CARIES IN DOGS

Introduction

Caries is a multifactorial, transmissible, infectious oral disease caused primarily by the complex interaction of oral bacteria (cariogenic oral flora) with refined, fermentable dietary carbohydrates on the tooth surface over time.

Modifying factors

- Presence of Strep. mutans in the biofilm (highly specific, but not sensitive)
- Saliva – composition, pH, flow
- Diet – refined carbohydrates fed separately as biscuits

Bacteria

The presence of cariogenic bacteria attached to the tooth surface is necessary for caries to develop S.mutans and Lactobacilli are quoted as primary cariogenic bacteria. However the composition of bacterial microbiota in caries lesions is much more diverse.
In dentinal caries lesions there is a great diversity in microbiota composition between individuals.

The oral biofilm is very diverse within individuals as the mouth is not a uniform environment (different levels of saliva flow, masticatory action) and in different oral habitats different bacteria predominate. (1)

Canine plaque has remarkably varied microbiota compared to human plaque (4), (8), (12) and Streptococci represent ~1% of plaque microbiota in dogs and 18 % of saliva microbiota; in humans Streptococci can represent up to 30% of plaque microbiota on coronal surfaces of teeth. No studies were found describing microbiota from canine caries lesions.

Environment

- Large interdental spaces between dog teeth facilitate the cleaning action of saliva flow.
- Canine saliva has a higher pH than in humans. This enhances enamel remineralisation.
- The occlusal pits of maxillary molars and fissures on buccal aspect of maxillary PM4 (often covered with tartar) are most commonly affected by caries in canines (3). Pits and fissures are also predisposed to caries formation in humans as they promote food impaction and restrict the flow of saliva (1)

Diet

- Dog diets are usually low in carbohydrates
- No data found on correlation of food and formation of caries lesions in dogs, however ‘food leftovers’ correlate with presence/higher levels of cariogenic bacteria (5)

Caries formation/pathogenesis (1), (3), (7)

- Colonisation of the plaque biofilm by cariogenic bacteria
- Production of organic acids (lactic, acetic, propionic) as a result of bacterial metabolism
- Further reduction of pH of biofilm
- Calcium and phosphates driven from enamel into biofilm – demineralisation of enamel surface – ***non-cavitated enamel caries lesions*** formed*

  *At this stage the process is reversible – saliva is oversaturated with calcium and phosphates and if the pH of biofilm increases (reduction of bacterial metabolism, bacterial load, increased saliva flow – buffering) enamel can remineralise. It is a constant, dynamic process. Presence of trace amounts of fluoride ions enhances the process of remineralisation and formation of fluorapatite (instead of hydroxyapatite) enhances enamel's acid resistance.
  During remineralisation of noncavitated enamel lesions metallic ions and organic debris can be entrapped, causing discolouration of enamel. These spots are called ***arrested caries***.

- Demineralised enamel matrix exposed to bacterial enzymes and leukocytes – process progresses
- Collapse of matrix - ***cavitated enamel lesions*** formed

Eventually the process reaches dentine and becomes faster due to:

- Lower mineralisation of the tissue
- No access for saliva (no buffering, cleaning action)
- Layout of dentinal tubules facilitates an ingress of bacteria and their metabolites towards the pulp
- Pulp cells lay down tertiary dentine, but eventually process spreads to the pulp causing necrosis

Caries in dogs (3), (7)

Reported as rare in approximately 5.25 **% of patients**. Predominantly areas of caries development in dogs are occlusal pits of maxillary molars and fissures on maxillary PM4s (3).
Anecdotally the reasons are believed to be:

1. Anatomy of mouth
- wider interdigital spaces
- enhanced salivary flow around teeth
- less pits and fissures that accumulate food

2. High saliva pH in dogs is less favourable for acidogenic streptococci
3. Low levels of simple carbohydrates in diet
4. Low levels of salivary amylase to break down starches

Discussion

- There is a major difference in the microflora and different primary bacteria that colonise dental plaque compared with humans – possibly the dog's microflora competes more successfully with cariogenic bacteria.
- Are the normal commensal bacteria in dogs preventing the colonisation of the mouth with Strep. mutans or is it the salivary pH and anatomy of teeth that prevents colonisation?
- It seems a reasonable assumption that S. mutans and/or Lactobacilli would be responsible for caries lesions in dogs as well (oral-to-oral transmission from humans and/or other dogs) – although no evidence found to confirm that.
- Could other bacteria (not Step. mutans and/or lactobacilli) be responsible for demineralisation of enamel in dogs?
- Do dogs that suffer with caries have lower pH of saliva
- Due to the thin enamel layer in dogs is early cavitation likely to expose dentine? Is progress of caries faster than in humans?
- Caries is known to be a transmissible disease in humans (7); could it be zoonotic? There is some evidence that periodontopathic bacteria can be transmissible between dogs and humans (9), but is not very common - oral-to oral contact promoted transmission (8).
- Are dogs with reduced saliva production (e.g. drug induced xerostomia) more prone to caries as people are?

Resources and reading:

1) Art and science of operative dentistry; Herman, Swift, Ritter
2) Identification of microbiota in caries dentine lesions; Junko Obata et al.
3) Dental caries in dogs; F Hale
4) Cultivable oral microbiota of domestic dogs; Elliot et al.
5) Comparison of the distribution of oral cavity bacteria in various dog populations; E. Lavy at al.
6) Biofilm Implication in Oral Diseases of Dogs and Cats; Zambori et al.
7) The Microbiology of Primary Dental Caries in Humans; J.M. Tanzer et al.
8) Comparison of the Oral Microbiomes of Canines and Their Owners Using Next-Generation Sequencing; Changin Oh et al.
9) Distribution of periodontopathic bacterial species in dogs and their owners; Yamasaki et al
10) The effect of environmental pH and fluoride from the substratum on the development of biofilms of selected oral bacteria; Ly, Bowden
11) The canine oral microbiome; Dewhirs et al. after:
12) Early Canine Plaque Biofilms: Characterization of Key Bacterial Interactions Involved in Initial Colonization of Enamel; Holcombe L. et al
13) Microbial complexes in subgingival plaque; Socransky SS et al.