Management of dental plaque to reduce disease

Dental hygienist Mhari Coxon gives an overview of dental biofilm

**Introduction**

It is without doubt that bacteria, and the bio-products of their life cycle, are the primary etiological factor in the chronic disease of periodontitis.

The bacterium in the mouth can be split into three groups—planktonic or free floating, those attached to the oral epithelium, and those attached to the tooth surface. The interaction of the planktonic and epithelial-based bacteria with the microbes attached to the tooth surface enables the complex biofilm that is dental plaque to develop. It is this plaque that triggers the hosts’ response, in susceptible persons, causing periodontal tissue degeneration to ensue until the biofilm changes its composition to an inflammatory response.

**Dental biofilm**

Dental biofilm was described well as a microially derived sessile community, characterised by cells that are irreversibly attached to a substrate or interface or to each other, and are embedded in a matrix of extra-cellular polymeric substances that may have produced, and exhibit an altered phenotype with respect to growth rate and gene transcription.

**Formation of the dental biofilm**

Microbialss generally prefer to develop in an attachment (sessile) formation. The microorganisms found to be pathogenic to humans can thrive as planktonic (free floating) phenotypes as well as sessile.

Recent research shows there to be over 500 microbial strains present in oral biofilm.

Formation of the biofilm can be separated into four stages.

**Stage One**

Once the surface of the tooth has been cleansed, a conditioning film of proteins and glycoproteins is adsorbed rapidly to the tooth surface. This is the saliva pellicle forming and starts immediately after the surface has been cleansed.

Debris such as protein, fragmented bacteria and amayilase found in saliva are embedded in the film, acting as receptors, allowing the attachment of the microbes to begin. These can involve protein-protein or carbohydrate-protein (lectin) interactions, and this process contributes to determining the pattern of bacterial succession.

**Stage Two**

Attachment can be defined as a slime layer forming around the colonising pioneer bacteria, which consist mainly of gram-positive cocci and rods that divide and form microcolonies.

These initial colonising bacteria connect to the pellicle and each other with networks of fine, hair-like structures called fimbrilae. Once they stick, the bacteria begin producing substances that encourage other planktonic bacteria to join the community. This is the recruitment phase. It is thought that the act of attaching to the pellicle stimulates the bacteria to excrete an extracellular slime layer that helps to anchor them to the surface and provides protection for the microbes already attached.

The biofilm then grows primarily through cell division of the already attached bacteria, rather than through the adherence of new bacteria. Next, the proliferating bacteria begin to grow away from the tooth. Plaque doubling times are rapid in this early stage of development.

**Stage Three**

Bacterial blooms are periods when individual species or groups of strains grow at a rapidly accelerated rate. More mesophilic, in the form of quorum sensing, and a second wave of bacterial co-aggregate with bacteria that are already locked to the pellicle.

Dense but perforated cloud-like structures grow up from the enamel surface, attached by stalks like protrusions, interspersed with bacteria-free channels used as diffusion pathways. Evidence is building to show that these colonies of bacteria are not passive neighbours, rather that they work together to create the best environment for themselves and protect the micro-group.

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**Stage Four**

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**Subgingival biofilm**

Following a few days of undisturbed plaque formation, the gingival margin becomes inflamed and tender. This influx of inflammatory fluid to the tissues results in the creation of a deep exudative sulcus. The biofilm then extends into this subgingival region and flourishes in this protected environment, resulting in the formation of a mature subgingival plaque biofilm. Gingival inflammation does not appear until the biofilm changes from one composed largely of

The subgingival dental biofilm is still formed mainly of gram-positive cocci and rods with some gram negative cocci and rods. The real change is the production of large numbers of gram negative rods and spirochetes which are either planktonic or attached to the epithelium.

**Summary**

The first stage is predominately gram-positive cocci and is represented by the streptococcal species, the second stage is cross-linking via fusobacterial species, and the third stage is predominantly gram negative organisms. Mature oral biofilms resist many treatments, acting as reservoirs of antibiotic resistance and virulence in deep periodontal pockets. Their uncontrolled growth may lead to eventual periodontal disease.

