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BASIC CANINE DENTISTRY

For Veterinary Hospital Staff

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Jean Hawkins, MS, DVM
Diplomate, American Veterinary Dental College

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Contents

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About the Author

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ORAL EXAMINATION

Ideally, the first oral examination should be done in pets at about 3 weeks of age when the deciduous dentition is beginning to erupt. Significant problems include mechanical dental interlock, fractured deciduous teeth, and primary (involving the lip, nose, and/or incisor bone) and secondary (involving the hard or soft palate) cleft palate.

The first dental examination is usually performed when the puppy is presented for its initial checkup at 6 to 8 weeks of age. Thereafter a brief dental examination should be performed at each vaccination visit and a dental-only checkup scheduled for 7 to 8 months of age to make sure that all deciduous teeth have been shed and that the permanent dentition is in the normal position.

Thorough familiarity with normal canine anatomy is necessary to detect any abnormalities. If the following areas are addressed, a fairly complete oral examination has been done:

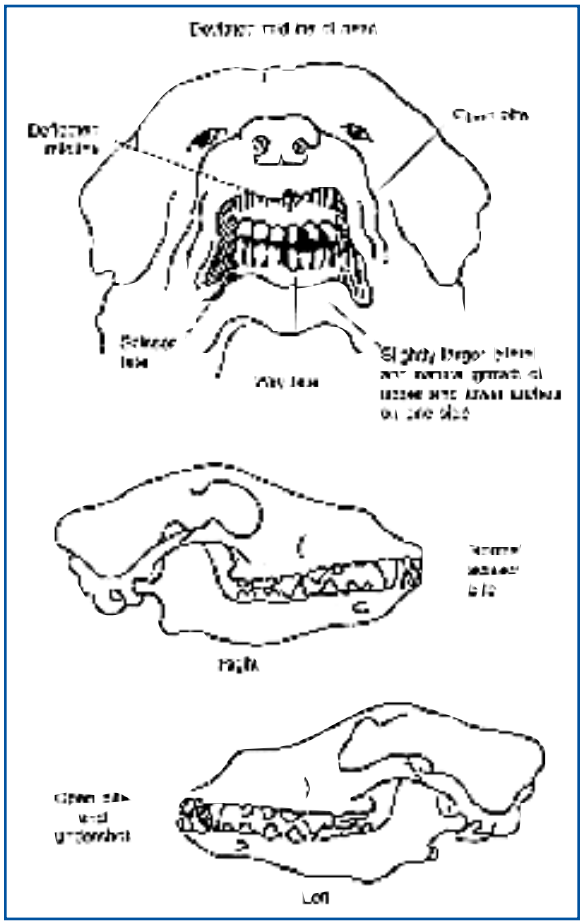


Figure 1. Examples of abnormal anatomy that may be seen during the oral examination.

- Before examining the inside of the mouth, all structures around the oral cavity should be checked (Figure 1).
- Is the head symmetrical? Is the nasal philtrum (center line of the nose) in the center of the muzzle?
- Are the lymph nodes or salivary glands enlarged?
- Is there any pain or swelling around the face or neck?
- Halitosis or bad breath can be an early sign of periodontal disease, but it can also be a sign of serious systemic disease, such as renal failure.
- Is gingival tissue smooth and healthy?
- Is there any evidence of gingivitis or periodontitis?
- Is there any accumulation of soft plaque?
- Has calculus formed on the tooth surfaces?
- Are there any fractured or worn teeth?
- Are any teeth missing, crowded, or rotated?
- Are there any retained deciduous teeth or supernumerary teeth?
- Are the buccal cheek tissue and sublingual tissue smooth?
- Are there any lumps or bumps within the oral cavity?

Maintaining good control of the animal's head is important in performing the oral examination. Aggressive dogs should be evaluated under anesthesia. To control the head of nonaggressive dogs, grasp the muzzle with the left hand and use the left thumb to press against the hard palate in the interdental space between the premolars and upper canine tooth (see Figure 2). In general, dogs will tolerate a cursory oral examination when this method is used.

Figure 2. Proper technique for controlling a dog to perform an oral examination.

Normal Deciduous Dentition

The deciduous dentition for puppies is:

	Incisors	*Canines*	*Premolars*	
Maxilla	3	1	3	× 2 = 14
Mandible	3	1	3	× 2 = 14
			TOTAL:	28 teeth

The incisors erupt at 2 to 3 weeks of age. The canine teeth have usually erupted by 4 weeks, and all primary teeth should be in place by 8 weeks of age. The root of a deciduous incisor is proportionately much longer than that of an adult incisor. This is important to note if extraction is necessary.

The deciduous canine tooth is similar in shape to the adult canine tooth. The deciduous teeth have very thin walls and can be easily fractured. Fractured deciduous canine teeth should be extracted to eliminate possible infection of the permanent tooth bud and alveolar bone through the open pulp canal.

The first and second deciduous maxillary premolars have two roots each; the third has three roots. The three lower deciduous premolars each have two roots. There are no precursor teeth for permanent premolar 1, upper molar 1 or 2, and lower molar 1, 2, or 3.

As the permanent dentition is forming, the tooth crowns lie in a certain order:

- The permanent incisor crowns form lingual to the deciduous incisors.
- The upper canine tooth crowns lie rostral to the deciduous canine tooth crowns.
- The lower canine tooth crowns lie lingual to the deciduous canine tooth crowns.
- The permanent premolar crowns usually lie lingual to the deciduous premolars but can occasionally erupt buccal to retained deciduous premolar teeth.

Normal Permanent Dentition

The permanent dentition for adult dogs (Figure 3) is:

	Incisors	*Canines*	*Premolars*	*Molars*	
Maxilla	3	1	4	2	× 2 = 20
Mandible	3	1	4	3	× 2 = 22
				TOTAL:	42 teeth

