Oral biofilms 101: the basics

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Biofilms are adherent communities of bacteria, fungi or protozoa living in a self-produced milieu of non-living matrix compounds. Their formation is complex and dependent on bacterial communication, which results in a specialized, pseudomulticellular existence.1,4

In the human body, biofilm formation offers pathogenic microorganisms protection against host immune defenses and antibiotics.3,4 Their development on hard, non-shedding surfaces such as teeth, artificial implants and indwelling catheters is ubiquitous, but they often colonize tissue cells as well. The United States National Institutes of Health estimates that more than 80 percent of human microbial infections are caused by bacteria growing as biofilms.4

Oral biofilms

The dense accumulation of bacteria was first reported by G.V. Black in 1898 in his description of dental plaques.5 Dental plaque remains perhaps the most well studied example of a biofilm.

The human oral cavity has been found to contain more than 700 different species of bacteria. Some of these species have been associated with the pathogenesis and progression of dental caries, periodontal disease, oral pathology and oral yeast infections such as candidiasis.6 With the link between these infectious, inflammatory oral diseases and systemic disease well established, investigation of oral biofilms is more essential than ever.1,5

Gingivitis and periodontitis

Gingivitis and periodontal diseases caused by bacteria that colonize the oral cavity in supragingival and subgingival biofilms.2,3,13 The community of bacteria observed in oral biofilms is distinct from those commonly cultured from saliva.9 It is recognized, however, that saliva can act as a reservoir for species that are usually found in biofilms. These planktonic individuals are free to seed new oral sites and are implicated in the transmission of oral diseases. Transmission of oral flora can be vertical (from mother to child) or horizontal (from spouse to spouse).2,12

Lowe and Theilade showed that without brushing, dental plaque deposition leads to gingivitis in three weeks or less.7,8

Much research has been dedicated to identify the etiologic bacterial species present in the dental plaques of patients with oral pathologies. Socransky et al.9 were the first to categorize these oral biofilm communities. They used genomic DNA probes and checkerboard DNA-DNA hybridization10 to identify bacteria in health and disease using 13,261 plaque samples.

Their study found three bacterial species, Bacteroides forsythus, Porphyromonas gingivalis and Treponema denticola, to be associated with increased pocket depth and bleeding on probing. These species, associated with clinical measures of periodontal disease, were labeled as the "red complex."10

Research followed to identify pioneer organisms and uncover the bacterial composition changes in plaque that lead to disease. Ritz noted that anaerobes succeed aerobic and facultative species, suggesting that the reduced environment created by the presence of anaerobes makes it more favorable for anaerobes to colonize.

Dental restorations

Crown restorations require proper physiologic contours to minimize plaque accumulation and the associated biofilm. Crowns should restore teeth to the natural physiologic contours, Stein and Kuwata coined the term "emergence profile" to describe the contour of a tooth or crown as it relates to the adjacent free gingival margin.15

A crown should have a straight emergence profile to allow for proper home care.14 Crown restorations with cervical over contours cause gingival inflammation and plaque accumulation.16 Even though glazed porcelain and polished porcelain seem to deter plaque, when examined microscopically, they are much more porous than highly polished high noble alloy.17

Historically, it was believed that supra-gingival margins were kinder to the periodontium and easier to finish and maintain rather than subgingival margins.18 However, contemporary literature indicates that the location of the margin is not as important as the dentist’s skill in providing a well-fitting and smooth finish.18

Basic principles from fixed prosthodontics regarding minimizing the biofilm should be followed for partial veneer restorations and conventional operative procedures such as amalgams, composite resin restorations and glass ionomer restorations. These restorations should also restore the tooth to the normal physiologic contours, with good marginal integrity and have favorable polished surface properties.

Bonding resin to the surface or liquid polished coatings have been shown to significantly reduce the biofilm thickness on dental restorations.19

The edentulous subject

Most studies to date have examined oral biofilms in the dentate subject, leaving us with limited knowledge regarding biofilms in the edentulous or complete-denture-wearing patient.

A recent study by Sachdeo et al.40 provided the first step in defining the organisms that are associated with the edentulous on both the soft (mucosa) and hard surfaces (denture).

The results from this study showed that periodontal pathogens Aggregatibacter actinomycetemcomitans and P. gingivalis that were believed to have disappeared from the oral cavity after extraction of all natural teeth11,41 were clearly present in biofilm samples from the edentulous patients.

The finding of these periodontal pathogens in the denture-wearing population by Sachdeo et al. is of great concern because if there