Detection of carious lesions; diagnosis of activity and relevance of preventive management

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**SUMMARY.** In its early stages the carious process can still be arrested by preventive treatment. In today's dentistry individual risk assessment becomes more and more important in order to provide the proper preventive treatments to high risk children. Diagnosis of caries implies more than just detection of lesions. The whole objective of caries management is to assess whether caries is progressing and if it is, attempts to arrest lesions should be made. This can be done by plaque control, modifying the diet, and use of fluoride. In fact it is the parent and the child who, each day, are in charge of the preventive management. This makes communication and behaviour modification a critical part of the work. With an early diagnosis more time will be available to tip the balance of the caries process towards delayed progression and lesion arrest.

**KEY WORDS.** Carious detection, Activity, Preventive management

Introduction

**Key features of the carious process**

The carious process has always been seen as a simple diagram. Sound enamel will demineralize in time if plaque bacteria are given the sugary substrate they need to produce acid (Fig. 1). However most people have a remineralizing solution in their mouths: saliva. Thus progression of the carious lesion is not inevitable and the disease can be controlled: the formation of a cavity is not inevitable. Lesion progression can also be arrested by improved plaque control, sensible dietary changes and the use of fluoride.

The features of the carious process are as follows [Fejerskov, 1997].

- At the crystal level the carious process is a continuous natural phenomenon.
- The process is spread over time.
- The process does not have to progress.
- All ages are susceptible to caries.
- Caries is the major cause of tooth loss in all age groups.

From the above it is obvious that the dental practitioner must be concerned with the carious process in all patients in the practice.

**Epidemiological perspective**

It was in the early 1980's that epidemiologists from around the world produced data to show a decline in caries prevalence in children [Glass, 1982]. Ten years later, contemporary data were re-evaluated and it was shown that caries prevalence had continued to decline [Murray, 1994]. Fluoride in all its many forms was tentatively suggested, by the research community, as the most logical explanation for the decline. A fluoride works by delaying lesion progression [Koch et al., 1994], it would appear that, on a population basis, the progression of the main arrow in Figure 1 has been delayed. Thus explanation, if correct, has interesting implications for practitioners. Let us hypothesise that in many young people the carious process will continue to progress, albeit slowly. The process may then present at the cavitation level in young adults. Apparently it did not disappear, but has been delayed only.

Accurate epidemiological data will continue to be of great relevance to the practitioner in the future.
Skewed distribution
Epidemiological studies, and our own clinical experience, show us that the distribution of caries in the population is skewed, with most of the disease being concentrated in a minority of the population [Murray, 1994]. The size of this ‘minority’ may well depend on the location of the individual practice or the age of the patients involved. In an inner city deprived area many patients may be at high risk to caries, just as the same applies for groups of immigrant children. However, these scenarios are the exception rather than the rule, because most dentists deal with a very mixed population.

Caries diagnosis and risk assessment
Caries lesions can be detected in extracted teeth, but diagnosis implies more than this. Diagnosis implies deciding whether a lesion is active, progressing rapidly or slowly, or whether the lesion is already arrested.
Without this information a logical decision about treatment is impossible. For instance, an active white spot lesion requires preventive treatment whereas no treatment is required for an arrested lesion. Thus a caries risk assessment of the individual patient is of great importance to diagnosis but individual features of a lesion are also important.

Why is early diagnosis important?
It is important to diagnose an active carious lesion as soon as possible, preferably before the surface of the tooth has cavitated. Thus, the lesion should be diagnosed at the stage of the white spot, so that preventive treatment has a chance to arrest lesion progression.