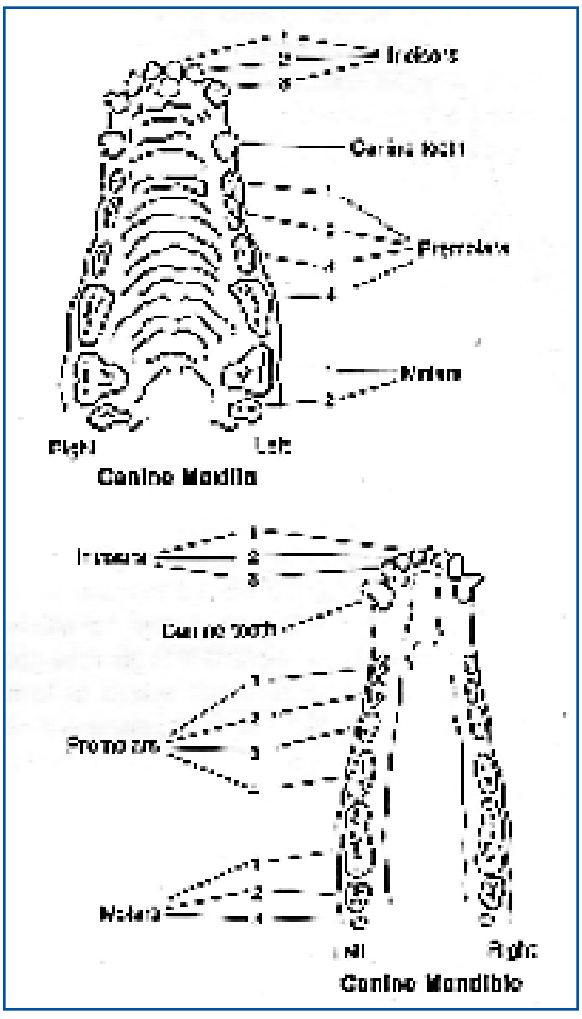


Figure 3. Permanent dentition of the adult dog.

In a normal dog eruption occurs from about 2 to 7 months. Any deciduous teeth remaining after 7 months should be extracted if there is a corresponding permanent tooth in place.

After completing the oral examination, the results (i.e., pathology or suspected pathology and anticipated treatment) should be discussed with the owner. When a course of treatment is decided, an estimate for the treatment should be made by the veterinarian and presented to the owner. If a dental procedure is scheduled, specimens for laboratory analysis should be collected (urine and blood). The veterinarian should consider whether antibiotic therapy is needed in view of the patient's medical history (e.g., heart murmurs, hip implants). In my opinion, the antibiotic of choice in treating periodontal disease in dogs is Clavamox® (Pfizer Animal Health). The dental procedure can be scheduled

Figure 4. The most common malocclusion seen in veterinary dentistry is the anterior crossbite (reverse scissor).

accordingly unless abnormal test results contraindicate immediate anesthesia and therefore necessitate postponement of the dental procedure. In an animal with minimal disease, no antibiotics are needed and the dental prophylaxis can be performed the same day as the examination, assuming that there are no contraindications to administration of anesthesia.

OCCLUSION

Dogs' teeth are designed to be self-cleaning when the animals consume a natural diet (i.e., wild dogs). Unless an abnormal anatomic relationship exists (such as in a brachycephalic head type), there are contact points only in the molar region.

Normally, each lower canine tooth occludes in the interdental space between the upper third (lateral) incisor and the upper canine tooth. The upper fourth premolar tooth overlaps the lower first molar, which together constitute the carnassial (shearing) teeth.

Malocclusions can cause a variety of problems ranging from mild (e.g., slight wear against the upper third incisor by the lower canine tooth) to severe (e.g., oronasal fistulas secondary to base narrow lower canine teeth). Some malocclusions are considered "normal" for specific breeds (i.e., brachycephalics), yet can lead to a greater incidence of dental disease in these animals.

Anterior Crossbite

One of the most common malocclusions seen in veterinary dentistry is anterior crossbite, which has no breed predisposition. This occlusion occurs when one or more of the upper incisor teeth are caudal to the lower incisor teeth. It is also known as *reverse scissor* (see Figure 4).

Mandibular Prognathism or Upper Arch Brachygnathism

In animals with an undershot arch the lower arch is of normal length but the upper arch is too short (upper arch brachygnathism, such as is seen in an increasing number of rottweilers). The reverse can also occur—that is, the mandible can be longer than normal (mandibular prognathism)—but this does not seem to be common. If the maxilla is short, the cheek teeth may be crowded and rotated and lose some of their self-cleaning ability. Consequently, plaque and debris are trapped, predisposing the area to periodontal disease if the condition is not recognized and treated. Treatment involves odontoplasty (reshaping of some of the crowded teeth) or extraction of one or more crowded teeth. Brachycephalic breeds such as the bulldog and pekinese are examples of animals with extremely undershot occlusion. As the upper arch becomes shorter, the third and second premolars rotate sequentially and may lose all self-cleaning aspects. These patients require more frequent prophylaxes and home care to maintain dental health.

Occlusion of and incisor and premolar relationship to the canine tooth should be assessed for contact areas that can cause premature wearing of tooth surfaces and secondary weakening of the tooth or teeth (attrition). Some cases can be treated by orthodontia to relieve the wear; in others, extraction of the smaller tooth or occasionally a vital pulp cap on an offending canine tooth may be needed. (I prefer almost any other alternative to a pulp cap, as this procedure tends to fail often.) If the patient is older, the pulp tissue may have been exposed and a root canal or extraction of the affected tooth is required.

In pets with decreased space between the upper third incisor and upper canine tooth there can be a lack of interdental space for the lower canine tooth; the upper third incisor is traumatized by the lower canine tooth each time the mouth is closed, thereby pushing and turning the upper third incisor into an abnormal position. Because of the abnormal anatomy and consequent plaque and calculus accumulation, premature periodontal disease of one or more incisors can result. The incisors should be extracted. The upper third premolar may need to be extracted to

restore the self-cleaning mechanism of the upper fourth premolar and maintain the patient's dental health. When the dental health of a canine or carnassial tooth is compromised by overcrowding by a smaller, less significant tooth, extraction of the latter should be considered.

Damage to soft tissue and bone and subsequently to the incisor tooth roots of the mandible may occur in some brachycephalic dogs. Such damage is the result of the cusps of the upper incisors repeatedly hitting the mandibular soft tissue. Using a diamond finishing bur in a high speed handpiece or white Arkansas stone bur in a low-speed handpiece (with irrigation) to shorten the tips of the upper incisors just slightly usually prevents further trauma from occurring.

Mandibular Brachygnathism

Mandibular brachygnathism, which is often referred to as *overshot occlusion,* is seen with increasing frequency. I have seen this problem in large breed dogs (e.g., German shepherds) as well as chihuahuas and other small breeds. Normally, the mandible is a specific length, and the teeth are evenly spaced; in pets with mandibular brachygnathism, however, the mandible is shorter than normal. The lower canine teeth may even be caudal to the upper canine teeth. As teeth become crowded in the lower arch, the lower fourth premolar may overlap the lower first molar, predisposing both to periodontal disease. Reshaping the contact surfaces (odontoplasty) between these teeth may reestablish their normal self-cleaning mechanism and prevent future periodontal problems. The genetic basis of these patients is very questionable, and they should not be bred. Frequent prophylaxis and home care help decrease dental disease.

