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Caries Control from Cradle to Grave

Abstract: Caries is a ubiquitous, natural process occurring in the biofilm. The interaction of the biofilm with the dental tissues may result in a caries lesion, the reflection of the process being the consequence that can be seen. However, lesion formation and progression are not inevitable because the process in the biofilm can be controlled by plaque control, fluoride and a sensible diet. This paper summarizes caries control in note form and it questions how these measures are to be carried out under the current Unit of Dental Activity payment system used within the NHS Dental Services in England and Wales.

Clinical Relevance: Caries control is the non-operative management of the ubiquitous, natural process in the biofilm so that lesions do not form, or established lesions are arrested. This paper seeks to present these caries control measures in note form as checklists to aid the dental team.

Dent Update 2010; 37: 651–656

Dental caries: the concept of a controllable process

Dental caries is a ubiquitous, natural process that occurs in the biofilm. The formation and metabolism of the biofilm cannot be prevented, but disease progression can be controlled so that the symptom of the process, the caries lesion, never forms. The progression of established lesions can also be controlled so that they do not progress further.

The important factors in caries control are:

- Plaque control;
- Use of fluoride;
- Dietary modification.

Combinations of the above can prevent the formation of visible lesions and transform an active caries lesion into an arrested lesion. This control is just as much treatment of the caries process as placing a filling. Indeed, fillings are a part of plaque control. They make holes in teeth accessible for cleaning.

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How to assess current caries activity and caries risk status

The most reliable evidence of caries activity and caries risk status is the presence of active caries lesions, cavitated and/or non-cavitated. The history of recent caries activity, the number of new/filled lesions in the past 2–3 years, is also important.

The following should be noted on clinical examination:

- How many lesions are present?
- Where are they?
- Multiple active lesions in areas of rapid salivary flow (lower incisors, buccal surfaces of molars) which would indicate high caries activity;
- Visible plaque and gingivitis indicating poor oral hygiene.

What constitutes high caries activity?

This is a relative judgement related to the caries activity of the population. As a rule of thumb, a yearly increment of two or more lesions would indicate a high rate of lesion activity and progression.

Why is it important to assess caries activity?

This information is relevant to the following:

- All patients should be advised to clean teeth twice daily with a fluoride-containing toothpaste, but some non-operative treatments for the individual patient (eg diet analysis and advice) should be focused on those with high caries activity.
- Dentists must identify which risk factors are relevant to the particular patient in order to ensure logical management.
- Dental treatment involves recall and reassessment. The caries activity and risk status is relevant to the recall interval.
- The patient needs to know his/her activity and risk status so that he/she can take appropriate action to reduce the rate of lesion progression and be aware of the appropriate recall interval.

Identifying biological risk factors

It is important to identify relevant risk factors because it may be possible to help the patient to modify these and thus slow down disease progression. Protective factors are also relevant because

these can be introduced if not present. Many of these factors are best identified by taking a careful history from the patient, while others become obvious when the mouth is examined.

Possible risk factors include:

- Medical history, particularly medications and systemic diseases causing dry mouth;
- Parents and/or siblings with active caries;
- Frequent sugar-containing snacks or drinks;
- Poor oral hygiene;
- Gingivitis (indicates poor oral hygiene);
- Erupting molars;
- Deep pits and fissures;
- Existing restorations and the need for them to be replaced;
- Low salivary flow.

Of all these risk factors, the medical history may be particularly important because many systemic diseases and medications cause a dry mouth. Persistent dry mouth is likely to result in new and recurrent dental caries and it can be difficult to prevent this. Table 1 lists systemic diseases and medications that may cause dry mouth.

All the patient's medications should be checked in the British National Formulary.[1] A dry mouth is noted in the formulary as a side-effect to the medication, where appropriate. Similarly, all illnesses should be checked in a suitable text where the dental relevance is explained.[2]

Relevant protective factors are:

- Good oral hygiene with assistance if required;
- Fluoridated water;
- Fluoridated toothpaste;
- Fluoride varnish applied by dental professional;
- Fissures sealed;
- Use of sugar-free chewing gum to stimulate saliva if salivary flow low.

Medications	
Antidepressants	Diuretics
Antipsychotic drugs	Anti-parkinsonian drugs
Tranquillizers	Appetite suppressants
Hypnotics	Antinauseants
Antihistamines	Antiemetics
Anticholinergics	Muscle relaxants
Antihypertensives	Expectorants
Systemic diseases or conditions	
Sjögren's syndrome	Hormonal changes
Rheumatoid arthritis	Pregnancy
Diabetes	Post-menopause
HIV/AIDS	Neurological disease
Scleroderma	Pancreatic disturbances
Sarcoidosis	Liver disturbances
Lupus	Nutritional deficiencies
Parkinson's disease	Anorexia nervosa
Alzheimer's disease	Malnutrition
Cystic fibrosis	Drug abuse
Asthma	Smoking
Strokes	
Dehydration	
Head and neck radiotherapy	
Chemotherapy	

Table 1. Causes of dry mouth.

