it is possible to develop long-term adhesion to both enamel and dentine in the oral environment, the way is open for a complete reassessment of cavity design. Whilst the materials currently available are still not perfect, they are adequate for the restoration of the smaller initial lesions and, in combination, can be used to restore cavities of moderate size.

When placing plastic restorative materials, reproduction of the original anatomy of the tooth is entirely dependent upon the skill of the operator and this will have a considerable bearing on the longevity of the restoration. It is accepted that longevity of conventional plastic restorative materials placed in a traditionally designed cavity is not great, varying between ten and fifteen years on average.[2] However, in the presence of a better understanding of the caries process and improved knowledge of the function of fluoride, it is now possible to limit the size of a cavity by retaining at least some of the demineralized enamel and dentine and allowing it to heal through remineralization.[3] Thus it is possible to retain more natural tooth structure with the

expectation of greater longevity and therefore the potential for longer periods between the need for replacement. It is inevitable that replacement will result in further loss of natural tooth structure and a cycle of destruction is propagated.

The understanding of the histopathology of the progress of the carious lesion is not new and, in fact, has been known and understood for many years.[4] What has changed is the understanding of the effect of fluoride on the demineralization/remineralization cycle. In addition the advent of true long-term adhesion with restorative materials such as glass ionomer and resin composite had led to modified concepts of cavity design.[5-7] These two factors make it possible to reconsider the classification of carious lesions and cavity designs first rationalized by G. V. Black over one hundred years ago.[8] Whilst his concepts are not entirely outdated, there is certainly a need to reconsider the design of cavities with the prime object of retaining as much natural tooth structure as possible during the treatment of any carious lesion because no restorative material can be regarded as a perfect replacement.

When Black defined the parameters for his classification the cavity designs were controlled by a number of factors, many of which no longer apply. Caries was rampant and the significance of fluoride was not understood. There were limitations in the available instruments for cavity preparation as well as the selection of restorative materials. The five categories of carious lesion were related to the site of the lesion and to the nature of the intended restoration but they did not take into account the dimensions of a cavity nor the increasing complexity of the method of restoration as the cavity enlarged. Black suggested that it was necessary:

1) To remove tooth structure to gain access and visibility

2) To remove all traces of affected dentine from the floor of the cavity

3) To make room for the insertion of the restorative material itself

4) To provide a mechanical interlocking retentive designs, and

5) To extend the cavity to 'self cleansing' areas to avoid recurrent caries.

The result was that, by today's standards, completed cavities for all restorations were large. In his designs Black showed commendable respect for remaining tooth structure as well as occlusal and proximal anatomy, but it was necessary to sacrifice relatively extensive areas of enamel to achieve his goals. Other far more effective methods of dealing with a carious lesion are now available. With modern understanding of adhesion and remineralization it is no longer necessary to remove all unsupported demineralized enamel around the cavity margin, the concept of 'self-cleansing' areas has been discarded, and removal of all affected dentine from the axial or pulpal wall of the cavity is strictly contraindicated because of the potential for remineralization and healing.[9,10]

Table 1. Cavity classification

	Size			
	Minimal 1	Moderate 2	Enlarged 3	Extensive 4
Site				
Pit/fissure 1	1.1	1.2	1.3	1.4
Contact area 2	2.1	2.2	2.3	2.4
Cervical 3	3.1	3.2	3.3	3.4

Many of the old limitations no longer apply and it is now appropriate to think again about the problems presented by a carious lesion. Without in any way denigrating the achievements due to Black's concepts and work, the following thoughts are offered and a new approach to the definition of cavity design is outlined. The proposed classification is designed to simplify the identification of lesions and to define their complexity as they enlarge and is expected to provide benefits for the profession and their patients (Table 1 refers).

The three sites of carious lesions

Carious lesions occur in three sites on the crown or root of a tooth, that is, in those areas subject to the accumulation of plaque (Fig. 1). These are:

Site 1. Pits, fissures and enamel defects on occlusal surfaces of posterior teeth or other smooth surfaces, such as cingulum pits on anteriors.

