In recent years, what had been termed as “plaque” has been reclassified as “oral biofilm” as we learn more about this common substance.

Research has shown that the sticky material found on the teeth—and more importantly, in the pockets—is not just a simple mix of bacteria, food particles and other accumulating debris. The biofilm has bacterial populations living within a self-produced extracellular matrix.

Do we have a quorum?

This oral biofilm is an aggregation of many types of microorganisms that form a colony on the tooth’s surface and within the periodontal pocket. Within the biofilm is a cell-to-cell communication mechanism—known as quorum sensing—that synchronizes responses to the population cell density. This aggregation of bacteria working together as a community produces specific proteins and enzymes by way of quorum sensing and utilizes oral fluids as the vector for transmission. Additionally, these biofilms have been shown to be resistant to antibiotics, as they are protected by the surrounding matrix.

Groups of bacteria can coordinate behavior via quorum sensing, giving the biofilm the ability to regulate numerous processes. These may include secreting specific enzymes that have the ability to turn the genes on and off in other bacteria. This provokes an immune response from the host, which sends in white blood cells (WBC) to the site to kill the invading bacteria. This results in localized inflammation in the surrounding gingiva.

The bacteria, via quorum sensing, also have the ability to confuse the defending WBC chemotactically by releasing chemicals into the environment, rendering the immune response ineffective.

The enzymes within the WBC that were intended to kill the bacteria are now available to turn on the very tissue they were meant to protect. Dentally, this translates into periodontal bone loss, a deepening of the pockets, and associated inflammation.

Beyond the mouth

Increasing evidence demonstrates that patients with periodontal disease also have a much higher risk of developing cardiovascular disease (atherosclerosis, coronary heart disease, stroke, etc.) and other systemic issues, than those individuals who take preventive measures to eliminate and control the biofilm in their mouths.

The major cause of periodontal disease, oral biofilm, harbors many harmful strains of bacteria. During the localized inflammatory response in the pocket, these bacteria enter the bloodstream and travel to other areas of the body, exerting a distant systemic effect that has been linked to numerous diseases (Fig. 1).

As these oral bacteria increase in number, they quickly create an intricate network of protective layers and channels. This biosystem develops out of more than 700 different species of bacteria...
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Bacteria within these biofilms may be a thousand times more resistant to antibiotics and biocides compared to their planktonic counterparts. Because of this, biofilms and infections resulting from them cannot be effectively treated with conventional antibiotic therapy.

Managing oral biofilm

Scaling and root planing effectively begin the physical removal and disruption of the biofilm in the deep pockets. But studies have demonstrated that biofilm re-establishes itself within 24–48 hours post debridement. As a result, long-term management is required on a daily basis to maintain good periodontal health and also to decrease or eliminate the biofilm’s systemic effects.

Home care alone is not sufficient to manage or eliminate these biofilms within the sulcus or pocket. Mechanical removal of the oral biofilm is insufficient for proper management because the toothbrush bristles can only extend 3mm into the pocket, at best, and do poorly interproximally, leaving biofilm undisturbed in inaccessible areas.

Oral irrigators are also ineffective, as the contact time between the solution being used (i.e., mouthwash, peroxide, etc.) and the oral surface is insufficient to break down the biofilm within the pocket.

Peroxide has been shown in the literature to break down the biofilm, as it is able to dissolve the matrix layer by layer, exposing the encompassed bacteria. But in order to achieve the desired effect, the peroxide needs to be in direct contact and have sufficient time to break down the biofilm (contact time).

Contact time is also dependent on the peroxide’s concentration. A 1.7 percent peroxide gel is effective when in contact for a 10-minute period. Peroxide at this concentration has no negative irritation factors with the inflamed gingiva, so patient comfort is maximized while effectively breaking down the biofilm in the pocket.

As the peroxide breaks down, the resulting products are water and ozone. Peroxide suppresses the enzyme that causes soft-tissue inflammation, and irreversibly degrades the amino acids holding the proteins together, which softens the calculus present.

Peroxide’s mechanism of antimicrobial action is via release of oxygen, with effects observed in gram-positive as well as gram-negative organisms. Gram-negative anaerobes cause the most damage, and are fortunately the first killed with the application of peroxide.

Additionally, hydrogen peroxide debrides bacterial cell walls. With a 10-minute
exposure, a 1.7 percent hydrogen peroxide gel penetrates the biofilm slime matrix and debrides the bacteria’s cell walls in the biofilms. Peroxide delivered and maintained in the periodontal pocket releases oxygen and changes the subgingival micro-environment, making it more difficult for anaerobic bacteria to survive.

Placing the hydrogen peroxide into the periodontal pocket and holding it there for a sufficient contact time is the key to treating periodontal disease. A customized prescription tray, such as Perio Tray by Perio Protect, is designed to deliver the hydrogen peroxide deep into the periodontal pockets. This process resists the crevicular fluid flow force that would push out of the pocket any material applied into the pocket with a syringe.

These trays are constructed based on a periodontal charting indicating the pockets’ depth so that the resulting tray creates a hyperbaric oxygen chamber in each pocket, driving the gel to the pockets’ depth and maintaining it there.

When the tray is worn with the peroxide gel for 15 minutes, the peroxide reaches the bottoms of pockets with depths greater than 7mm. Initially, patients are instructed to wear the trays three to four times daily, depending on the severity of the periodontal disease. This is decreased to two times daily when bleeding and inflammation subside. Patients transition to using the trays once or twice daily for long-term maintenance after the first periodontal recall, where evidence of active periodontal disease remains absent.

Using Perio Trays can quickly and effectively fight the bacteria that cause gum disease, and the systemic issues that have been associated with the oral biofilm.

References