Posterior Crossbite

In patients with posterior crossbite the mandible is wider than the maxilla in the carnassial tooth area or the angle of eruption of the carnassial teeth is abnormal. Either of these conditions causes the lower carnassial tooth to occlude buccal to the upper carnassial tooth.

Posterior crossbite occurs occasionally in boxers and long-muzzled (dolichocephalic) breeds

Figure 5. Supernumerary teeth (polyodontia) occurs in about 9% of dogs. This figure shows supernumerary lower premolars.

such as collies. As one might guess, not much is possible in the area of correction; however, the abnormal anatomy should be pointed out to the owner. Heavy amounts of calculus will accumulate on the buccal surfaces of the lower premolar and molar teeth. These pets require regular toothbrushing and more frequent professional prophylaxis.

Wry Mouth

The growth in each quadrant of the mouth (upper and lower right and left) is independent of the others. Uneven growth among these areas produces a wry occlusion *(wry bite, wry mouth).* It may be very minor and found only on close visual examination of the midline of the maxillary and mandibular incisors. In some cases, however, one side of the head may be smaller and the nose turned slightly to one side. Minor abnormalities may be seen in the midline of the rugae of the hard palate.

Oligodontia

Some animals do not have a full complement of teeth, a disorder called oligodontia. Oligodontia is insignificant to tooth function; however, for certain breeds to be shown, the American Kennel Club requires a full complement of teeth or no more than four missing from the adult dentition. Usually, the missing teeth are premolars or incisors. Radiographic evaluation of the dentition of potential show puppies between 12 and 16 weeks of age should reveal the presence or absence of all permanent tooth crowns. This can be a valuable ancillary veterinary service to offer breeders or purchasers of potential show dogs. Complete absence of teeth (anodontia) is very rare in dogs.

Figure 6. Dental interlock occurs when deciduous teeth erupt in an abnormal pattern. In effect, the mandible is mechanically locked in place by the upper canine teeth.

Figure 7. As shown in this figure, retained deciduous teeth usually remain in place along with the permanent teeth. This disorder should not be confused with supernumerary teeth.

Polyodontia

Animals with supernumerary teeth (Figure 5) have a disorder called polyodontia. The extra teeth are usually premolars or incisors, although occasionally a supernumerary canine tooth may be found. A supernumerary tooth can be differentiated from a retained deciduous tooth by examining the anatomy of the crown (which is larger in the supernumerary tooth) and by radiography (a deciduous tooth has thin enamel and long, thin roots). It has been estimated that 9% of dogs have polyodontia.

Dental Interlock

Dental interlock occurs when deciduous teeth erupt in an abnormal pattern that places the upper deciduous canine teeth rostral to the lower deciduous canine teeth, preventing forward growth (Figure 6). The mandible is in effect mechanically locked in place by the upper canine teeth. Approximately 50% of abnormal occlusions in interlock can be corrected if the dental interlock is eliminated. After extraction of the lower deciduous canine and incisor teeth, there are three possibilities: (1) no change, (2) the short arch may grow, or (3) the long arch may grow longer faster! Extracting the deciduous teeth does *not* change the genetic predisposition of the animal.

RETAINED DECIDUOUS TEETH

Retained deciduous teeth are teeth that remain in the dentition along with the permanent teeth (Figure 7). Retained deciduous teeth are known to be a genetic fault in small breed dogs. Occasionally, there will be no permanent tooth bud (this can be determined radiographically and is fairly common in the premolar area of some small breeds), in which case the retained deciduous tooth should not be removed unless it is causing problems.

The crowns of permanent tooth buds form during the first 2 to 5 months of life. All permanent crowns are initially positioned lingual to the deciduous teeth. The upper permanent canine tooth moves so that it lies rostral to its precursor; even at 8 weeks of age, it is just beneath the gingiva in the interdental space.

As the permanent teeth begin to erupt, they normally move into the spaces occupied by the deciduous teeth. The deciduous tooth roots are resorbed, and the crowns are pushed out of position and lost as the permanent teeth emerge. If this sequence of events does not occur, the simultaneous presence of deciduous and permanent dentition predisposes the animal to dental disease. During eruption, however, the incisors and premolars may occasionally become transposed and the permanent tooth may even erupt in an abnormal position relative to the dental arch (upper fourth premolars tend to erupt perpendicular to the dental arch). Most retained deciduous teeth are seen in miniature breeds, although large breed dogs occasionally are presented with retained canine or incisor teeth. Retained teeth should be extracted as soon as possible to allow the permanent teeth to migrate into normal occlusion.

IMPACTED UPPER CANINE TEETH

Seen with increasing frequency in some breeds (such as miniature poodles and Shetland

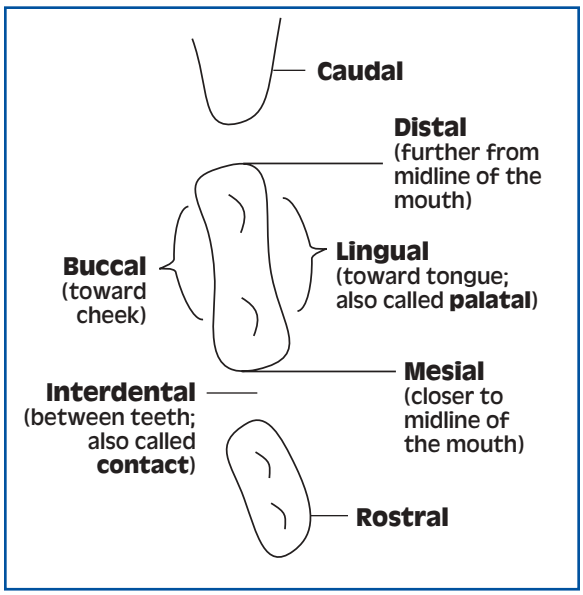


Figure 8. Dental terms relating position of tooth to oral tissues.

sheepdogs) are impacted (or undescended or lance-like) upper canine teeth. Impacted upper canine teeth are genetic in origin (owners of these animals should receive genetic counseling), and they may or may not be found in conjunction with retained deciduous canine teeth.

Impacted/undescended teeth should be extracted or moved into their correct position orthodontically at about 10 months of age (when the facial bone is near maturity). Orthodontic buttons can be cemented onto the clean, acid-etched tips of the undescended canine teeth (or tooth) with a bonding cement such as Resiment™ (HSI #228-0851).* (In an impacted/undescended tooth, the tip is through the gumline. Usually, enough tooth is exposed to cement a button to it; if not, a gingivectomy can be performed to expose more of the tooth.)