**Micro communities**

As the biofilms develops, gradients in biologically significant factors develop, and these permit the co-existence of species that would be incompatible with each other in a homogeneous environment. These micro colonies have micro environments with differing pH levels, nutrient availability, and oxygen concentrations.

**Disruption of the biofilm**

The key weapon against this maturation that is able to professional patients remains regular, and where possible, removal of the biofilm and saliva pellicle causing a break in the cycle. This tends to inhibit the microbial growth. We know that, if left untouched for up to 12 weeks, pockets will be colonised and so the need for maintenance care remains as valid as it always has.

**Adjuncts**

Some adjuncts have proven to be helpful in slowing and reducing the cycle of biofilm.

**Mouthwashes**

Chlorhexidine, Cetyl pyridinium Chloride and Essential oil mix mouthwashes have all shown some penetration into a biofilm of varying percentage in research. These in conjunction with good toothbrushing and interdental cleaning can be used in the reduction of incidence of the chronic diseases of periodontal disease and dental caries. No antimicrobial can disrupt the biofilm significantly without mechanical intervention.

**Photodisinfection**

Pertive is a Photodisinfection system developed by Ondine that utilizes low-intensity lasers and wavelengths-specific, light-activated, available to specifically target and destroy microbial pathogens and reduce the symptoms of disease. The compounds are generally topically applied and one or more lasers are used to activate the compounds and complete the disinfection. Research is ongoing in this field.

**Probiotics**

There was a probiotic launched this year specifically aimed at supporting a healthy dental plaque. There is some early research available but more in-depth study is needed.

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**Diagram 1: Four Stages of Biofilm Cycle. With kind permission of Professor John Thomas, West Virginia University**

**Diagram 2: Biofilm Development Cycle. With kind permission of Professor John Thomas University of West Virginia**
Dental Practices nationwide are benefiting from the advantages of adding Periowave to their treatment regime.

Dr David Africa of Elm Dental Practice, Chessington, Surrey, has noted Periowave’s virtues. “The inclusion of the Periowave method in our armamentarium in the fight against periodontal disease has been a fantastic choice,” he says. “The ease of use and the acceptability by patients of the new technology, as well as the predictability of the results, makes everyone confident that we can significantly reduce the risk factors for periodontal disease.”

“In my experience with Periowave when combined with splinting,” Dr Africa continues, “I have seen amazing results, especially in the lower anterior region in patients of all ages. During their follow-up visit, patients immediately tell us about the significant improvement in the feel of their gums, and the disappearance of bleeding that was there before treatment.”

Philip S Burns & Associates Dental Practice, Sheffield, are happy with the results of Periowave. “There is considerably less bleeding after treatment and the pocket depths are reduced. Patients have noted that any bad taste has disappeared and there is far less tenderness in the gums. Patients have been delighted with the treatment.”

Tony and Lisa Appleton of Church Street Dental Practice appraise the commercial decision to take on board Periowave.

“We looked at each of the areas of dental care we were providing and highlighted and researched those areas we felt we could improve. Fortunately for us our research coincided with the UK launch of Periowave and we were lucky enough to secure one of the first Periowave machines in the country.”

“Patients appreciate the pro-active treatment Periowave offers and are happily paying for it. The ease of the treatment is a winner with both patients and practitioners alike! Initial data of pocket depth reductions suggest decreases of up to 3mm at the 6-week post-op review. We are currently looking to expand our periodontal team and firmly believe that Periowave has given us this welcome boost to the practice.”

Dental biofilm and caries

In dental caries, there is a shift toward community dominance by acidogenic and acid tolerating species such as mutans streptococci and lactobacilli, although other species with relevant traits may be involved. Strategies to control caries could include inhibition of biofilm development (for example, prevention of attachment of cariogenic bacteria, manipulation of cell signaling mechanisms, delivery of effective antimicrobials, etc), or enhancement of the host defenses. Additionally, these more conventional approaches could be augmented by interference with the factors that enable the cariogenic bacteria to escape from the normal homeostatic mechanisms that restrict their growth in plaque and out compete the organisms associated with health. Evidence suggests that regular conditions of low pH in plaque select for mutans streptococci and lactobacilli. Therefore, the suppression of sugar catalysis and acid production by the use of metabolic inhibitors and non-fermentable artificial sweeteners in snacks, or the stimulation of salivary flow, could assist in the maintenance of homeostasis in plaque.