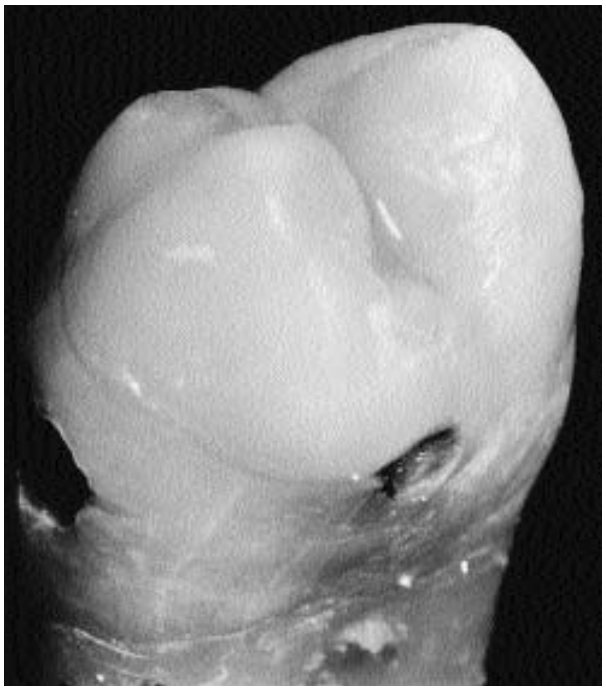


Fig. 1.–The crown of a bicuspid showing the three sites for the initiation of a carious lesion. The occlusal fissure is not particularly involved in this tooth but both the proximal surface, in relation to the contact area, as well as the cervical margin show active caries.

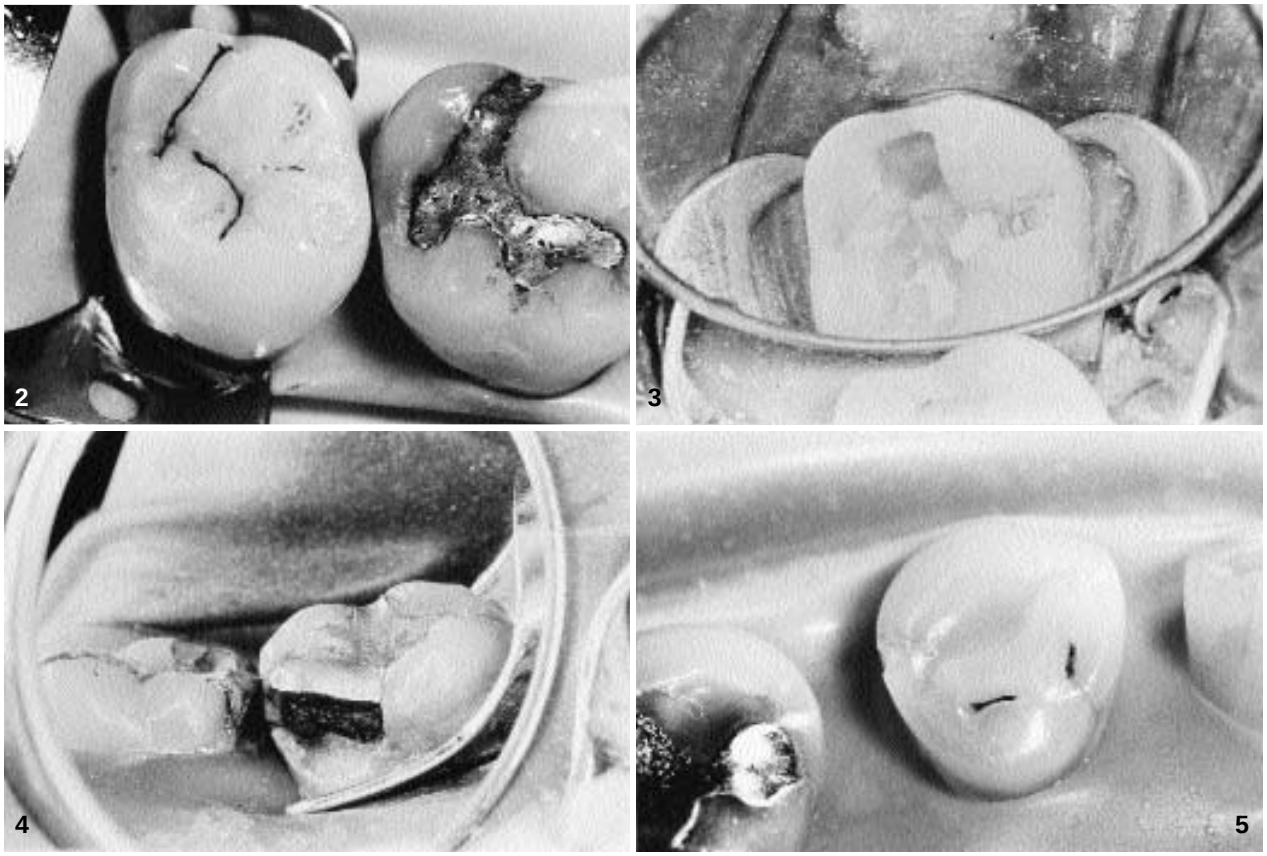


Fig. 2.–It is assumed that the occlusal fissure on the extracted second molar is actively carious and a very conservative Site 1, Size 1 cavity (#1.1) will be prepared to deal with the fissure lesion. Note the existing G. V. Black Class I amalgam in the first molar and this is classified Site 1, Size 2 (#1.2) because it is very extensive by modern standards.