What are the conditions for early diagnosis?
Caries diagnosis requires: good lighting, good eye sight, clean teeth, a three-in-one syringe so that teeth can be viewed both wet and dry, ‘blunt probes’ and reproducible bitewing radiographs [Kidd and Joyston-Bechal, 1997].
It is perhaps slightly ironic that the white spot lesion, although caused by plaque, is also hidden by it! Perhaps a logical way to proceed is for the dentist to examine the teeth both before and after removal of plaque. Many experienced practitioners will choose to carry out their examination immediately after the patient has seen their hygienist.
The three-in-one syringe is invaluable in the diagnosis of the depth of penetration of the white spot lesion. A white spot lesion that is only visible once the enamel has been thoroughly dried has only penetrated about halfway through the enamel. On the other hand a white or brown spot lesion that is visible on a wet tooth surface has penetrated all the way through the enamel and the demineralization may be in dentine [Ekstrand et al., 1997]. Demineralization may be in dentine before cavitation occurs, but the lesion can still be arrested if plaque control can be established.
The explanation for this useful optical phenomenon, originally noted by G. V. Black [1908], is the relative refractive indices of air (1.0), water (1.33), and enamel (1.62) [Thylstrup and Fejerskov, 1994]. When a small white spot lesion is thoroughly dried, air replaces the water in the porous tissue. A s
the refractive index of air is further away from enamel than water, the lesion becomes easier to see. On no account should a white spot lesion be touched with a sharp probe to see if the probe 'sticks' in the tissue. The probe is likely to break the relatively intact surface zone of the enamel lesion and cause a cavity [Ekstrand et al., 1987].

Finally good bitewing radiographs are essential for the diagnosis of approximal lesions where a contact point is present [Kidd and Pitts, 1990]. A film holder and beam aiming device should always be used to ensure the correct angulation of the radiographic beam and as an aid to reproducing the same geometry in any subsequent radiograph. Where a lesion is to be monitored for progression or arrest, this reproducibility of view is essential, otherwise an apparent change in the lesion may simply be an artefact of geometry.

**Diagnosis of active and arrested lesions on individual tooth surfaces**

Free smooth surfaces. Vision is the adequate diagnostic tool. Uncavitated, active lesions are close to the gingival margin and have a matt surface. Inactive lesions may be further from the gingival margin, white or brown in colour with a shiny surface. Cavitated lesions exposing soft dentine are active, whereas inactive, cavitated lesions have hard, dark brown, dentine at the base.

Occlusal surfaces. Visual examination and examination of the bitewing radiographs are both important [Ekstrand et al. 1997]. The active, uncavitated lesion is white, often with a matt surface. The corresponding inactive lesion may be brown [Ekstrand et al., 1998]. These enamel lesions are not visible on a bitewing radiograph. Cavitated lesions may present as microcavities with or without a greyish discolouration of the enamel. More advanced lesions may present as cavities exposing dentine. Cavitated lesions are usually visible in dentine on a bitewing radiograph and these lesions are active. The microcavity is easily missed on visual examination unless the surface is perfectly clean and dry. Careful examination of bitewing radiographs is very important and serves as a useful safety net to avoid missing microcavities. A lesion that has been missed on visual examination but found on radiograph has been called ‘hidden’ caries [Weerheijm et al., 1992].

Approximal surfaces. The bitewing radiograph is the appropriate diagnostic tool for the enamel lesion but it is not possible to tell from the radiograph whether the lesion is active or inactive. However, the presence of a cavity is very important on this surface because plaque cannot be removed, and therefore the lesion will be active and progress. Studies have shown that lesions confined to enamel on radiograph are not usually cavitated. Lesions just visible in dentine on radiograph may or may not be cavitated. A cavity is more likely to be present in a high risk patient and where gingival inflammation persists despite careful flossing [Ekstrand, 1998]. The presence or absence of a cavity can be confirmed by using an orthodontic separator and taking an impression of the surface after separation. Lesions approaching the pulp on radiograph are cavitated and active. Fibreoptic transillumination can be used to diagnose approximal lesions in dentine, but as with a radiograph [Mitropolous, 1985] this test will not differentiate active from inactive and cavitated from uncavitated lesions.