An orthodontic button is cemented in a similar manner to the upper fourth premolar and upper first molar on the same side. To prevent unintentional movement of the upper fourth premolar, an orthodontic button can be cemented to the buccal surface of lower molar one. Alternatively, a #2 round bur can be used to burr a hole in the mesial developmental groove, through which a wire can be threaded and twisted to form a loop to anchor the power chain. The chain is attached for 5 days to the upper fourth premolar and then attached for 3 days to the lower first molar.

*HSI numbers indicate order numbers from the Henry Schein catalog for selected products.

Figure 9. Thickening and proliferation of the gingiva are characteristic of gingival hyperplasia, which is a nontumorous lesion of the soft tissue.

Power chain or orthodontic "C" chain (massel chain) is measured from anchor button to canine button without tension. Three spaces are counted back, and the chain is snipped and stretched over the buttons (in a 20 lb dog, there will be about 1 oz of tension). Every 3 days the original chain is shortened by one or two links by the owner to maintain tension as the elasticity decreases. New chain can be measured and changed by the owner each time the anchor tooth is alternated. No visible movement should occur during the first 2 weeks. The canine tooth (or teeth) then moves gradually into its normal position, usually in about 2 to 3 months.

When an undescended canine tooth remains in the alveolus, the patient is predisposed to inapparent oronasal fistula with or without nasal discharge, periodontal disease, or possibly endodontic involvement; tumors may also develop secondary to cells remaining around the unerupted tooth.

BASE-NARROW LOWER CANINE TEETH

Also seen with increasing frequency are base-narrow lower canine teeth, which may be found in conjunction with retained lower deciduous teeth. Base-narrow lower canine teeth are genetic in origin, and owners should be counseled not to breed these animals. In such cases the permanent canine teeth are lingually or mesially (Figure 8) displaced; displacement may occur independently (i.e., not associated with retained deciduous teeth) or as a result of a narrow or short mandible. If left untreated, soft or hard tissue damage may occur and may even result in formation of an oronasal fistula.

Extraction or amputation of the lower canine teeth is not desirable for cosmetic reasons. A palatal appliance, with grooves to guide the lower canine teeth into normal position, works well in directing these teeth into proper alignment between the upper third incisor and upper canine tooth. Sometimes the upper third incisor must be extracted to provide space for the lower canine tooth.

A simple acrylic appliance can be constructed in the oral cavity to correct most cases of base-narrow lower canine teeth. With the patient in dorsal recumbency, the distal aspect of both upper canine teeth is notched slightly with a small dental bur about 2 to 3 mm from the hard palate. A 28 gauge (or other small size wire) is placed in the groove and tied in a figure 8 pattern around the teeth. Any soft tissue defect is filled with ointment. Orthodontic powder (Jet Ortho Acrylic Kit; HSI #125-0630) is sprinkled on and liquid is dropped on to form a pyramid between the upper canine teeth. An ointment-coated cotton swab stick is used to form grooves where the lower canine teeth should slide. (Make sure there is room between the upper canine and upper third incisor teeth for the lower canine to fit.) The pyramid should be built up rapidly, as the acrylic becomes exothermic as it polymerizes. The patient should be extubated to check for the fit of the lower canine teeth against the appliance. Adjustment in the groove can be made with an acrylic lab bur (e.g., HSI #147-7975).

The acrylic should be irrigated with cold tap water and a syringe once exothermia has begun. If the appliance needs modification, the acrylic adheres to itself and more can be added after the original has cooled.

The owner should be instructed to flush under the appliance with a 0.12% chlorhexidine solution using a syringe and tomcat catheter at least twice a day to remove food and debris. To facilitate this, flushing channels can be formed by placing ointment-coated cotton swab sticks between the second and third incisors on the left and right sides while placing the acrylic. These are removed when the acrylic begins to polymerize, leaving the flushing channels. The owner is instructed to hold the pet's mouth closed for 5 minutes at a time three times daily to ensure that the pressure needed to move the teeth is applied consistently. The teeth usually move in 2 to 4 weeks. Some breeds such as the bull terrier may require up to 4 months.

COMMON PATHOLOGIC DISORDERS

Hard Tissue Lesions of the Oral Cavity

Abnormal masses in the mouth can be infectious or cancerous, benign or malignant. Every abnormality should be carefully charted. Biopsy is highly recommended.

Gingival Hyperplasia

Gingival hyperplasia (Figure 9) is a thickening and proliferation of the gingiva as a result of chronic inflammation. This condition is considered to be a nontumorous lesion of the soft tissue. A few breeds are predisposed to gingival hyperplasia, particularly boxers.

Stomatitis

Stomatitis is inflammation of soft tissue of the oral cavity. It can be caused by foreign bodies, chemicals, burns, or immune-related conditions.

In foreign body stomatitis the onset is generally acute, and the animal exhibits signs of considerable oral pain. Anesthesia may be necessary to permit removal of the foreign body, if possible.

Stomatitis that is chemically induced (i.e., secondary to ingesting a substance that is irritating to the mucous membranes) is very painful as

STOMATITIS/KISSING ULCERS: HOME CARE PROGRAM

- Twice daily toothbrushing or swabbing/flushing the oral cavity (alternate Maxi/Guard [Addison Biological Laboratory] and CHX® Guard LA [VR_x])
- Sanitizing food and water bowls daily
- Washing the muzzle (if muzzle is hairy) with an antibacterial soap (e.g., Nolvasan® Scrub [Fort Dodge Laboratories]) two or three times a week
- Giving multivitamin supplements with zinc, B complex vitamins, vitamin E, and vitamin C
- Feeding high quality dry food
- Providing plaque-reducing treats (such as Pedigree® Dentabones™ [Waltham])

