Caries

CURRENT CONCEPTS OF CARIES

Nature and Aetiology & Clinical Aspects of Caries Diagnosis

Nature & Aetiology

The Traditional Model of Caries

The traditional model of caries is that decay is a one-way process of acidic demineralisation of a susceptible tooth surface. The process is initiated by a combination of plaque and frequent consumption of refined carbohydrates (Figure 1).

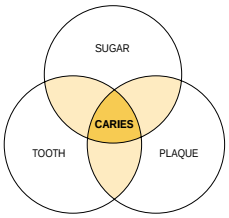

Figure 1
This model portrays caries as the result of interaction between the three factors represented by the circles.

Current knowledge about decay requires us to rethink the traditional model (Figure 1), and to realise that the process is much more complex than this model suggests.

A number of factors have emerged in recent years. Spencer *et al.* (1994) reported a mean of approximately one tooth affected by caries per 12 year old child in 1993 compared with a mean of five teeth affected in 1977. This trend of declining decay occurred over a time when sugar consumption and plaque control measures changed little (Spencer, 1997).

The main reason for the decline in caries in children is the extensive use of fluoride in its many forms that has provided a buffer against caries, despite the continued high sugar consumption.

In a group of high-risk adults (McIntyre and Blackmore, 1992), a high rate of caries was found to be associated with a deficiency in fluoride exposure, reduced salivary protection, or with excessive frequency of carbohydrate consumption. The carbohydrate consumption pattern was often complicated by intake of highly acidic foods and beverages.

The traditional model does not accommodate the importance of fluoride and saliva, and other aspects of diet than carbohydrate intake. Further, the possibility of repairing a tooth surface affected by an early caries lesion is now widely accepted, but is not implied in the traditional model.

Individual variation in diet, plaque control, exposure to fluorides and salivary protection result in some individuals remaining highly susceptible to caries.

Current Concepts of Caries

The current concept considers caries as a dynamic and reversible process. Caries activity is the result of the interplay of a number of aetiological factors. Some of these factors cause demineralisation, others promote remineralisation of the tooth. Demineralisation occurs several times a day following each period of food consumption. Usually demineralisation is limited and quickly reversed by the effect of fluoride and the buffering and repair actions of saliva. Where this does not occur, progressive demineralisation causes porosities to develop in enamel, forming the 'sub-surface' incipient or early lesion. If this demineralisation process continues, cavitation will eventually result. Caries can be arrested or even reversed at the precavitated stage, providing a balance towards remineralisation can be established.

The recognition of the fact that caries is potentially reversible in its early stage has considerable implications for current dental practice. It suggests that restorations should not be considered as the preferred management option for the early stage lesion.

Figure 2 presents a new simplified model of the decay process. Diet and plaque are considered to be the major demineralisation factors, and fluoride and saliva the main factors facilitating protection and repair.

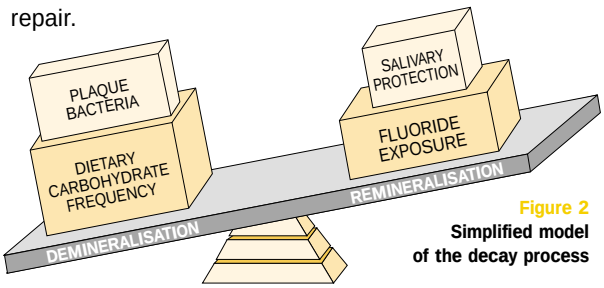

Figure 2
Simplified model of the decay process

This model allows dental practitioners to understand the tooth environment as a homeostatic system, where factors promoting remineralisation should balance factors causing demineralisation. Clinically, the task of the dental practitioner is to detect when the environment is out of balance towards excessive demineralisation. The nature of the imbalance can be assessed from the patient's history and clinical evidence. Preventive strategies aim to stabilise the tooth environment by helping the patient to achieve greater control over factors causing demineralisation and encouraging factors that lead to remineralisation. Both areas of activities will be covered in greater detail at a later stage of this program.

Sugar is still a major aetiological factor

While fluoride exposure and saliva are major reparative factors in the caries process, the role of carbohydrates, particularly sugar, must continue to be recognised as the major contributing factor in caries initiation and progression across the whole population. In a high proportion of the population, fluoride successfully counteracts the cariogenic effects of sugar (Sheiham, 1991). However, many Australians far exceed the consumption levels of sugar for which fluoride can provide protection. It is also becoming recognised that our increasing consumption of highly acidic foods or beverages, often combined with high sugar content, can hasten the demineralisation process by providing short term exposures to pH at erosive levels. Perhaps the best example of this is in early childhood caries where fruit syrups, juices or cordials at a pH around 3, if in frequent contact with teeth, can cause erosion and subsequently caries.

