Impact of nutrition on dental issues in companion animals

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MARGE CHANDLER DVM, MS, MACVSc, DACVN, DACVIM, DECVIM-CA, MRCVS considers the effect of a pet's diet on the prevalence and type of dental disease it may develop and looks at other methods of improving dental health

ORAL health is a very important part of pet welfare. Periodontal disease is the most common disease of adult dogs and cats, with prevalence rates estimated at 60 per cent to more than 80 per cent of dogs and cats (Logan et al, 2010; Lund et al, 1999; Hamp et al, 1984).

Understanding the terminology and pathophysiology of dental disease is necessary to understand the effect of diet on tooth care.

Several materials accumulate on the surface of teeth and affect dental and periodontal disease. Dental plaque is a soft adherent biofilm that consists of aggregates of bacteria, salivary glycoproteins, extracellular polysaccharides and sometimes epithelial and/or inflammatory cells.

Plaque forms along the free gingival margin (supragingival plaque) and in the gingival sulculus (subgingival plaque). As plaque matures, the bacterial population shifts from primarily Gram-positive aerobic to Gram-negative anaerobic organisms. The inflammation and destruction of periodontal disease results from the action of bacteria on the periodontal tissues.

Gingivitis – inflammation of the gums – can progress to bacterial penetration and colonisation into subginival tissues.

Periodontitis has two distinct, but interconnected, aetiologic components: periodontopathic bacteria adjacent to the periodontal tissues, and host-mediated connective tissue-destructive responses to the causative bacteria and their metabolic products (Golub et al, 1998). This process can cause destruction of the periodontal apparatus, resulting in loose or even lost teeth.

Periodontal disease is graded from stage one (clinically normal) to stage four (advanced periodontitis). Periodontal disease has been associated with cardiac valve disease, and the inflammation and potential bacteraemia may also be associated with other chronic disorders. It also contributes to insulin resistance, which can make control of diabetes mellitus more difficult.

Dental calculus (tartar) is mineralised plaque, which is a hardened substrate formed by the interactions of salivary calcium and phosphate salts and plaque. Calculus is cosmetically unattractive, but calculus control without plaque control does not prevent periodontal disease (Warrick et al, 2003).

Acquired dental staining of adult teeth is similarly mostly cosmetic and differs from the enamel staining caused by disease or antibiotic administration during tooth development.

Dry versus moist pet foods

A common perception in small animal practice is that feeding dry pet foods will decrease plaque and calculus, and canned foods promote plaque formation. It would seem the crunching action of biting into a hard kibble should clean the teeth. Actually, moist foods may perform similarly to a typical dry food in their effect on plaque and calculus accumulation (Boyce and Logan, 1994; Harvey et al, 1996). As the pet bites into a typical kibble it shatters and crumbles, which provides no mechanical cleaning (Logan et al, 2010; Figure 1).

Dental diets and treats

Some foods and snacks designed to clean teeth have a texture that maximises contact with the teeth. Foods with the right shape, size and physical structure can provide plaque, stain and calculus control (Logan, 1996; Logan et al, 1997: Jensen et al, 1995).

A six-month study that compared feeding a dental diet to feeding a typical maintenance diet showed about a third less plaque and gingival inflammation in the dogs fed the dental diet (Logan et al, 2002). When a dental diet was fed to beagles with pre-existing plaque, calculus and gingivitis, there was a significant decrease in these parameters, whereas they increased in the beagles eating a control maintenance diet (Finney et al, 1996). The type of fibre in the dental diets is thought to exercise the gums, promote gingival keratinisation and clean the teeth (Logan et al, 2010).

Additives

As well as fibre to help clean teeth, some diets and treats contain antibiotics or additives as retardants or inhibitors of plaque or calculus.

Sodium hexametaphosphate (HMP) forms soluble complexes with cations such as calcium, to reduce the availability for incorporation into plaque causing the formation of calculus. The calcium-HMP complex is then swallowed with saliva and disassociates in the acid of the stomach.

Adding HMP to a dry diet decreased calculus in dogs by nearly 80 per cent when fed a softened dry diet (Stookey et al, 1995).

Another study, however, showed no difference in plaque or calculus when HMP-coated biscuits were fed to dogs for three weeks (Logan et al, 2010).

Veterinary Oral Health Council

One way to check if a pet food or treat is effective in preventing or decreasing plaque or calculus is to check if it has been approved by the Veterinary Oral Health Council (VOHC; vohc.org).

The VOHC is a non-regulatory agency that includes representatives from the American Veterinary Dental College, Academy of Veterinary Dentistry, American Veterinary Dental Society, American Veterinary Medical Association, American Animal Hospital Association, United States Food and Drug Administration, private practice and industry.

Products produced in the US are mostly considered for approval, but many of the same pet food companies also sell these products in Europe.