Summary Box

Reducing the caries forming biofilm

• Decrease sugar intake in clients’ diet
• Improve oral hygiene
• Increase saliva flow

Dental biofilm is a complex group of communities which, when allowed, will create a suitable environment to thrive at the detriment of the host. Oral hygiene ensuring good plaque control still remains a major control element in maintaining a healthy dental biofilm. Diet and lifestyle are also important factors in determining the quality of dental plaque.
Although new techniques and new materials are creating new opportunities, and new challenges for clinicians to meet and overcome—not to mention new dento-legal risks to deal with—there are still plenty of familiar ‘old chestnuts’ that crop up with monotonous frequency in claims and complaints against dentists. One such problem is the provision of newly-provided dentures, or even the indignity of having to remake the dentures on one or more occasions, only for the patient to send back, declaring the new dentures to be unwearable. Most of the complaints and claims associated with full dentures can be categorised into three groups:

- the oral cavity
- the patient
- the clinician

Mentioned, the patient’s saliva may have a direct impact on the retention and comfort of the denture.

Dry mouth or significant changes in the content of saliva is commonly found in the elderly, and often compounded by certain medical conditions and by many different types of medication. A careful medical history and assessment of the saliva can alert a clinician to possible problems arising from this area.

Recording the Assessment

Surprisingly few dental records for complete denture cases confirm that these essential first steps have been taken, so it becomes easy for patients (or their lawyers) to argue that the clinician has failed in his/her duty of care to carry out a full examination and assessment prior to constructing the dentures.

When things go wrong in the later stages of denture construction, it is easy to be wise after the event and not uncommonly a dentist will say ‘this was always going to be a difficult denture because of the patient’s bite’ (or the lack of edentulous ridges, or dry mouth etc.). This then invites the question of whether these problems were ever discussed in sufficient detail with the patient before proceeding.

If you do anticipate problems for any reason, then take the time to warn the patient, and record these warnings in a dated entry in the clinical notes. Without such record card entries, the way is left open for the patient to argue ‘I would never have gone ahead with these dentures if the dentist had only explained to me that...’

This is essentially a consent issue, although it may not have appeared so at first sight. That same line of thinking begs the question that ‘had the patient been appropriately and adequately warned, would he or she preferred a referral to a prosthodontic specialist, or perhaps to someone with special expertise or experience in full denture construction?’ In short, if the initial examination reveals anything about the patient’s mouth that would limit the prospects of constructing full dentures successfully, then discuss these constraints with the patient in advance.

The Patient

As we all know, different patients present with different problems. Some are extremely demanding and difficult to satisfy, others seem impossible to deflect from unrealistic expectations of treatment outcomes. Some talk too much and are apparently determined to control the treatment at every stage, while others talk too little and fail to give us crucially important information about their previous history or current problems. With some patients we are on a hiding to nothing from the outset—because of our age, or sex, or appearance, or ethnicity, and because they come to us with preconceptions and perceptions of what they want, what they expected, and what they need.

Clinical Confidence

All of these problems—and more—can prejudice the prospects of success when providing complete dentures. A patient, who is confident in the clinician providing the dentures, is more likely to be happy with the dentures; conversely once a patient loses confidence in the clinician who is providing the dentures, the prospects of a successful outcome can be slender or non-existent.

Getting to Know Them

It is short-sighted to focus exclusively on the dentures themselves; an important aspect of the equation in full denture construction is to maintain the relationship between...

**Fig. 1**

**Fig. 2**

**Fig. 3**

**Fig. 4**

**Fig. 5**

**Fig. 6**

**Fig. 7**

An irregular maxillary alveolar ridge together with a tendency to a dry mouth and an existing stomatitis could be a challenge, particularly when opposed by the natural anterior teeth and a lower partial denture.

Plenty of alveolar bone for retention of the upper denture, but the mandible could be more of a problem. It would be sensible to keep tight control of the patient’s level of expectation in this potentially difficult case.
dentist and patient. Time spent at the outset in getting to know the patient and understanding any expectations, is seldom wasted. If nothing else, it can alert you to situations where the best option is not to become involved in the treatment at all, or where the additional experience of a specialist is advisable.