Facts about post-fluoride caries

1. In Australia, 59% of 12 year old children had no past or present experience of cavitated carious lesions in their permanent teeth (Davies and Spencer, 1997). Furthermore, in 1987-88, 65% of children and 59% of adults had no untreated cavitated lesions present (Barnard, 1988).
2. Caries progresses slowly. It may take years instead of months for progression to the cavitation stage (Thylstrup and Fejerskov, 1994).
3. Community-wide exposure to fluoride and early detection of lesions in the individual patient makes it much more feasible to obtain stabilisation or repair, through enhancement of remineralisation. Restoration is necessary only when cavitation is evident, or when radiographs show caries has undoubtedly invaded dentine.
4. In those patients with a continuing high caries rate, inadequate levels of oral hygiene, a cariogenic diet, an insufficient exposure to fluoride and deficiencies in salivary protection are frequently contributing factors. Recognition of these deficiencies should be reflected in the treatment plan, with recommendations for more stringent diet and plaque control, and the use of professionally or self-applied fluorides to enhance stabilisation or repair.
5. Recurrent or secondary caries can be controlled by appropriate use of fluoride in a similar way to non-cavitated lesions. This approach greatly reduces the need for replacement of deficient restorations (Horsted-Bindslev and Mjor, 1988).

The main contemporary caries problems in Australia

1. A continuing significant prevalence of early childhood (nursing) caries.
2. A high rate of caries activity in the 15-30 year age group.
3. A high rate of caries activity in the elderly, including coronal, root surface and recurrent caries.
4. Increased risk of caries among individuals that are medically compromised, or with some physical disability.
5. Increased risk of caries among recent migrants and among other groups who are socio-economically disadvantaged.

Clinical Aspects

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The diagnosis of caries has become more demanding. It is no longer sufficient just to detect cavitated lesions and automatically management option i.e. non-restorative management aimed

A further complexity is an assessment of caries activity stat effective management plan. It implies assessment of whether lesions are in an active or arrested stage, the extent to which major aetiological factors are out of balance, and the remineralisation potential.

Detecting early stage lesions

Coronal caries

1. Smooth surfaces:

   Visual examination for incipient or early “white spot” lesions on smooth surfaces is best achieved by:

   - strong lighting,
   - use of improved vision, eg. fibre optics and magnification (dental loupes),
   - cleaning the surfaces to be examined of gross debris and calculus, and thoroughly drying the tooth surface.

White spot lesions of enamel on smooth surfaces are most frequently detected on the accessible cervical third of the tooth surface.

2. Pit and fissure:

   Incipient or early lesions are difficult to detect, and improved vision is recommended. Cleaning the fissure as much as possible, followed by drying may permit ‘whitened’ enamel on the walls of the fissure to be detected.

The presence of dark brown or black staining in the fissure is not a reliable indicator of caries presence. Examination for a ‘sticky’ pit or fissure should not be carried out using a sharp probe as it will damage the fragile enamel surface if an early lesion is present.

Where caries is strongly suspected, though not visually detectable, a ‘wait and see’ approach is indicated for most cases where the caries risk is low or moderate. For those patients with increased risk of caries bitewing radiographs may be periodically necessary to detect the presence of ‘occult’ or hidden occlusal caries and its depth.

Root surface caries

Early lesions on root surfaces are often difficult to observe visually and require tactile examination with a blunt instrument, eg periodontal probe. Use of a periodontal probe will allow detection of the leathery consistency of demineralised cementum/dentine. Sometimes colour change (darkening) is present, though not always. Even in more advanced root surface lesions, cavitation may not be present, though the surface will be soft to touch. A history of recent sensitivity is often a symptom assisting diagnosis.

ries Diagnosis

restore them. Early detection at the precavitated stage is critical to the preferred at control or repair. ***The earlier the detection, the more likely repair can be achieved.***

tus. This aspect of the diagnosis is fundamental to the establishment of the most

Determining activity status of caries

Assessment of the activity status of a lesion is important to determine the most effective management plan.

- Active cavitated lesions require immediate action to arrest caries and to protect pulp.
- With long standing lesions, stabilisation is not necessary and normal restorative management of cavitated lesions may proceed with minimal risk of pulpal complications.

It is difficult to assess activity status in early lesions. The rate of enamel 'whitening' of wet incipient lesions with drying gives an indication of the degree of subsurface porosity. Lesions which are just starting to form or those already remineralised are slower to 'whiten', while established active incipient lesions lose their translucence very quickly.

