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Considerations for Chew Items for Dogs and Cats

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Abbreviations

CRP	C-reactive protein
UCF	Uncomplicated crown fracture
VOHC	Veterinary Oral Health Council

Abstract

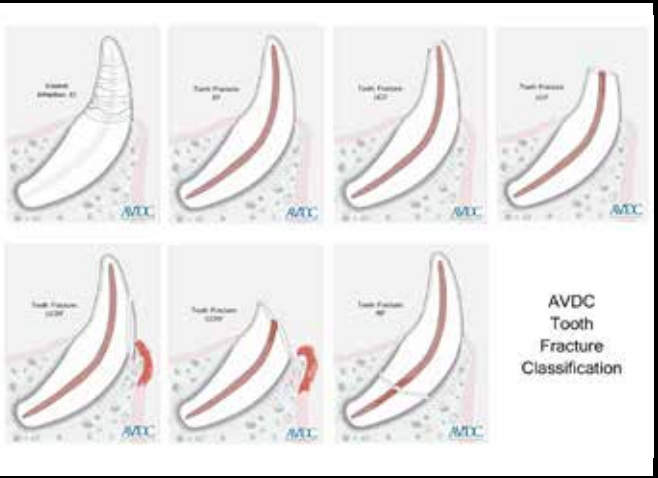
Veterinary practitioners are often asked by pet owners, "What chew items should I give my pet?" Considerations include dental trauma, chewing behavior and bite forces, and periodontal disease. Characteristics of the ideal chew item may include, but not be limited to, the following: (1) It must be of interest to dogs and cats to encourage chewing behavior; (2) it is either long-lasting or, alternatively, it can be administered frequently without adverse consequences; (3) it is of high nutritional quality with minimal calorie increases above the current diet; (4) it is proven to decrease plaque and calculus; (5) it is not excessively hard to avoid harm to the teeth and jaws; (6) it has a broad safety spectrum with minimal risk of toxicity, choking, and GI obstruction. Maintenance of periodontal health may help to minimize systemic inflammation and sequela of chronic inflammation.

Introduction

As a board-certified veterinary dentist, a large percentage of my caseload is represented by dogs and cats who have sustained dentoalveolar trauma. The source of trauma, in many cases, is avoidable and self-inflicted. Particularly in dogs, inappropriate chew items account for most of the tooth fractures we encounter.

Although an explanation of types of dentoalveolar trauma is considered beyond the scope of this manuscript, resources exist for a detailed list and explanation of the various manifestations of dental trauma (1). (**Figure 1**) The most relevant classification difference between various tooth fractures is the distinction between complicated and uncomplicated tooth fractures. The term *complicated* has been adopted by the American Veterinary Dental College (AVDC) nomenclature committee to describe a tooth fracture that has resulted in exposure of the nerves and vessels within the pulp chamber of the tooth. An uncomplicated crown fracture (UCF) does not result in direct pulp exposure but may still result in sensitivity due to exposure of dentinal tubules beneath the enamel. Although uncomplicated fractures are less likely to result in loss of tooth vitality, these teeth should be closely

Figure 1



AVDC tooth fracture classification. Abbreviations : EI, enamel infraction; EF, enamel fracture; UCF, uncomplicated crown fracture; CCF, complicated crown fracture; UCRF, uncomplicated crown-root fracture; CCRF, complicated crown-root fracture; RF, root fracture. AVDC, American Veterinary Dental College. Image courtesy of AVDC.

monitored. Whereas complicated crown fractures (CCFs) by definition allow oral bacteria to migrate into the pulp to cause inflammation and endodontic infection, uncomplicated fractures do not always result in endodontic disease. A recent study that radiographically evaluated UCFs of maxillary carnassial teeth in dogs found that 24% of UCFs showed radiographic evidence of lesions of endodontic origin (2).

Chewing Behavior of Dogs and Cats

Chewing is a natural behavior of dogs and cats. Undomesticated carnivores and omnivores devour the bones of their prey, and because bite forces generated by their jaws are significant, the teeth may suffer consequences of chewing on hard items such as bones. One study showed that the frequency of tooth fractures in gray wolves was related to the availability of prey. In areas where prey was sparce, tooth fractures were more common. When prey-predator ratios declined, kills were more fully consumed, and rates of tooth fracture more than doubled (3). Naturally occurring tooth wear and tooth fractures were studied in lions, hyenas, and leopards. Lions showed a significantly higher tooth fracture rate than leopards on a per-tooth basis. Spotted hyenas had the highest rates of tooth wear and fracture among all three carnivores and greatly exceeded previously recorded rates based on historical samples (4). Differences between species in fracture rate may be related to the amount of available prey, anatomical differences/forces generated by the jaws of different species, and differences in chewing behavior among varying species. In another study, endodontic disease secondary to dental trauma was found in 73.3% (11/15) of captive jaguars. The authors of this study suspected that some of this endodontic disease and dental trauma was likely a result of capture and chewing on cage bars (5).