The emotional component associated with full dentures is not often appreciated. It is worth considering why the patient has chosen this particular moment to seek the replacement of the dentures they have been wearing for so many years. An understanding of the patient’s motivation often provides the key to understanding his/her needs and expectations. It may also alert the clinician to the potential difficulties.

Getting Used to Them
A patient’s ability to adjust to new dentures that are different in some ways from others worn over a long period, may be influenced by events in his/her life that are quite unrelated to the dentures themselves. The dentures become a convenient scapegoat for an unhappy patient to focus his/her problems on. Adapting to the new dentures may simply represent one challenge too many for a patient who is already under stress for one reason or another, and whose ‘coping’ mechanisms are already compromised for reasons outside the clinician’s control.

The Clinician
There is still a lot of wisdom in the old adage that an extra five minutes spent at each stage of the construction of a denture, saves ten minutes at the next. Anyone who has accepted a less-than-optimal impression, or who has rushed the ‘bite’ stage of a full denture, will probably relive a few nightmare cases upon reading this. Similarly, adjustments that are easily and inexpensively made at the wax ‘try-in’ stage, are a costly and time consuming frustration once the dentures have been completed.

Easy Does It
‘Eases’ and other adjustments of tight areas are not the patient’s to determine. They are quick and easy enough to achieve, but each successive removal of acrylic results in the patient’s confidence being very carefully, Before removing any acrylic from a completed denture, it is worthwhile asking yourself what it is designed to achieve, and for whose benefit the material is being removed. After several cases, there is a danger you will have removed much of the retention initially achieved by denture flanges, or the accuracy of the fitting surface. Adjustments in the ‘post-dam’ area should be approached with caution. Many such adjustments made at the patient’s insistence have eventually led to the need for a complete remake.

When to Stop
If patients return time and time again, complaining that they are unable to wear their dentures, it is tempting to dismiss them as patients who will never be satisfied, whatever is done for them. It is salutory to remember that the majority of these patients subsequently go on to have perfectly satisfactory dentures constructed by another dentist.

Dentists who have remade dentures on one or more occasions, or who have invested a great deal of time over many visits, may feel that they have done everything humanly possible to achieve a satisfactory outcome for the patient. This makes it all the more frustrating and hurtful when patients throw all this commitment back at the dentist, saying that they had attended twenty times, and allowed the dentist to have three attempts, but the dentist was still unable to make a denture that they could wear.

A New Start
One learns with experience when that stage has been reached. This is the time when it makes more sense for the patient to make a fresh start with another dentist, than to persevere with a case when the confidence and patience is wearing very thin on both sides.

About the author
We are the world’s largest specialist provider of dental professional indemnity and risk management to the whole dental team. The articles in this series are based upon Dental Protection’s 10,000 years of experience, currently handling more than 8,000 cases for over 51,000 members in 70 Countries. Visit us at www.dentalprotection.org

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Minimal intervention, best results

James Goolnik insists you needn’t drill your patients’ teeth away to create the perfect smile, when you can use Durathin porcelain veneers

Think about it. You carry out smile-design principles and remove healthy enamel for the labial surface of your patients’ teeth. No matter how good your clinical skills, your patient is likely to have transient sensitivity during the temporisation phase and for a brief period after final cementation of your new restorations. Even in the most conservative preparations 10 per cent of the teeth you have prepared will lose vitality in the future. You are also relying on fifth-generation bonding agents, so there is a possibility of debonding in the future.

An aesthetic alternative

You may have heard of minimal-preparation veneers, but not seen any cases that look good. This is a thing of the past, now that Durathin porcelain veneers are available in Europe. Invented by Mark Willies and Dennis Wells, they are natural looking, ultra-thin (0.2mm) veneers that once bonded to the enamel of the teeth give both you and the patient what they are looking for. This is a paradigm shift in the thinking of all the team. The most critical step is in the planning stage. It is essential you provide the patient with provisional restorations in which they can ‘test drive’ their new smile. This is carried out in two ways:

1. Diagnostic wax-up. Using a technician who also thinks in the same field. An additive technique allowing a realistic smile. Then using silted matrix to copy this into a provisional smile (Luxatemp) in the mouth.