Fig. 3.–A Site 1, Size 2 (#1.2) amalgam has been removed from the occlusal of the second molar revealing a split at the base of the mesio-lingual cusp. The cavity is now a Site 1, Size 3 (#1.3) lesion and the cusp requires a protective type cavity preparation to relieve the load from the split.

Fig. 4.–The same tooth as shown in Fig. 3 approximately ten years later. The mesio-lingual cusp has finally failed and the cavity is now a Site 1, Size 4 (#1.4) lesion.

Fig. 5.–Erosion lesions such as this one on the tip of the buccal cusp of the first bicuspid is regarded as a Site 1, Size 1 lesion (#1.1).

Site 2. Approximal enamel immediately below areas in contact with adjacent teeth.

Site 3. The cervical one-third of the crown or, following gingival recession, the exposed root.

It is regarded as logical to classify lesions by these sites and then to grade them by size according to the extent of progress.

The four sizes of carious lesions

Taking into account the progress of the carious lesion, it is possible to consider restoration in four sizes regardless of the site of origin of the lesion:

Size 1. Minimal involvement of dentine just beyond treatment by remineralization alone.

Size 2. Moderate involvement of dentine. Following cavity preparation remaining enamel is sound, well supported by dentine and not likely to fail under normal occlusal load. That is, the remaining tooth structure is sufficiently strong to support the restoration.

Size 3. The cavity is enlarged beyond moderate. The remaining tooth structure is weakened to the extent that cusps or incisal edges are split, or are likely to fail if left exposed to occlusal or incisal load. The cavity needs to be further enlarged so that the restoration can be designed to provide support and protection to the remaining tooth structure.

Size 4. Extensive caries with bulk loss of tooth structure has already occurred.

The Size 1 cavity will necessarily be a new lesion and adhesive restorative materials are ideal, and should always be used for restoration under these circumstances. Cavities in the Size 2, 3 and 4 range may be new lesions that have progressed to a considerable extent without the patient presenting for treatment or they may result from a breakdown of an old restoration which requires replacement. The same basic principles for developing a cavity design will apply in both cases and, for obvious reasons, the larger the cavity the greater the problems in restoration and the shorter the probable longevity of plastic restorative materials. The selection of the most suitable material for the larger restorations will be dictated by such properties as resistance to fracture and flexure as well as abrasion resistance.