Bite forces generated by dogs can be highly variable, depending on many factors (6-8). Dogs bite harder on the caudal teeth and at lower gape angles (vertical range of motion of the temporomandibular joint). Half of all bite force is generated by contraction of the temporal muscles, which insert on the medial, dorsal, and lateral aspects of the mandibular ramus (6). Bite force increases with the size of the dog, as might be expected. Brachycephalic dogs showed higher bite forces for their size than mesocephalic dogs (6). At least one study suggests that domestication has not resulted in a disruption of the functional components in the jaw system in dogs (6). An ex vivo study that looked at fracture patterns of canine teeth found no significant difference in the amount of force required between different force directions. However, force direction did affect fracture pattern (9). When a marrow bone is positioned within the vise of the carnassial teeth at a low gape angle, teeth will fracture before the bone breaks, which usually manifests as a slab fracture of the maxillary carnassial tooth. Because enamel of all dogs and cats is very thin, even teeth that have no developmental abnormalities are prone to breaking.

Why Are Chew Items Important?

Periodontal disease is the most common disease of dogs and cats (10). Gingivitis is the first stage of periodontal disease, which is followed by inflammation of the periodontium (periodontitis), resulting in loss of the attachment structures of the teeth (periodontal ligament and alveolar bone) (11). Plaque, the biofilm of the mouth, is composed of saliva, food particles, and more than 500 bacterial species (11). Periodontal disease is not a simple infection. The immune system's reaction to antigens of plaque bacteria is what results in gingivitis and periodontitis (11). Dynamics of the canine oral microbiome change during the course of disease, with a microbial succession characterized by a reduction of previously abundant, health-associated taxa (12).

How does calculus contribute to periodontal disease? Although plaque is the source of oral inflammation, calculus forms from plaque when calcium salts within saliva allow for mineralization of plaque. Calculus provides a protected environment where anaerobic bacteria can flourish. Unlike plaque, once calculus is formed it cannot be easily dislodged from the surface of the tooth (11).

Plaque accumulation results in a potential source of chronic systemic inflammation and bacterial challenge. Bacteremia is frequent in patients with active periodontitis and is actively cleared by the reticuloendothelial system in healthy patients (13). Studies in humans and dogs have shown an association between periodontal disease and various manifestations of distant organ disease (14). In a study in dogs that documented the severity of periodontal disease and effects of appropriate treatment on systemic inflammatory mediators, C-reactive protein (CRP) levels were measured before and after appropriate dental treatment. Results showed that decreases in CRP concentration after treatment were correlated with the severity of periodontal disease (15). It is widely accepted that the presence of systemic inflammation is not a favorable contributor toward longevity. One study in elderly humans indicated that elevated CRP concentrations were associated with a higher risk of mortality of any cause (16).

Although not yet studied in detail in our veterinary patients, genetics plays a role in development of periodontal disease. Small-breed and extra-small-breed (<6.5 kg) dogs are up to 5 times more likely to develop periodontal disease than giant-breed dogs (17).

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Hierarchy of Plaque/Calculus Prevention Tools

Of all the tools available to prevent plaque and calculus, daily toothbrushing is considered the gold standard (11). As practitioners, we often let our suspicions regarding long-term compliance affect how well we educate pet owners regarding brushing. However, I have learned that client education can be very effective. One study conducted almost 30 years ago looked at long-term compliance in dogs and found that the majority of well-trained clients were still brushing their pets' teeth when surveyed 6 or more months after instruction (18). Another study showed that daily or every-other-day brushing resulted in significant improvement compared to weekly or every-other-week brushing (19).

Although the author knows of no studies that have been published to support this, multimodal strategies are likely to be more effective than a single home care option. Other plaque/calculus prevention modalities include mechanical cleansing aids, chemical prevention of plaque/calculus accumulation, and surface treatments that extend the plaque-free period after a cleaning (20, 21). Some dental diets act as mechanical cleansing aids that are specially designed to encourage more chewing and/or minimize accumulation of food particles on the teeth. Some dental diets have a hardness, kibble size, and composition that aids in disruption of plaque before it can become mineralized and adhere to the tooth as calculus. Practitioners who are concerned about carbohydrate intake of their patients should be aware that some dental diets have carbohydrates as their first, second, third, and sometimes fourth ingredients, including brewers' rice, corn gluten meal, and whole-grain corn. Feeding dental diets as treats may provide some degree of plaque control.

Dry food results in less plaque, calculus, and periodontal disease in both dogs and cats than soft food (22). Dental deposits (46.0% versus 14.2%) and periodontal disease (69.7% versus 33.2%) were more often absent in cats fed dry food compared with cats fed soft food. Differences in these parameters between cats fed mixed food and those fed soft food were also significant. In dogs fed dry food compared with those fed canned food, dental deposits (44.3% versus 17.2%) and periodontal disease (77.8% versus 45.3%) were more commonly absent. Differences in these parameters between dogs fed mixed (dry and soft) food and dogs fed soft food were also significant (23).

Some dental diets and treats contain chemicals such as sodium hexametaphosphate, which chelates calcium salts and decreases calculus accumulation (23). At least one veterinary study and multiple human studies have shown safety and/or efficacy of products containing sodium hexametaphosphate, including dentifrices (23, 24).