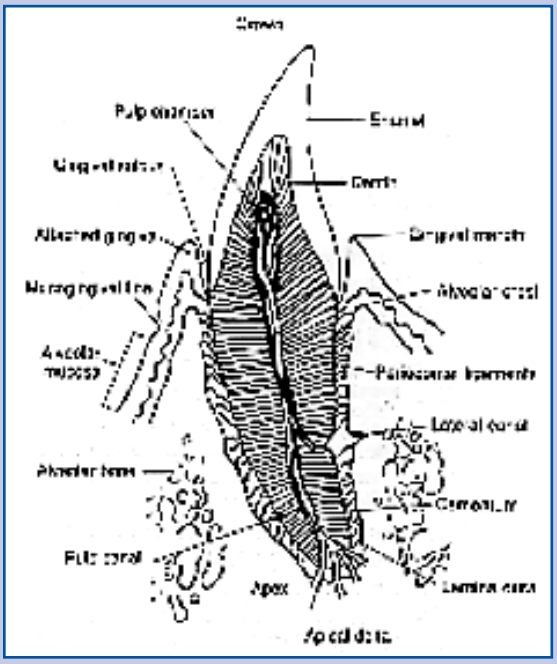
NORMAL TOOTH STRUCTURE

The *crown* of the tooth is covered with *enamel,* which is the hardest body substance. Enamel is formed by ameloblasts. Once enamel is formed and the tooth erupts, the ameloblasts die. At this point the body is unable to repair enamel should it be damaged. Enamel is a crystalline structure of hydroxyapatite that becomes slightly harder with age. Fluoride bonds with the calcium in enamel to make the enamel more resistant to the acidic by-products of the bacteria that cause caries. Dogs are more resistant to caries because the pH of the saliva is more basic than in humans. The canine oral cavity is less conducive to caries formation than slightly more acidic environments (as in humans).

The bulk of the tooth is composed of *dentin.* Harder than bone but not as hard as enamel, dentin is formed by odontoblasts that line the hollow chamber in the center of the tooth. Odontoblasts produce the dentin in a neat tubular arrangement perpendicular to the central chamber, and small odontoblastic processes extend into the dentin and serve as sensory detectors for the tooth. Odontoblasts continue to form dentin after the tooth erupts (secondary dentin), and the center chamber becomes smaller as the tooth ages. Secondary dentin is not organized and is a darker color than is primary dentin, which is slightly yellow. Secondary dentin forms to close the pulp chamber in the crown of the tooth and subsequently to close the root canal in the tooth root. In response to irritation or trauma, tertiary or reparative dentin, which may be quite dark, can form quite rapidly to protect pulpal tissue.

The odontoblasts are nourished by *pulpal tissue,* which enters through the *apical foramen* (root tip of the tooth) that forms slowly as the tooth matures. The apical foramen (single opening) gradually closes, and an *apical delta* (which appears to be a solid tooth) forms. The apical delta has numerous very small canals through which the pulpal tissue now enters the tooth. Occasionally, a lateral canal enters the tooth from the side. Generally, these are of no consequence unless root canal therapy is to be performed.

The *pulp* extends into the crown of the tooth and takes the same general form of the tooth crown. The *endodontic system* is called the *pulp chamber* in the crown of the tooth. In the tooth root, the endodontic system is called the *root canal.*



well. Often only supportive therapy is advisable until the lesions heal.

Electrical burns usually occur when an animal chews on an electrical cord. The tissue may be burned so badly that sloughing of a significant portion of the tongue, hard palate, and mucosa occurs. Occasionally, the extent of tissue loss is life threatening. Debridement and supportive therapy may need to be followed by reconstructive surgery.

Immune-related stomatitis is frustrating for veterinarians and owners and very painful for the patients. Pemphigus vulgaris is probably the most common type identified. Diagnosis is by biopsy of fresh lesions and histologic examination. Michel's fixative as well as formalin-fixed biopsies of fresh lesions should be submitted.

For treatment of stomatitis, I have had positive results with the combined use of home care program (see box on p. 9), judicious use of topical prednisolone and liquid prednisolone in a tapering dose until inflammation is controlled. CHX® Guard LA (VR_x) Maxi/Guard Oral Home Care Gel (Addison Biological Laboratory) and Stomadhex™ (ImmunoVet) are especially helpful. Pain medication such as Rimadyl® (Pfizer Animal Health) is also strongly recommended.

Kissing Ulcers

In my opinion, kissing ulcers (lesions that develop where the alveolar mucosa and a prominent tooth come in contact; Figure 10) are probably secondary to some as yet unidentified

Figure 10. "Kissing" ulcers occur where the buccal mucosa touches a large tooth surface such as the upper canine tooth (shown here on upper fourth premolars).

Figure 11. Malformation of the enamel is known as enamel hypoplasia, a condition that can result from high fever, nutritional deficiency, or parasitism.

immune deficiency. These contact ulcers usually disappear following a thorough basic dental prophylaxis (teeth cleaning) but reappear only a few days to a few weeks later. If plaque can be removed daily from the teeth and no subgingival pockets remain in the mouth, patients can sometimes be managed fairly successfully; however, clients must be educated to follow a comprehensive home care program (see box on p. 9). In addition to the recommendations in the box, owners should ensure that the pet receives frequent dental prophylaxes as needed (in some cases every 2 to 3 months). Various treatments with antibiotics, antiflagylates, autogenous bacterin, and steroids may help some patients; however, good home care is imperative if the patient is to be comfortable over the long term. In many patients with severe or chronic kissing ulcers all teeth in affected areas must be extracted before a decrease in inflammation is evident.

Abnormalities of Tooth Structure

Malformations of the tooth can occur as a result of improper or incomplete development, disease, or an iatrogenic cause. (Normal tooth structure is described in the box on p. 10).

Enamel Hypoplasia

Enamel hypoplasia (malformation of the enamel) is caused by interruption of the cells that form dental enamel during its development in the second to fifth month of age. The condition can be caused by distemper, high fever, nutritional deficiency, severe parasitism, or major stress such as surgery. Clinically, these teeth may not be as strong as normal teeth. The enamel may be irregular, pitted, thinner than normal, or even absent in certain areas (Figure 11), and/or it may be heavily stained.

Recommendations:

- Daily toothbrushing
- Dental prophylaxis as needed
- Weekly application of 0.4% stannous fluoride gel to decrease sensitivity
- Cautions not to use hard chew toys or bones
- Cosmetic restorations, if requested

Gemination

Gemination (splitting of the crown) occurs occasionally during crown development (Figure 12). Generally, no treatment is needed. Plaque can accumulate in the fissure and predispose the gingiva near the tooth to periodontal disease.

Recommendations:

- Daily brushing of affected area
- Cosmetic restoration, if requested

Tetracycline Staining

Tetracycline staining of the teeth occurs if the animal is placed on tetracycline or one of its derivatives while enamel is forming. If the bitch is given tetracycline during gestation, the deciduous teeth of the pup may be stained. Likewise, if a puppy receives tetracycline therapy while enamel is forming on the permanent teeth, staining may result. Structurally, the teeth may or may not be as sound as normal teeth.

Recommendations:

- Daily brushing
- Cosmetic bonding or bleaching, if requested by owner

Figure 12. Although gemination (splitting of the crown) generally requires no treatment, the resultant abnormal fissure can be a haven for plaque accumulation.