Identifying social risk factors

Social factors can have an overriding influence on health and disease and the lifestyle changes that a patient can or will make.

The following may become apparent and may (or may not!) have some relevance:

- Age;
- Cleanliness;
- Demeanour;
- Disability;
- Nationality;
- Speech;
- Dress;
- Religion;
- Educational status;
- Employment status;
- Whether the patient is alone or accompanied;
- Social class.

However, the professional must be very careful not to jump to unwarranted conclusions. To give an example, dental caries is concentrated in socially deprived people, but not all socially deprived people will present with lesions.

Categorizing caries activity and risk status[3]

On the basis of the history and examination, the patient may be allocated to one of the following caries activity status and caries risk status:

- *Caries inactive/caries controlled* (green); no active lesions and no history of recurrent restorations.
- *Caries active but all relevant risk factors can potentially be changed,* such as plaque control, fluoride, diet (orange); presence of active lesions and a yearly increment of more than two new, or progressing or filled, lesions in the preceding 2–3 years. Caries control may be achieved by changing risk factors.
- *Caries active but some risk factors cannot be changed* (such as some dry mouths and some medications) *or caries risk factors cannot be identified* (red); this category will always be high risk although it may still be possible to control caries by maximal control of risk factors.

The dentist may wish to colour code this risk status with green, orange and red stickers inserted in the notes. The aim is

to help the patient change the risk factors so that, at recall, the caries activity status may be deemed to have changed because there are no new active lesions and/or lesions previously judged as active are now deemed arrested.

What caries control factors are available?

This paper will now concentrate on the various non-operative treatments that control caries. The reader should note the use of the word 'treatment' to describe these measures. The word 'treatment' is used to set non-operative treatment alongside operative treatment, both being time-consuming, skilful and worthy of payment.

The arrows in the non-operative quiver are:

- Plaque control;
- Use of fluoride;
- Dietary modification;
- Saliva stimulation or replacement for those with a dry mouth.

Plaque control

Caries lesions form as a result of the metabolic events in dental plaque. Thus plaque control is the logical cornerstone of non-operative treatment. Teeth should be brushed with a fluoride-containing toothpaste. The brushing interferes with the growth and ecology of the biofilm and fluoride application retards lesion progression.

The preventive action of toothbrushing can be maximized if the following principles are followed:[4]

- Brushing should start as soon as the first deciduous tooth erupts;
- Brush twice daily, last thing at night and at one other time each day;
- Children under 3 years should use a toothpaste containing no less than 1000 ppm fluoride;
- Children under 3 years are likely to swallow toothpaste and this may cause fluorosis. To prevent this they should use only a smear of paste and not be allowed to eat or lick toothpaste from the tube;
- From 3 years onwards, family fluoride toothpaste (1350–1500 ppm fluoride) is indicated;
- Children between 3 and 6 years should use no more than a pea-sized amount of toothpaste in order to prevent fluorosis if paste is swallowed;
- Children need to be helped and supervised by an adult when brushing;
- The occlusal surface of erupting molars should be individually brushed with the brush coming in at right angles to the arch;
- Adults with multiple lesions and/or a dry mouth should be prescribed a high fluoride paste (2800 or 5000 ppm fluoride);
- Dependant adults should be helped with tooth cleaning;
- Rinsing with lots of water after brushing should be discouraged; 'spit, don't rinse', is the relevant advice.

Oral hygiene instruction

Instruction should be general to the whole mouth and site specific to the particular lesion. The patient should be aware of the problem areas, seeing these in their mouths and/or on radiograph. The following may be helpful with respect to *toothbrushing*:

- The patient should attend each appointment with their brush and toothpaste;
- The dental health professional should check the toothpaste for fluoride content;
- Disclose the mouth so that the plaque can be clearly seen by the patient;
- Can the patient (or parent/carer) remove the plaque or should the technique/brush be altered?
- Is thorough brushing in the surgery causing gingival bleeding. If so, does the patient realize this indicates gingivitis caused by dental plaque?
- If active lesions are present, is the patient aware where they are and able to remove disclosed plaque from them?
- Where active approximal lesions are present, either in the enamel or on the root surface, an *interdental cleaning* aid will be needed. In young patients, lesions are best cleaned with floss, whereas interdental brushes are preferred for cleaning larger interdental spaces following gingival recession.

The following may be helpful with respect to interdental cleaning:

- Advice must be site-specific;
- Examining the tape or brush after use may show the plaque that has been removed and this can be a useful motivating factor;
- A special holder for the floss or brush may help the patient;
- If the gingivae bleed, the relevance of this should be explained to the patient. If bleeding persists for days after effective cleaning is instituted, this may indicate a cavity is present that prevents the patient removing the plaque from the hole. A restoration is needed to restore tooth integrity.