Water additives are unable to rely on mechanical cleansing and therefore employ various chemical methods of plaque/calculus prevention. Oral rinses containing dilute concentrations of chlorhexidine (0.1%-0.12%) have been proven to decrease oral bacterial counts (25). However, they may stain the teeth. Essential oils used as oral rinses or water additives may play a role in prevention of periodontal disease and halitosis (26, 27). Surface treatments include compounds that are applied either at home by pet owners or in the clinic when the patient is under anesthesia. These include single-application resin products that may remain on the tooth for up to 6 months or waxy substances that may be reapplied weekly (20, 21).

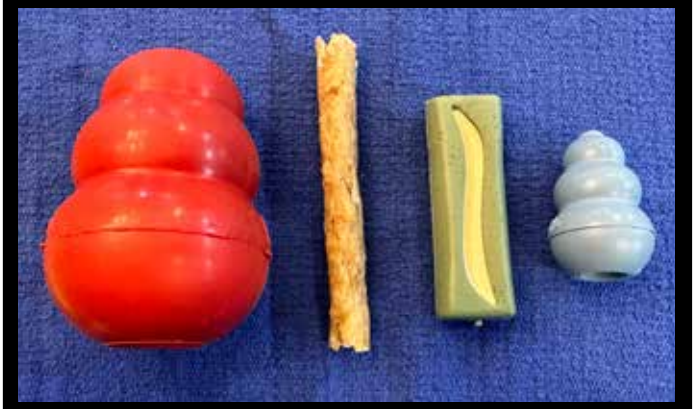
The Ideal Chew Item

The ideal chew item has the following characteristics: (1) It must be of interest to dogs and cats to encourage chewing behavior; (2) it is either long-lasting or, alternatively, it can be administered frequently without adverse consequences; (3) it is of high nutritional quality with minimal calorie increases above the current diet; (4) it is proven to decrease plaque and calculus; (5) it is not excessively hard to avoid harm to the teeth and jaws; and (6) it has a broad safety spectrum with minimal risk of toxicity, choking, and GI obstruction.

Chew items that would be excluded based on criterion 5 include real bones, nylon bones, antlers, cow hooves, yak milk treats, some harder bully sticks, and ice cubes. These items are commonly reported in our practice to have resulted in tooth fracture in owners' pets. Criterion 6 would exclude some forms of rawhide products. Tennis balls should be avoided as a chew option because the surface felt of the tennis ball will accumulate dirt, acting like sandpaper to abrade the teeth. Some veterinarians discourage pet owners from giving rawhide to dogs because of the challenges to digest the rawhide properly, its tendency to swell in the stomach, and the chemicals used to process some types of rawhide. Soft rawhide chews that break up into small pieces have been proven to significantly decrease plaque, calculus, and gingivitis (28). Even when a pet is provided with a malleable or easily breakable treat, it is important to follow the manufacturer's recommendations for size of treat based on weight class. Plush toys can cleanse teeth, much like a soft-bristled brush or gauze, but care should be taken to avoid obstruction by removing the toy if a pet attempts to swallow portions of the toy. Rubber toys can satisfy

inherent chewing behavior while avoiding tooth fracture and possibly mechanically remove plaque. Patient acceptance of rubber toys will be variable. Hollow rubber toys can be stuffed with dental diet kibble to increase interest levels. **(Figure 2)**

Figure 2



Acceptable chew items for dogs and cats. Acceptable chew items include, but are not limited to, rubber chew toys, soft rawhide chews, and flexible treats. It is important to follow manufacturer recommendations regarding pet size and chew item size. Pets should be observed when offered a chew item to assess whether they try to swallow unacceptably large pieces.

The Veterinary Oral Health Council (VOHC) is an independent group of veterinary dental experts who voluntarily assess studies for proof of plaque and/or calculus reduction by a particular product. Pet owners may look for the VOHC seal of acceptance for items/diets/water additives that have been shown to have a beneficial effect on plaque/calculus reduction. Although many products lack scientific publications proving effectiveness, interested individuals may be able to obtain internal study results from companies that have developed products. It is important to know that the VOHC does not currently make assessments of the nutritional value, digestibility, or hardness of the specific item submitted for approval of plaque/calculus reduction (29).

Conclusion

It is easier to provide a list of inappropriate chew items than a list of items with perfect attributes. Based on the criteria listed above, the perfect chew item may not currently exist, and the perfect chew item varies from patient to patient. Toothbrushing is not only advisable but worth revisiting if abandoned early during initial attempts with a specific pet. Because they are typically provided more than once a day, dental diets can play an important role in plaque/calculus reduction if the patient's existing medical condition allows for consideration of such diets. The minimal criterion of acceptable chew items should, first and foremost, do no harm. Ideally, the chew item's research and development process will provide sufficient evidence that it decreases plaque and/or calculus accumulation based on prospective controlled studies reviewed by independent experts within the field. It is important to supervise and observe pets' chewing behavior when they are introduced to a chew item.

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