Studies on Pellicle and Early Dental Plaque in 
Relation to Periodontal Conditions

AKADEMISK AVHANDLING

som för avläggande av odontologie doktorexamen vid Sahlgrenska akademin vid Göteborgs universitet kommer att offentligen försvaras i föreläsningssal 3, institutionen för odontologi, Medicinaregatan 12E, Göteborg onsdagen den 5 december 2012, kl. 9.00

av

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Avhandlingen baseras på följande delarbeten:


Abstract

Studies on Pellicle and Early Dental Plaque in Relation to Periodontal Conditions

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Background and Hypothesis: Bacterial receptors in dental pellicles may influence colonisation and subsequent plaque formation. Studies on such receptors in the dental pellicles and bacterial adherence have mostly been performed in vitro and focused on proteins of salivary origin. We have only a limited knowledge of the receptor functions of plasma proteins and even less on the in vivo situation where they could reach the pellicle via the gingival crevicular fluid. Our hypothesis was that plasma proteins in the gingival crevicular fluid affect pellicle formation and the establishment of the early dental microflora on the tooth surface.

Material and Method: In the present series of studies, plasma proteins in pellicles formed on hydroxyapatite in vitro and on teeth in vivo and the adherence of bacteria to these pellicles were examined. In vivo studies were performed at different periodontal conditions in periodontally healthy and diseased subjects. Samples were taken at healthy and experimentally inflamed gingival margins as well as before and after surgical pocket elimination. The samples were taken from the gingival and incisal parts of teeth and, in one study group, even from surgically exposed root surfaces. Pellicle proteins were analysed using sodium dodecyl sulfate polyacrylamide gel electrophoresis, immunoblotting and image analysis. Bacterial adherence in vitro was examined using radiolabelled bacteria and liquid scintillation. In vivo plaque samples were analysed by culturing and the PCR technique.

Results: Components from plasma were readily incorporated into the experimental pellicles and into natural pellicles on tooth surfaces in vivo. These components mediated the adherence of Porphyromonas gingivalis, Fusobacterium nucleatum and Actinomyces spp. in vitro and were found to a higher extent in pellicles formed at the gingival part of the tooth surface than at the incisal part. The amount of pellicle proteins and the numbers of bacteria were higher in the presence of periodontal inflammation. In experimentally inflamed gingival margins of periodontally healthy individuals, this observation was pronouncedly seen on the incisal parts of the tooth surfaces. In the presence of periodontal pockets, higher amount of pellicle proteins and numbers of bacteria was seen on the gingival tooth surfaces when compared with the situation after surgical pocket elimination. In periodontally healthy individuals, the bacterial findings indicated a pattern of less streptococci and Actinomyces spp. and more bacteria associated with periodontitis in the 4-hour dental plaque formed during experimentally inflamed conditions, compared with healthy conditions. Periodontitis-associated bacteria were also more frequently found in the 4-hour plaque in the presence of periodontal pockets compared with the status after pocket elimination surgery. Pellicle and early dental plaque on surgically exposed root surfaces contained significantly more plasma proteins and total numbers of bacteria compared with the adjacent gingival enamel surfaces. Actinomyces spp. were found in comparably high numbers on the exposed root surfaces.

Conclusions: Plasma proteins with the ability to mediate the in vitro adherence of periodontitis-associated bacteria are important components of the in vivo pellicle, particularly in the presence of periodontal inflammation. As the gingival crevicular fluid flow increases so does the relative amounts of plasma proteins in the pellicle, thereby modifying bacterial attachment and early dental plaque composition. Surgically exposed root surfaces were found to bind significantly higher amounts of plasma proteins and total number of bacteria than the adjacent enamel surfaces. Further on, the extent of the root surface exposure significantly reduced the amount of plasma proteins binding to the adjacent enamel surface. On the basis of our observations, we suggest that the bacterial composition of early dental plaque may be governed by the presence of plasma proteins in the pellicle and the presence of exposed root surfaces.

Key words: bacterial adherence, in vitro pellicle, in vivo pellicle, periodontitis-associated bacteria, gingival crevicular fluid, plasma proteins, dental biofilm, experimental gingivitis, chronic periodontitis, periodontal pocket, exposed root surfaces

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