Targeting Actual Dental Caries-Associated Bacteria

Dental caries is known to be caused by several distinct microorganisms in a dental plaque that secretes weak acids onto the tooth surface following metabolism of carbohydrates. Mutans streptococci species, especially *Streptococcus mutans* and *Streptococcus sanguis*, are considered to be major cariogenic microorganisms (initiators). In addition to the major cariogenic microorganisms, other bacteria such as lactobacilli species exacerbate the initial dental caries in the enamel surface to a deep dentinal caries lesion and are considered to be secondary invaders rather than initiators of caries, apart from being associated specifically even with caries of primary teeth. Previously, root caries was considered to be caused by *Actinomyces naeslundii* or *Actinomyces viscosus*, but of late, *S. mutans* and lactobacilli have also been reported to be detected in samples obtained from root caries lesions in several studies.

For decades, the sugar-fermenting acidogenic species *S. mutans* has been considered the main causative agent of dental caries, and most diagnostic and therapeutic strategies have been targeted toward this microorganism. Although there are studies showing an association between dental caries and *S. mutans*, lactobacilli, and *Actinomyces*, an important hurdle in determining the etiology of tooth decay is that many samples were not taken from the disease site itself but from other noninvasive samples such as saliva, which does not represent the cariogenic microbiota. This could suggest that other microorganisms can contribute to the dental caries process. It is now recognized that this disease results not solely due to the presence of *S. mutans* or any single organism in dental plaque but is rather caused by interactions of multiple acid-producing organisms with other biofilm residents.

However, recent DNA- and RNA-based studies have uncovered an extraordinarily diverse ecosystem, where *S. mutans* accounts only for a tiny fraction (<1%) of the bacterial community. In relation to *S. mutans*, which is probably the most studied caries-associated species, a dramatically low proportion was found in all samples, ranging from 0.73% in enamel lesions to 0.48% in open dentin and 0.02% in hidden dentin lesions. The low proportion detected confirms that this species is a minority and questions its importance as the main etiological agent of tooth decay.

DNS-based studies of microbial diversity in the oral cavity have estimated that the dental biofilm contains 500–700 bacterial species. In carious lesions, however, the number decreases dramatically to 100–200 species-level phylotypes, both in initial enamel caries lesions and in dentin or deep dentin cavities, and many of the organisms detected may be inactive and not contributing to the lesion progression. The recent RNA-based data identify bacteria that are actively involved, narrowed the list of organisms to 40–160 active bacteria per sample.

According to the putative list of caries-associated bacteria revealed by this technique:

- *S. mutans* accounts for 0.02% of the active microorganism in hidden dentin cavities, 0.48% in open dentin cavities, and 0.73% in enamel caries lesions. There is substantial evidence that *S. mutans* is associated with caries risk
- Main players of enamel caries are *Veillonella*, *Rothia*, and *Leptotrichia*
- Main players of dentin caries are *Streptococcus sanguinis*, *Atopobium*, *Schlegelella*, Pseudoromibacter, and lactobacilli
- *Scardovia wiggsiae* is identified as the new etiological bacterial agent for Severe Early Childhood Caries.

This supports the concept that consortia formed by multiple microorganisms act collectively, probably synergistically to initiate the dental caries lesion and expand the cavity. Therefore, it is the change in dental plaque ecology that leads to caries lesion development.

This change in the paradigm in the bacterial etiology of tooth decay must be translated into appropriate therapies. Given the polymicrobial nature of dental caries, it is predicted that diagnostic and preventive strategies directed toward specific bacteria will not be universally effective. Caries risk assessment diagnostic kits, traditionally focused on culture counts of *S. mutans* and lactobacilli, and preventive or therapeutic approaches like passive immunization strategies (antibodies directed against *S. Mutans*-specific antigen), and active immunization strategies (caries vaccine), explored mainly against *S. mutans* antigens, may not suffice if a key, universal bacterial repertoire is not present in caries development.
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