Recurrent caries. Lesions adjacent to restorations are called recurrent carious lesions. All the features of primary caries that have been described above apply to recurrent lesions. Unreliable in the diagnosis of active recurrent caries are ditching around an amalgam restoration, staining around an amalgam restoration [Kidd et al., 1995] and staining around a tooth-coloured restoration [Kidd and Beighton, 1996].

**Caries management**

The management of active caries always requires preventive treatment and where cavities preclude plaque control operative treatment is also needed. Figure 2 gives a caries control checklist which practitioners and other members of the dental team may find useful. Notice the use of the term preventive treatment, which implies active intervention by the dental team which is skilful, time-consuming and worthy of payment.

**Preventive treatment**

I involve the patient and the parents. In paediatric dentistry it is not just the dentist and the patient that is involved. There is a third party involved: the parent. Until 10 years of age parents are not only responsible but should also help their children with tooth cleaning, fluoride supplement use and a proper diet. As the child grows up more and more responsibility should be given to the child by the parents. They should set rules and limits at a young age, loosening them gradually, only to hope that
The child will be able to deal with the growing responsibility. Unfortunately not all parents take this responsibility. A permissive approach can start at an early age. When the parents are not supportive we have to keep in mind that the child is sometimes too young to take his own responsibility.

It is absolutely essential to involve patient and parents from the outset and they must own the problem and have some sense of control over it [Barker, 1997]. One of the best ways is to turn them into their own personal dentist so that they can give themselves a check up every day! Give them a mirror and show them their own carious lesions. Show them the white spot, the cavitated lesion, the new cavity forming next to a filling, a red and swollen gingival margin that bleeds on probing. Apply disclosing solution to show the plaque in that specific position. Explain how plaque causes caries, and teach them to read their own radiographs. Explain that they are looking at decay and that the cause must be found so that the process can be arrested. Explain that only they can carry out this part of the treatment. The ability of patient and parents to understand their role in disease control will greatly influence the prognosis.

Above all, begin to determine their wishes with respect to their caries problem. What efforts are they prepared to make in caries control? Consider how many people smoke despite the proven link to lung cancer. It cannot be stressed too often that the patient and parents are in charge of their dental destiny with respect to caries and although fillings have an important role to play in restoring cavities and thus facilitating the patient’s plaque control, they are only part of the treatment. However, direct questioning on attitudes may be unhelpful because a patient may tend to answer in a sociably acceptable way. It can take a long time before the patient’s attitudes are revealed. These attitudes are all important in assessing prognosis in logical and realistic treatment planning.

Why is the patient a caries risk? It is important to determine the relevant importance of the various caries promoting factors for the individual patient. Unless practitioner and parents can combine on an efficient detective job to find the cause of the problem, relevant solutions will not be found. The involved patient and parents will begin to understand the relevance of the partnership approach and will often enter into the detective job with admirable enthusiasm. It is really important to emphasise that they should not be criticised. Parents may feel guilty that their child has a problem but this guilt can be counterproductive. For instance they may blame the child «I told you not to». But the animosity this causes is not helpful.

Mechanical plaque control. A clean tooth surface will not decay and plaque control is very important. Disclose plaque to show the patient the problem areas and then watch the parents (until 10 years of age) and patient in action with their own brushes and floss, helping to improve their technique where necessary. Encourage the patient to feel the shiny plaque-free surfaces with their tongue with the aim of achieving this feel at home. Note whether they are really able to remove plaque. If they can, but do