Figure 13. The upper fourth premolar is one of the common sites for slab fractures (i.e., one in which the lateral surface of the tooth is removed). Radiographic evaluation is usually required.

Fractures

Teeth often fracture in such a way that the pulp chamber is exposed. The teeth most often fractured are the canine teeth, upper fourth premolars (Figure 13), and incisors. Surprisingly, many dogs do not exhibit obvious pain secondary to the pulpal exposure. An open pulp chamber represents a source of chronic infection, however, and the eventual result will be periapical disease at the root tip.

Not all fractured teeth develop visible draining tracts. Fistulous tracts may drain into the mouth and appear as a red dot at the mucogingival junction or drain through the muzzle skin, as in the case of infraorbital abscess of the upper fourth premolar. Fracture of the canine and premolar teeth can cause swelling of the muzzle as well as infraorbital swelling. Fracture of the molar teeth can cause protrusion of the eye as well as pain and pressure when the mouth is opened. The infection causes pain whether or not visible tracts develop. Tracts can even reduce the pain because the pressure is relieved.

Any tooth that is pink, purple, gray, or black should be radiographed. Even if the tooth is not fractured, the blood supply may have been lost. In such cases the endodontic system will be larger in the affected tooth than in adjacent teeth. A lucent area around the apex indicates the presence of an abscess or diseased bone. If the tooth is pink but no difference is seen in the size of the endodontic system, the damage may be temporary (i.e., like a bruise) or it may not yet be visible radiographically; in such cases patients should be reexamined in 6 months.

Recommendations:

- Endodontic therapy or extraction
- Replacement of abrasive chew items with soft chew toys

Attrition

As a tooth begins to wear, tertiary dentin is exposed and a tan to dark brown dot appears in the center of the worn area (commonly seen in incisors). If sufficient secondary dentin has formed around the pulp chamber, worn teeth will be healthy. If the pulp chamber is open, worn teeth are subjected to the same pathology as fractured teeth. Tertiary dentin in a healthy worn tooth is distinguished from that in an unhealthy worn tooth (i.e., has an open pulp chamber) or a fractured tooth (fractured teeth may also have a black or dark brown center) by gently pulling the tip of an explorer instrument across the dark area. The tip will slide across tertiary dentin if the pulp chamber is sealed but will catch on the sides of an open pulp chamber, which is indicative that the tooth needs endodontic therapy or extraction.

Recommendations:

- Replacement of abrasive or rock-hard chew items with softer chew toys to minimize further wear
- Flea control measures, if appropriate

Inapparent Oronasal Fistula

Traditionally, an oronasal fistula is a hole between the mouth and nasal passage, which remains after an upper canine tooth is lost or extracted. The pet may show signs of distress such as sneezing when eating or drinking; however, infection is usually not present.

Figure 14. This patient presents a characteristic sign of inapparent oronasal fistula (that is, frequent licking of nasal discharge). Note the purple hue to the upper canine tooth.

Inapparent oronasal fistula occurs when the upper canine tooth is still in place in the mouth (Figure 14). The tooth may not even be loose on palpation. The patient may have a unilateral or bilateral nasal discharge, sneeze frequently, or be asymptomatic.

Diagnosis of inapparent oronasal fistula is confirmed by anesthetizing the patient and examining the gingival sulcus using a periodontal probe (see p. 22). As the probe is moved within the gingival sulcus, it drops into a very deep pocket on the medial (palatal) aspect of the upper canine tooth. A drop of blood may trickle from the unilateral nostril. If the pocket is flushed and solution drains from the unilateral nostril, inapparent oronasal fistula is confirmed.

Recommendations:

- Extraction of the affected tooth with primary closure or closure at a later date (after the infection has cleared)
- In a young dog (e.g., a 5-year-old Yorkshire terrier) a perioceutic such as Heska™ Periodontal Disease Therapeutic should be tried at least once if the owner has a "dental conscience" and will comply with home care and repeat prophylaxis every 6 months

Caries

Caries occasionally occur, most often as scooped out lesions on the occlusal surfaces of molar teeth in dogs. The explorer tip will catch or stick in the soft tissue of a decayed tooth. Subgingival caries may also be present at or underneath the gingival margin in dogs. Likewise, resorption of tooth roots can occur within periodontal pockets; these lesions are radiographically evident as lucencies, but the tissue within them is hard, not sticky, as is the case in a caries. A slab fracture into an open pulp chamber of an upper fourth premolar could be mistaken for a caries; a portion of the crown of the tooth will be missing, however.

Recommendations:

- Restoration using standard techniques such as preparation and amalgam or posterior composite restoration as long as the lesion does not involve the pulp (this would require endodontic therapy)
- Extraction may be treatment of choice (usually caries occur on upper and lower molars)

Periodontal Disease

Periodontal disease is inflammation of the tissue surrounding and supporting the teeth: the free gingival margin, attached gingiva, periodontal ligaments, and alveolus or bony socket. Periodontal disease is caused by plaque, a soft, sticky film of bacteria, food and debris, and salivary glycoproteins that attach to the tooth surface near the gingival margin.

The by-products of bacterial metabolism irritate gingival tissue and begin a chain reaction that, if unchecked, can lead to dental disease and, possibly, systemic disease. Plaque can mineralize into calculus in as little as 48 to 72 hours if not removed. Plaque also covers the irregular surface of calculus. Calculus mechanically irritates the gingiva.

The two active phases of periodontal disease are gingivitis, which is reversible, and periodontitis, which produces irreversible changes (Figure 15).

Gingivitis

In cases of gingivitis the bacterial population generally consists of nonmotile, gram-positive, aerobic cocci. No irreversible changes have occurred to tissue surrounding the teeth. The patient will have halitosis or bad breath, plaque on the teeth, perhaps some calculus, and slightly to significantly erythematous gingival margins that bleed easily and are edematous.

Clinically, the acute phase of gingivitis may be missed entirely (Figure 16) because the patient was not presented during this time or the gingivitis was not noticed by the owner or clinician.