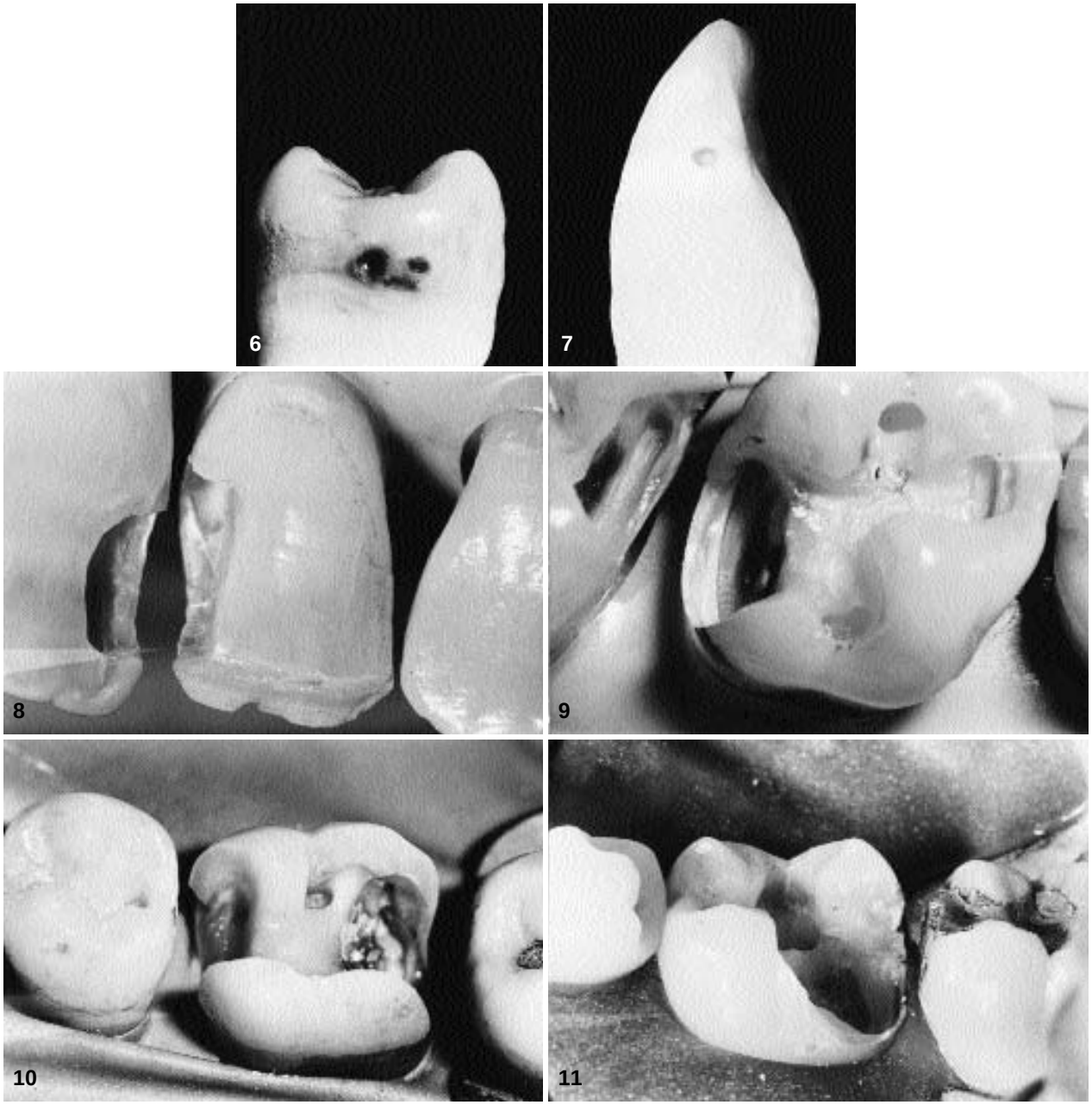


Fig. 6.–There is a proximal carious lesion on the distal of the upper first bicuspid related to the contact area so this is a Site 2, Size 1 (#2.1) lesion.

Fig. 7.–The proximal lesion on the distal of the upper anterior is related to the contact area with the adjacent tooth so it will also be categorized as a Site 2, Size 1 (#2.1) lesion.

Fig. 8.–The lesion in the distal of the upper central incisor does not include the incisal edge and is therefore classified as a Site 2, Size 2 (#2.2). However, the lesion at the mesial of the adjacent upper lateral incisor has just involved the incisal corner and is therefore a Site 2, Size 3 lesion (#2.3).

Fig. 9.–An existing amalgam restoration in the upper molar has failed and is to be replaced in amalgam. The cavity is a relatively conventional design with all cusps well supported with remaining dentine. The classification is therefore Site 2, Size 2 (#2.2).

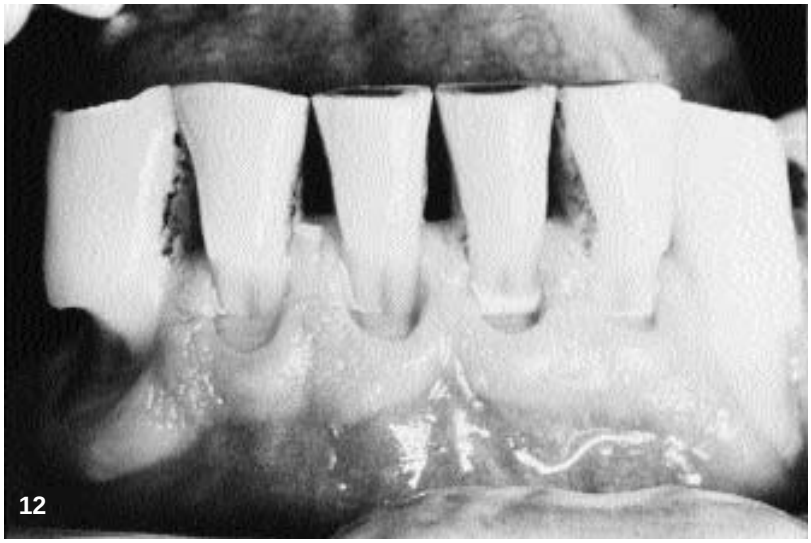
Fig. 10.–There is already a split at the base of the lingual cusps of this lower first molar and the buccal cusps are also undermined and weakened. As all cusps require protection from occlusal load the cavity has been modified to allow for this and the classification will be Site 2, Size 3 (#2.3).