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<th>Communication</th>
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<td>Involve the patient and the parent; they are in control</td>
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<td>High caries risk patient will have multiple active lesions</td>
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<td>Show the patient and the parent the lesions, clinically and on radiographs.</td>
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<th>Why is this patient high risk?</th>
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<td>Is it: Diet? Plaque control? Fluoride use or lack of it?</td>
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<th>Preventive Treatment</th>
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<tr>
<td>Diet: Use of diet sheet Negotiate goals Record these Recall and reassess</td>
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<th>Plaque control</th>
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<tr>
<td>Mechanical: Disclose Show the patient and the parent See them in action Recall and reassess</td>
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<tr>
<td>Chemical: Chlorhexidine gel Chlorhexidine varnish</td>
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<td>Fluoride: Check toothpaste Mouthwash Varnish</td>
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<th>Operative Treatment</th>
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<td>To aid plaque control Fissure sealing Restoration of cavities Patient compliance will be relevant to treatment plan</td>
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not, the problem is motivation, not manual dexterity. It is important to explain to the parents that young children are not manually skilled enough to clean their own dentition. Eruption of new permanent molars should be an extra motivation to urge them to help with tooth brushing. Most parents are very surprised that around 6 years of age new molars erupt. After all, this erupting tooth is “hiding”, being set down from the occlusal plane. Thus the parents should be shown to stand behind the child, bringing the brush in at right angles to the arch, seeking out the occlusal surface of each erupting tooth. Try to find together the most appropriate moment to help the child with cleaning of the tooth.

Chemical plaque control. Mutans streptococci are important organisms in the carious process because they are efficient producers of acid and thrive in acidic conditions. There is now evidence to show that chemical targeting of these specific organisms may have a useful role to play in caries control. Chlorhexidine will decrease bacterial counts of mutans streptococci and its use is justified in high risk patients where mechanical plaque and dietary control, and fluoride use have failed to check disease progression. A chlorhexidine gel should be applied to the teeth in closely fitting, flexible vacuum-moulded trays, made on impressions of the patient’s mouth. The gel should be used for five minutes per day for fourteen days and this should be repeated every three months because recolonisation gradually occurs [Kidd, 1991; van Rijkom et al., 1996]. An alternative way to use chlorhexidine is in the form of a varnish applied to specific areas after a prophylaxis.

Dietary advice. Dietary advice should be based on the diet sheet [Kidd, 1995]. Figure 3 shows one day out of a typical diet sheet. The sugar attacks should be highlighted and the number of individual attacks written at the top. This gives the dentist the opportunity to explain the Stephan curve and the importance of decreasing the frequency of sugar intake. Try to get the parents and patient to suggest changes. This will help them to set realistic goals and enable the dentist to see whether the relationship between diet and caries has been understood by them. Check that main meals are adequate and a list of foods that are safe for teeth may be helpful here [Barker, 1994]. A chewing gum containing xylitol and/or chlorhexidine may be a useful alternative for a sweet snack [Simons, 1996]. Record the negotiated dietary change on paper so that the parent can take this away and think about it. Record the goals agreed in the notes so that specific enquiry can be made at the next visit.

Use of fluoride. Check that the patient is using a fluoride toothpaste. Some products formulated for sensitive teeth and some herbal toothpastes do not contain fluoride. A small amount of this paste should be used twice daily and a minimum amount of water should be used to rinse after brushing. For older high risk children (when they are able to rinse and spit things out) a fluoride mouthwash (0.05% sodium fluoride) used every day is a useful fluoride supplement although the cost of the product may preclude its use by some patients. A prediction of a fluoride varnish is a sensible preventive measure and particularly valuable in those unlikely to comply.

**Fig. 3** - One day out of a typical diet sheet. The sugar attacks should be highlighted and the number of individual attacks written at the top.
with a daily mouthwash regime.

**Conclusion**

Demineralization of enamel and the development of carious lesions is mostly a time consuming process. The whole objective of caries management is to assess whether caries is progressing and if it is arrested the progression of the main arrow (Fig. 1). This can be done by plaque control, modifying of the diet, and use of fluoride. It is the parent and the patient who, each day, are in charge of the preventive management. This makes communication and behaviour modification probably the most important part of the work. With an early diagnosis more time will be available to tip the balance of the caries process towards delayed progression and lesion arrest.

**References**


Ekstrand KR, Bruun G, Bruun M. Plaque and gingival status as indicators for caries progression on approximal surfaces.