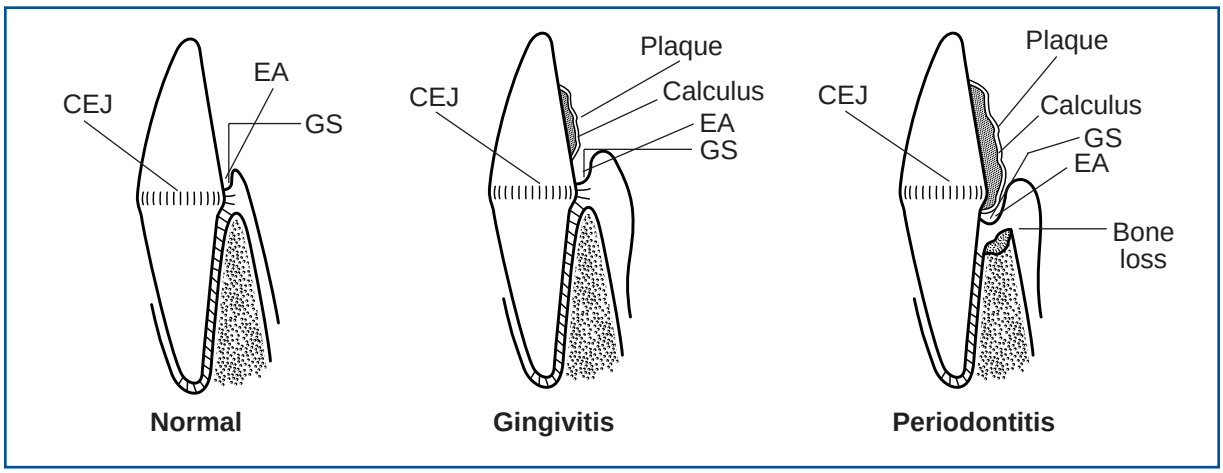


Figure 15. Progression of periodontal disease. CEJ = cementoenamel junction; EA = epithelial attachment; GS = gingival sulcus.

As gingivitis becomes chronic (Figure 17), fibrosis of the gingival tissue may occur and the inflamed gingival margin disappears. In general, the smaller breeds seem to develop gingivitis at a young age—in many cases younger than 1 year of age.

Gingivitis is treated by removing the plaque and calculus that have accumulated on the teeth. Gingival pockets may develop secondary to edema. These resolve after treatment for gingivitis. If fibrosis is present and the pocket does not resolve, a gingivectomy may be required.

Fibrotic gingiva does not disappear. The inflammation, edema, and halitosis that signal the presence of gingivitis, however, will be gone.

Recommendations:

- Prophylaxis and polish
- Daily home care with a product such as C.E.T.® enzymatic toothpaste (VR_x) or Maxi/Guard Oral Cleansing Gel (Addison Biological Laboratory)
- Hard rubber chew toys such as Hercules Gel® (Nylabone) and Kong® toys (The Kong Company), which may help remove some plaque and keep periodontal ligaments strong

Periodontitis

If gingivitis is not treated, periodontitis is likely to develop. The time span from development of gingivitis to development of periodontitis is variable. In as few as 2 weeks the organisms can change from those that cause gingivitis to the primarily motile, gram-negative, anaerobic rods that cause periodontitis. This irreversible phase of periodontal disease can begin at 4 to 6 years of age. Clinically, the disease often is evident earlier in the miniature breeds.

Periodontitis apparently develops after untreated gingivitis has allowed organisms to penetrate the gingival sulcus and marginal tissue (Figure 18). Endotoxins cause migration of the epithelial attachment from the cementoenamel junction toward the root tip of the tooth. As peri-

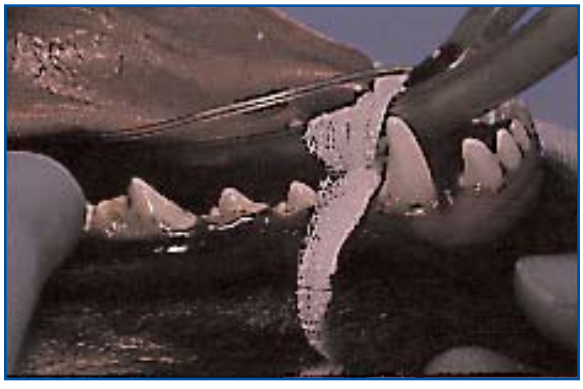


Figure 16. Example of a mild case of acute gingivitis, which can often go unnoticed.

Figure 17. Example of chronic gingivitis. Note the fibrosis but absence of inflammation around the gingival margin.

Figure 18A

Figure 18B

Figure 18. (**A**) A greyhound with moderate to severe periodontitis. Note the horizontal gingival recession and bone loss leaving exposed roots. (**B**) A chihuahua with severe periodontitis. The animal had a grade VI systolic murmur and was in renal failure.

odontitis progresses, periodontal ligaments attaching the tooth to the alveolar socket are destroyed and the alveolar crestal bone surrounding the tooth begins to be resorbed. Formation of periodontal pockets begins to occur when the original epithelial attachment moves toward the root tip.

If periodontitis is allowed to progress untreated, the tooth is eventually lost; as a result, however, the oral tissue returns to a healthy state. When a tooth is surrounded by periodontitis, the affected tooth seems to be treated as if it were a foreign body; the sooner the tooth is rejected, the more quickly recovery can occur. Unfortunately, for many patients, periodontitis can exist around one or more teeth for years. All stages of oral health—normal, healthy gingiva, gingivitis, and periodontitis (see Figure 15)—can exist in the same mouth simultaneously.

The extent of treatment for periodontitis will vary because of periodontal pockets. The epithelial attachment has migrated apically, and periodontal ligament attachment is lost. Resorption of bone can occur with periodontitis. The degree of attachment loss may range from mild to severe (i.e., tooth loss).

Plaque begins to form subgingivally as periodontitis develops and mineralizes to form subgingival calculus. Subgingival calculus can be removed with powered scalers or a hand curette. The root surface should be smoothed by root planing until it is glassy smooth and hard; the smoothness of the surface can be assessed by using an explorer tip against the root surface around all aspects of the pocket.