Use of fluoride

Fluoride works by delaying lesion progression. Vehicles for fluoride include:

- Water;
- Toothpaste;
- Mouthwash;
- Professionally applied high concentration varnishes.

In caries active patients, it is essential to intensify the fluoride therapy until the situation is under control. This could be achieved by intensive use of fluoride toothpaste, fluoride-containing mouthwashes or operator-applied topical applications. The choice of vehicle is not crucial, but it must be combined with improvement in oral hygiene. It is very important that the patient accepts the mode of treatment and complies with advice.

Water fluoridation

Be aware of the fluoride content of the water where your patients live.

Toothpaste

Fluoride toothpaste is cheap, requires minimal patient co-operation and enhances the patient's appreciation of his/her essential role in caries control. See above for advice on fluoride concentration and toothpaste use.

Fluoride mouthwashes

These can be prescribed for patients aged 8 years and above, for daily or weekly use. Below 8 years, they are not advised because there is a risk of swallowing sufficient mouthwash to cause fluorosis in the developing dentition. The rinse should be in addition to twice-daily

brushing with toothpaste containing at least 1350 ppm fluoride. Rinses require patient compliance. They should be used at a different time from toothbrushing to maximize the topical effect which relates to frequency of availability.

- Daily rinse 0.05% NaF;
- Weekly rinse 0.2% NaF.

The product should be rinsed around the mouth for a timed minute. Be aware that some products are very astringent. These will be uncomfortable for children and painful for those with a dry mouth. A bland mouthwash, that does not contain alcohol, should be advised in these groups.

The indications for mouthwash are:

- Patients over 8 years with high caries activity;
- Patients with orthodontic appliances which inevitably encourage plaque accumulation and therefore predispose to caries lesions;
- Patients with a dry mouth;
- Patients developing root caries. In these patients a weekly concentration mouthwash may be advised for daily use.

Professionally applied fluoride varnish

The fluoride concentration of the varnish is high, 22,600 ppm F or 2.2%F. Systematic reviews of research have shown that fluoride varnish application by dental care professionals reduces the caries increment in the deciduous dentition by 33% and by 46% in the permanent dentition. These are impressive reductions in caries, but the dental professional should be aware that:

- Professional application must be repeated at 3 or 6 monthly intervals to be effective and this is inevitably costly;
- The emphasis switches to the care being by the professional rather than by the patient;
- The concentration of fluoride is high and this means the varnish is potentially toxic (the child could vomit) to the small, and therefore light, child if the varnish is swallowed. The maximum dose advised for use in the primary dentition is 0.25 ml and in the mixed dentition is 0.5 ml, and the varnish is safe in these amounts.

The varnish should be applied to isolated, clean, dry teeth. An ideal time to apply varnish is therefore when the teeth are being examined for caries lesions because, to detect caries lesions, the teeth must be isolated, clean and dry. Once the charting is complete, it takes only seconds to apply varnish to fissures, over contact points, cervical margins buccally and lingually and exposed root surfaces.

Frequency of varnish application

The Department of Health in England and Wales has suggested that varnish be applied as follows:[4]

- Apply twice yearly to all children from 3 years to young adulthood;
- Apply twice yearly to adults with active caries and/or a dry mouth;
- Apply 3-4 times yearly to children with active caries and/or special needs.

Dietary modification

The evidence that the frequency and amount of sugar consumption is linked to caries is irrefutable. Thus emphasis on diet in caries control would seem logical. Unfortunately, the evidence that it is possible to modify people's diets is lacking! Since the advent of fluoride, the emphasis in caries control has shifted from diet to oral hygiene with a fluoride-containing toothpaste. However, this does not obviate the dental professional from giving dietary advice to all patients. It is almost impossible to open a newspaper today without reading about the obesity epidemic in children and young adults. This already has profound implications for health. Being overweight or obese is linked to:

- Heart disease;
- Stroke;
- High blood pressure;
- Type 2 diabetes;
- Some cancers;
- Some studies link social deprivation with both obesity and dental caries.

Reducing the amount and frequency of sugary food intake can reduce dental caries and could help weight control. All health professionals have a responsibility to give advice on diet, in the same way that we have a responsibility to give advice on smoking.

We should all eat the right amount of food relative to how active we are. In addition, there are key messages with respect to diet:[4,5]

- Eat a range of foods;
- Eat at least 5 portions of fruit and vegetables per day;
- Eat at least 2 portions of fish per week and 1 should be an oily fish;
- Cut down on saturated fat and sugar;
- Eat less salt;
- Drink plenty of water.

The consensus recommendations to prevent dental caries are:

- Reduce frequency and amount of sugars; keep sugars to mealtimes;
- Limit consumption of foods and drinks with added sugars to 4 times per day.