Fig. 11.–The disto-buccal cusp has failed on this lower molar and must be replaced. Therefore the classification will be Site 2, Size 4 (#2.4).

Restorative materials

1) The use of resin composite will be controlled by its limited resistance to wear as well as shrinkage on setting, whether it is auto-cured or light-activated; and also by the presence or absence of well supported enamel strong enough to provide adhesion through acid etching around the entire margin.

2) The main limitation for amalgam is aesthetics although its physical properties are generally adequate for all circumstances.



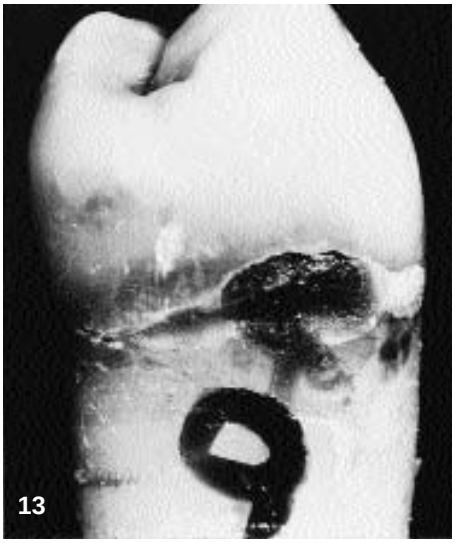


Fig. 12.–Erosion lesions at the gingival margins of all six lower anteriors would be classified as Site 3, Size 1 (#3.1) lesions. The lesion on the lower right canine is so extensive that it may be judged to require additional pulp protection so it may be justified to classify this as a Site 3, Size 2 (#3.2).

Fig. 13.–There is a root surface caries lesion at the cervical margin of this bicuspid. It is not related to the contact area so the classification will be Site 3, Size 3 (#3.3).

Fig. 14.–There is an extensive lesion at the cervical of this lower canine which extends from the labial around to the lingual surface. As this is a very complex situation to restore, it will fall within the classification of a Site 3, Size 4 (#3.4) lesion.

3) Glass ionomer cement develops excellent adhesion[11,12] to both enamel and dentine and provides satisfactory aesthetics, but has limited strength and is therefore not universally recommended for restoration of incisal edges and marginal ridges.

Discussion

To assist in communication and understanding, the relationship between Black's classification and the modern site and size concept is discussed below.

Site 1 – Size 1, 2, 3 and 4 – pit and fissure caries

• *Cavity located on the occlusal surface of a posterior tooth or any simple enamel defect on an otherwise smooth surface of any tooth (Fig. 2-5).*

Under the Black's classification the smaller Size 1 could not have been carried out because suitable instruments for such fine cavity preparations were not available. Neither were the adhesive restorative materials. Thus the Black classification began with Site 1, Size 2 (#1.2).

Site 2 – Size 1, 2, 3 and 4 – approximal lesion commencing in relation to contact areas

• *Cavity located on the approximal surface of any tooth (anterior or posterior) initiated immediately below the contact area (Fig. 6-11).*

In the Black classification these lesions were divided between posteriors (Class II) and anteriors

(Class III) but as the initiation and progress of the lesion is identical there is no logic in this division. Because of equipment and materials limitations there could be no equivalent of Size 1 so the Black classification begins with Site 2, Size 2 (#2.2) in both posteriors and anteriors.

Black Class II

• *A cavity arising in relation to the contact area between any pair of posterior teeth.*

Because of materials and equipment limitations there was no equivalent to Size 1 so the Black classification begins with Site 2, Size 2 (#2.2) and extends to Site 2, Size 4 (#2.4) (Fig. 9-11).

Black Class III

• *Cavity located between anterior teeth only.*

Because of materials and equipment limitations there was no equivalent to Size 1 so the Black classification begins with Site 2, Size 2 (#2.2) and extends to Site 2, Size 3 (#2.3) (Fig 7, 8).

Black Class IV

• *An extension of a Class III lesion involving the incisal corner or incisal edge of an anterior tooth.*

An alternative cause would be traumatic fracture of the incisal corner and now classified as Site 2, Size 4 (#2.4) (Fig. 8).