2. Direct composite mock-up (my preference). Adding composite and sculpting it to get a beautiful smile. Take an alginate to send to the laboratory to copy.

Ask the patient to return a few days later to check the appearance and speech. Flick the restorations off and take accurate silicone impressions and send to the laboratory. There’s no need for further temporisation unless the patient cannot wait to show off their new smile.

On the fit appointment, no anaesthetic is necessary, you may choose to use a small amount of anaesthetic to make the rubber dam placement more comfortable. The seating protocol is slightly different as the restorations are more delicate until cemented so a delicate touch is advised. No drills, no sensitivity, no anaesthetic and they can be removed with almost no changes to the enamel.

If you want to find out more, Dr Dennis Wells, Dr James Goolnik and Mark Wallis will be presenting Minimal Intervention Dentistry, otherwise know as ‘you are not going to drill my tooth down to a stump!’ on Friday June 26. They will also be offering a hands-on verification course.

About the author

James Goolnik is the owner and founder of Bow Lane Dental Group with six treatment rooms, an on-site dental laboratory and a multi-specialist team of 16, including four dental hygienists. The practice was voted London practice of the year in 2006. He is president-elect of the British Academy of Cosmetic Dentistry and set up his company Smiles by James, to train all members of the dental team in minimal invasive dentistry. Visit www.smilesbyjames.com for further details and to book a place on the above mentioned seminar.

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Luxatemp

Provisionals should not only look good they should, above all, fit well, immediately and precisely. Luxatemp from DMG offers the perfect fit you can rely on. It is therefore no surprise that the material is a worldwide success – and has been the Number 1 in the US for a decade. And, furthermore, the natural fluorescence gives it a great appearance. Nice when everything fits. DMG. A smile ahead.

Additional information is available at www.dmg-dental.com

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» Best of the Best «
»Composite Provisional Materials «
In an ideal occlusal scheme, Centric Relation (CR) is coincident with Centric Occlusion (CO). See fig 1. This occurs naturally in only 10 per cent of the population. CR can be defined as 'when the heads of the condyles are in their most superior position within the sockets, with the discs properly aligned and full neuromuscular release'. CO can be defined as maximum intercuspation of the teeth' and is otherwise known as habit bite. 2/Assess any discrepancy between CR and CO, as this may result in a slide with the potential for occlusal disharmony.

5/ Assess the static occlusion to evaluate the overbite and overjet. The overbite will help determine how much incisal length can be increased with or without opening the vertical dimension and will help the diagnosis of a traumatic palatal occlusion or anterior open bite. The overjet will help determine the teeth that will be involved in the excursive scheme. It is essential that the teeth as far away from the hinge axis that the skeletal pattern will allow take the excursive loads.

4/ Assess for wear facets and abfraction lesions. Use Shimstock and articulating paper to assess holding contacts before doing any restorations. See figures 2 and 3 – these show poor guidance in right hand excursion.

5/Assess anterior and protrusive guidance – ideally there is a canine protected occlusal scheme with posterior discussion in all lateral and protrusive excursions. Failing this, anterior group function is acceptable but there must be NO working and/or non-working interferences and no posterior interferences in protrusion. See figs 4 to 6.

6/Do I work in CO or CR? CO or conformative dentistry is most commonly used in single tooth or quadrant dentistry while CR or reorganised occlusion is most commonly used in rehabilitation cases. Reorganising an occlusion can be as non invasive as an equilibration or can involve a full arch or even a full mouth reconstruction.

7/Assess bitewing radiographs for the presence of any vertical bony defects, which may be associated with poor function – see fig 7.

8/Believe your patient – if they say that the bite ‘feels high’ after placing a restoration (direct or indirect) it probably is!

9/Triple trays work well for single tooth or quadrant dentistry but check patient is in CO.

10/Learn how to use a face bow as articulators are essential for larger cases or smile cases.

And remember to attend an occlusion course to help your understanding of the basic principles and the diagnosis of occlusal disease and their potential consequences.
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• How to use photography to treatment plan
• How to apply the principles of occlusion for longevity of your restorations
• How to take the perfect Centric Relation bite

• Why and how to take a face bow
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