Once cavitation has occurred, exposed dentine is a good indicator of activity status. Active or progressing caries in dentine is usually light brown in colour and very soft. In long standing caries, the dentine is usually much firmer to touch and dark in colour. Root caries also shows these characteristics.

Special dyes have been promoted to stain demineralised dentine in a cavity to determine what should be removed as a preparation for a restoration. Caution is urged in their use as only very limited research has been done in that area and their use may lead to unnecessary over-removal of tooth structure.

Evaluation of the patient's remineralisation potential

Fluoride exposure

Patients with a continuing high caries rate have been frequently found to have inadequate exposure to fluoride. This may include:

- no past or current exposure to fluoride through water fluoridation,
- reduced exposure to fluoridated water through use of rain water, bottled water or water filters,
- low level or no use of fluoride toothpaste.

If any of the above fluoride deficiencies are detected advice regarding appropriate use of fluoride needs to be given. To achieve better results, advice may need to be accompanied by patient education pamphlets. Use of written educational materials for the patients gives an opportunity to discuss the issue during subsequent visits and to answer any questions that patients may wish to ask.

Salivary factors

Where caries continues to be a problem, and fluoride exposure, sugar consumption and plaque control are at an acceptable level, it may be necessary to assess the salivary protection. A markedly diminished flow rate (referred to in the literature as xerostomia or hypo-salivation) can result in significantly increased caries risk.

The finding of a deficiency in salivary protection will enable the practitioner to determine a more effective caries management plan, involving increased use of discretionary (topical) fluorides.

Salivary stimulation may also be beneficial, particularly where salivary gland tissue remains undamaged. Available tests to measure salivary flow and salivary stimulation will be discussed in a later information sheet.

Alternatively, some patients may complain of a feeling of dry mouth without suffering from reduced salivary flow. These patients often take frequent drinks or use lozenges etc to compensate for their perceived 'dry mouth'. Drinks or lozenges which contain sugar may place these patients at a greater risk of caries.

Use of radiographs

Bite-wing radiographs are essential where increased caries risk is present. In the post-fluoride era, caries can penetrate deeply into dentine in individual teeth with little visual surface change being evident (occult or hidden caries). Therefore, diagnostic aids such as x-rays may be very helpful. With the slow rate of caries progression for most patients (four years for both interproximal and fissure lesions; Schwartz et al, 1984; Pitts, 1983), *radiographs may need to be taken no more frequently than every 24 months, preferably three yearly.* Radiographs may be indicated more frequently over periods of rapid caries development. Caution is needed in interpretation of the x-rays as the image does not indicate activity status. Even partially remineralised interproximal lesions will show on bite-wings. The radiographic evidence needs to be considered along with other clinical evidence, and it is preferable to wait until the next recall visit before judging whether lesions have progressed or remained stabilised.

Caries is potentially reversible in its early stage. This has significant implications for caries management in our patients.

Other diagnostic criteria: The estimation of individual caries risk

It is frequently difficult to detect early lesions, and if they are present, to assess their need for preventive or restorative management. Given the reduced caries rate in the post-fluoride era, the probability of caries is lowered for most patients. However, where caries is suspected it is essential to thoroughly assess risk factors for each individual patient. Factors such as:

1. history of exposure to fluoride,
2. medical history, eg. systemic disease, taking medication with high concentrations of sugar or with possible xerostomic side-effects,
3. social history and dietary pattern (food and beverage consumption), lifestyle, history of long term unemployment, loneliness and depression especially in old age, attention to preventive behaviours, attitude etc,
4. salivary factors, eg flow rate,
5. past dental history, should be thoroughly investigated.

If any of these factors are considered adverse, increased caries risk has to be considered. An appropriate method of caries control and a management strategy needs to be established including plan for long term observation of the patient.

...a risk profile for every patient...

It is fortunate in the post-fluoride era that even when it is difficult to obtain effective plaque and diet control we have agents such as discretionary fluorides and physical protective mechanisms such as sealants to help minimise the rate of caries progression and need for restorations. It is now possible to help many patients control caries.

The most effective approach to prevention and control of caries will be the subject of the next information sheet.

SUMMARY

Despite the overall reduction in caries prevalence in the Australian population during the last 25 years, a proportion of the community continues to experience high caries levels. Frequently, it is due to an inadequate fluoride exposure or consumption of both acidic and carbohydrate foods and beverages.

The current concept of caries is as a dynamic and reversible process. Successful control of caries depends on:

- **detection of caries at its precavitated stage,**
- **accurate determination of its multifactorial aetiology,**
- **formulation of an effective management programme.**

It is important to determine a caries risk profile for each patient in the practice, in order to achieve long term success.

Further information

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