Most sugars are in processed and manufactured foods and drinks such as:

- Sugar and chocolate confectionery;
- Cakes and biscuits;
- Buns, pastries, fruit pies;
- Sponge puddings and other puddings;
- Table sugar;
- Sugared breakfast cereals;
- Jams, preserves, honey;
- Ice cream;
- Fruit in syrup;
- Fresh fruit juices;
- Sugared soft drinks;
- Sugared, milk-based beverages;
- Sugar-containing alcoholic drinks;
- Dried fruits;
- Syrups and sweet sauces.

Dietary advice for dental patients

No change in diet should be advised for the caries inactive patient, but the dentist should make the patient aware of how an adverse change in diet and/or salivary flow could pose a problem, especially if oral hygiene is poor. All our patients should be aware of the link between sugar and caries.

With the caries active patient a fuller investigation of the diet may be warranted. Advice is based on the diet sheet. Be aware that this technique is time-consuming and therefore expensive. When the diet sheet is returned, the sugar attacks should be highlighted. This gives the dentist the opportunity to explain the Stephan curve and the importance of decreasing the frequency of sugar intake. The following may be useful in giving advice:

- Try to get the patient to suggest changes as this helps the patient to select

realistic goals and it allows the dental care professional to check whether the relationship between sugar intake and caries has been understood;
- A list of safe snacks and drinks will be useful to help the patient choose alternatives to sugar;
- Record the negotiated changes in the notes and on paper for the patient to take away and ponder on at leisure;
- Aim to confine sugar to mealtimes;
- Check main meals are adequate;
- Follow up with enquiries about progress at the next appointment.

Salivary stimulation or replacement for those with a dry mouth

Controlling caries when the mouth is dry is very difficult. A dry mouth is miserable for the patient and can be a worry for the dentist. These are the cases you may think about in the darker reaches of the night.

The approach should be:
- Immaculate oral hygiene;
- Prescribe a high fluoride toothpaste (5,000 ppm F);
- Prescribe a fluoride mouthwash;
- Apply fluoride varnish to lesions every 3 months;
- Ask the patient to keep a diet sheet and try to minimize sugar intake;
- Be aware that the patient needs to moisten his/her mouth frequently and plain water is safe;
- Recall the patient every 3 months;
- Saliva may be stimulated by chewing a xylitol-containing chewing gum, provided there is sufficient glandular activity;
- In cases of Sjögren's syndrome or post-radiotherapy to head and neck, a saliva substitute may be required;
- Check any anti-fungal agent does not contain sugar.

The role of operative dentistry in caries control

The role of operative dentistry in caries control is to facilitate plaque control. Tooth restoration also sends the caries process back to the tooth surface potentially to start again if the factors which determined the caries activity in the first place are not controlled. This dental game of 'Snakes and Ladders' gives the patient time to establish new habits.

Tooth restoration also restores:
- Appearance;
- Form;
- Function.

It arrests the progression of the lesion towards the pulp and therefore prevents the onset of pulpitis with its attendant pain.

Are these recommendations compatible with the NHS Unit of Dental Activity (UDA) payment system?

The author does not understand how these recommendations can be carried out economically by the practitioner working under the NHS Unit of Dental Activity payment system. The recommendations in this paper come under Band 1 of the contract which is described as: *Diagnosis and treatment planning, maintenance*. This is worth 1 UDA, average value £24.38 (figure produced by the National Association of Specialist Dental Accountants[6]). This might represent 15 minutes of surgery time, although some associates are working to a UDA value as low as £5, which is presumably less than 5 minutes.

In this time the dentist needs to carry out:
- History;
- Clinical examination according to NICE guidelines;[7]
- Radiographs, if required;
- Formulate the treatment plan;
- Explain it to the patient;
- Obtain consent;
- Carry out all preventive treatments (advice re plaque control, fluoride, diet, fluoride applications);
- Scaling and polishing if required.

To suggest that this could be done in 15 minutes is, in the opinion of this author, a deception. It seems incomprehensible that the Department of Health can, on the one hand, produce the Evidence-Based Toolkit of Prevention[4] which recommends the preventive advice and treatments to be carried out for all patients and, on the other hand, continue to support this UDA system. These are very strong words, but the suggestion that the new contract encourages prevention has been reduced to a bad joke or a nightmare for the ethical dentist. In addition, this system has virtually written the hygienist out of the new contract if they have to work a UDA system because the dentist is not going to split this derisory fee. The practitioner will presumably suggest the patient sees the hygienist privately. In these hard economic times this may not be a viable option.

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CPD ANSWERS
November 2010

1. A, B, C
2. A, B, D
3. A, B, D
4. B, C
5. A, B, D
6. B, C, D
7. A, D
8. A, B, C
9. A, D
10. A, B, C