Site 3 – Sizes 1, 2, 3 and 4 – gingival one-third of the clinical crown or exposed root surface following recession

• *A cavity located in the gingival one-third of the crown or exposed root (Fig. 12-14).*

The Black classification does not recognize lesions on the gingival one-third of the approximal surface, particularly root surface caries, as being different from Class II lesions. An erosion/abrasion lesion or a small carious cavity would be a Site 3, Size 1 (#3.1) or Site 3, Size 2 (#3.2) and interproximal lesions would generally be recorded as Site 3, Size 3 (#3.3) or Site 3, Size 4 (#3.4).

Cavity design and preparation

It will be noted from the above that the Black's classification did not allow for the Size 1 lesion in either Site 1 or Site 2 because of the absence of adhesive restorative materials and, to a degree, equipment limitations. Also, it must be recognized that there is a clear division between restoring a new lesion and replacing a failed restoration. When dealing with new active caries, the cavity design should be very conservative because it is possible to remineralize areas of both enamel and dentine which are only demineralized and not cavitated. Margins need to be extended only to smooth surfaces which are capable of remineralization and the conept of 'extension for prevention' no longer applies. It is often possible to maintain tooth-to-tooth contact interproximally, and cavity outline form should be dictated by cavitation only.

On the other hand, in replacement of a failed restoration, the cavity outline is already defined and will often be more extensive than ideal. For replacement restorations most of the principles laid down by Black will still apply, if for no other reason than tooth structure cannot be replaced. In fact, for both Size 3 and Size 4 lesions there is essentially no change (Fig. 9-11).

Whether the problem presenting is a new lesion or replacement of a failed restoration, the limitations of the physical properties of both the remaining tooth structure and the restorative material must be taken into consideration. A small restoration can be reliably supported by remaining tooth structure, particularly in the presence of adhesive restorative materials. In fact, it is claimed that a tooth crown can be restored to full physical strength in the presence of adhesion.[13] However, as the cavity enlarges the tooth becomes weaker until it reaches a point where the restoration must be placed in such a way that the restorative material itself will support remaining tooth structure[14] (Fig. 10). This requires modification to cavity designs and some consideration as to which material to utilize. The ultimate problem arises following loss of bulk tooth structure (Fig. 11) in the Size 4 cavity because of the difficulty of restoring coronal anatomy both proximally and occlusally.

It is suggested that there are a number of other advantages to be derived from adoption of the proposed classification. A number system such as this can be readily and accurately utilized for record-keeping on a computer. In conjunction with the FDI notation system for the identification of teeth, all records can be computerized to some advantage.

Even though there are additional numbers involved, the system represents a simplification of the Black classification and is therefore easier to learn. Black separated the proximal lesion into anterior and posterior and the anterior lesion into one further division on the basis that the groups required a different type of treatment. That is, a proximal lesion in a posterior tooth required an occlusal extension to both include the occlusal fissure as well as provide a mechanical interlock for retention of the restoration. Such a design was unnecessary in an anterior but retention of the restoration posed further problems following involvement of the incisal edge. However, in the presence of adhesion, this subdivision is no longer necessary and can be safely abandoned.

There is a further problem with the Black classification in relation to root surface caries (Fig. 13). It is unlikely that interproximal root caries lesions, unrelated to the contact area, were at all common at the beginning of the century because of the relatively short life span of both the teeth and the patient. It really did not have to be accounted for so there is no special mention of it. However, it now poses problems for both prevention and restoration and it seems desirable to be able to properly record it.

Recent literature has demonstrated a growing need for a new classification because confusion is arising as a result of the developing demand for more conservative cavities. The terms 'tunnel' or 'slot' to describe a minimal approach to new, unrestored Size 1 proximal lesions are becoming common but are rather clumsy and not clearly definitive. A 'Class I/fissure seal' has been described without any clarification.[15] Some authors are even suggesting the introduction of a 'Class VI' without there being any unanimity on its parameters.[16]

Finally, accuracy of record-keeping and communication both within and outside the profession would be facilitated with the ability to describe the increasing complexity of restoration of the extending cavity which arises, particularly with replacement dentistry. At present a 'Class I' is a 'Class I' regardless of the extent of the lesion. Whether it involves one section only of the fissure system or takes in the entire occlusal surface with the need to replace a cusp, it still retains the same definition. This is not desirable for record-keeping and communication and the proposed classification would overcome all such restrictions.

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