The VOHC provides independent and objective reviews of tests of dental products submitted to it that are in accordance with its protocols, although it does not provide testing itself. The VOHC awards a seal of acceptance for two categories: those that help control plaque and those that help control tartar.

Vitamin deficiencies

Deficiencies in vitamin A, C, D and E and the B vitamins folic acid, niacin, pantothenic acid and riboflavin have been associated with gingival disease (Logan et al, 2010).

The amount of these vitamins is adequate in diets that follow the European Pet Food Industry Federation (FEDIAF) guidelines (fediaf. org), but can be deficient in diets that do not meet those guidelines, such as many home-made diets.

Natural diets and feeding raw bones

Proponents of natural foods or of feeding raw bones have claimed this will improve the cleanliness of teeth in pets; further claims are sometimes made that feeding commercial pet food contributes to the high prevalence of periodontal disease in domesticated cats and dogs.

However, a study in foxhounds fed raw carcases, including raw bones, showed they had varying degrees of periodontal disease as well as a high prevalence of tooth fractures (Robinson and Gorrel, 1997).

The skulls of 29 African wild dogs eating a “natural diet”, mostly wild antelope, showed evidence of periodontal disease (41 per cent), teeth wearing (83 per cent) and fractured teeth (48 per cent; Steenkamp and Gorrel, 1999).

A study in small feral cats on Marion Island (South Africa) that had been eating a variety of natural foods (mostly birds) showed periodontal disease in 61 per cent of cats, although only nine per cent had evidence of calculus (Verstraete et al, 1996).

In a study in Australia of feral cats eating a mixed natural diet there was less calculus compared to domestic cats fed dry or canned commercial food, although, again, there was no difference in the prevalence of periodontal disease between the two groups (Clarke and Cameron, 1998)

These studies show a natural diet, or one containing raw bones, does appear to confer some protection against dental calculus, but not against the more destructive periodontal disease. There is also the risk of fractured teeth.

Saliva and diet

Saliva contains the enzymes lysozyme, myeloperoxidase, lactoperoxidase, as well as lactoferrin, and peptides, which help decrease pathogenic bacteria and yeasts.

Saliva is also thought to have a flushing action to inhibit the attachment of bacteria to the gums (Cave, 2012). In animals given a liquid diet, salivary gland atrophy begins in days. This is reversible when harder foods are fed.

Harder food consistency also increases the synthesis of salivary proteins and the amount of saliva produced. Tube-fed dogs develop plaque and gingivitis similar to dogs fed a soft diet (Egelberg, 1965).

Probiotics

Nitric oxide (NO) is an important inflammatory mediator and involved in the pathophysiology of several inflammatory disorders. An increase in NO production has been demonstrated in human periodontitis and a role in the inflammatory response of periodontal tissues has been suggested (Matejka et al, 1998; Lappin et al, 2000; Hirose et al, 2001).

These findings resulted in a hypothesis suggesting treatment with agents able to block the production of NO or its effects might be therapeutically valuable for gum lesions (Paquette and Williams, 2000). *Lactobacillus brevis* is a probiotic strain of bacteria, which contains high levels of the enzyme arginine deiminase. High levels of arginine deiminase, which metabolises arginine to citrulline and ammonia, aids *L brevis* in inhibiting NO generation by competing with nitric oxide synthase for the same arginine substrate.

Studies in humans have shown the ability of topical application of probiotics containing *L brevis* to decrease inflammatory mediators involved in periodontitis (Ierardo et al, 2010). Preliminary results of a small study of the use of topical *L brevis* CD2 in dogs showed a reduction of gingival inflammatory infiltrate (Vullo, 2014).

Brushing teeth and gums

Gingival stimulation by brushing teeth and gums is held to be the gold standard of dental care for dogs and cats, and can even reverse some existing disease.

In dogs with good dental health, brushing three times a week is sufficient to maintain gingival health (Tromp et al, 1986). Daily brushing prior to development of calculus can improve existing gingivitis. Mechanical stimulation of the gums by brushing enhances proliferation of fibroblasts and collagen synthesis (Horiuchi et al, 2002). It also enhances gingival pocket oxygen tension, which helps inhibit growth of anaerobic bacteria, and increases microcirculation and saliva flow (Tanaka et al, 1998).

Summary/conclusion

While ideally all pet owners would brush their pets’ teeth, this is often not practical and compliance is very low. The use of VOHC-approved diets and treats is probably the next best suggestion, along with dental prophylaxis.

While the common idea of dry food cleaning the teeth is appealing, it appears many dry foods do not decrease the risk of periodontitis. Feeding natural foods or raw bones may decrease dental calculus, but does not appear to improve the risk for development of periodontitis. In the future, use of approved fibrous foods and treats and, possibly, added appropriate probiotics may improve the dental health of dogs and cats.

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Figure 1. Dental tartar present on the teeth of a dog fed a maintenance dry food.