If a periodontal pocket is more than 4 to 5 mm deep, a periodontal flap procedure should be performed by a trained veterinarian so that the tooth root or roots can be adequately visualized. An envelope flap, however, may be sufficient to treat many periodontal pockets (Figure 19). A periosteal elevator, such as the ST7 (Schein), can be inserted into the pocket and gently moved apically past the pocket apex. The gingival tissue may expand enough so that the diseased root surface can be clearly seen and cleaned without making an incision. These procedures are well described in many veterinary dental textbooks.* Heska™ Periodontal Disease Therapeutic (Heska Corp. [Fort Collins, CO]) is a long-acting time-released doxycycline polymer for use in treating periodontal pockets. After cleaning, the material is packed into the pockets and the tissue closed. The material stimulates tissue reattachment and

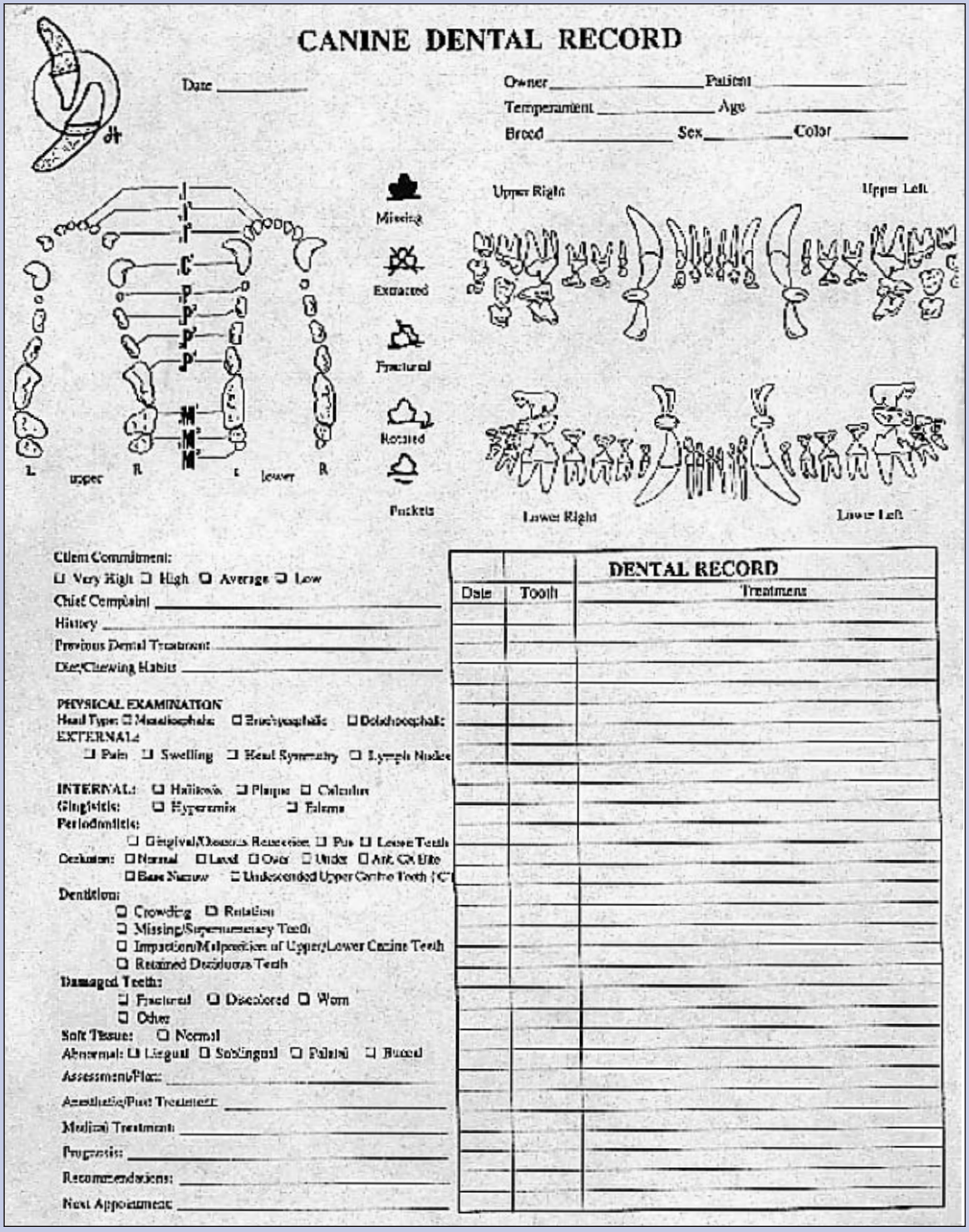
Figure 19. An envelope flap can be gently elevated to help visualize vertical periodontal pockets.

*Suggested readings include Wiggs and Lobprise's *Veterinary Dentistry: Principles and Practice*, Emily and Penman's *Handbook of Small Animal Dentistry*, and Harvey and Emily's *Small Animal Dentistry* (see p. 27).

DENTAL CHARTING SYSTEMS

Anatomic System

The anatomic system designates the teeth as follows: I for incisor, C for canine, P for premolar, and M for molar. The tooth number (1 to 4) and quadrant are then designated by placing the number as a superscript or subscript in the appropriate quadrant around the letter designation.



DENTAL CHARTING SYSTEMS (cont.)

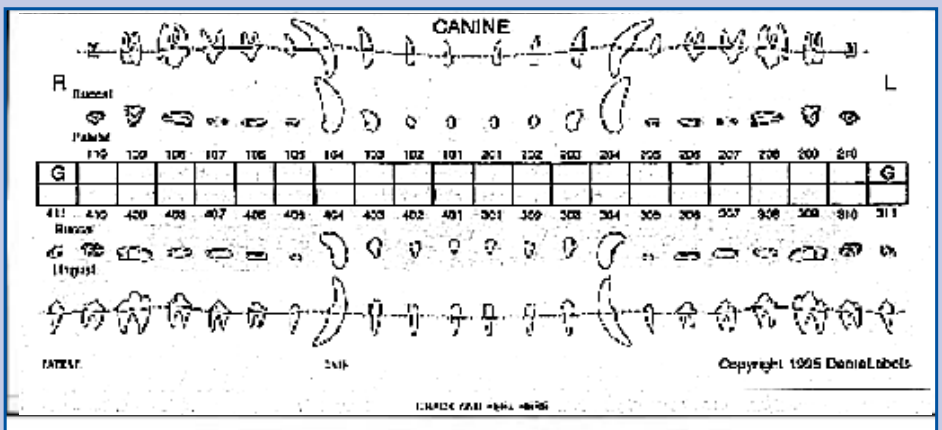
Triadan System

In the Triadan system (DentaLabels) a three digit number is assigned to each tooth. Each quadrant is indicated by the first number:

	Permanent Dentition	*Deciduous Dentition*
Upper right	100	500
Upper left	200	600
Lower left	300	700
Lower right	400	800

For dogs each tooth is designated by the following numbers:

Incisors = 1, 2, 3 Premolar teeth = 5, 6, 7, 8
Canine teeth = 4 Molar teeth = 9, 10, 11



DentaLabels **CODE KEY**

CA	Carious Lesion	**GR**	Gum Recession	**RP**	Retained Primary Tooth
CR	Crowding	**H**	Hyperplasia (Gingival)	**RR**	Retained Root
C/S	Calculus/Slight	**M**	Mobile Tooth (M_1, M_2, M_3)	**RT**	Root Canal Therapy
C/M	Calculus/Moderate	**N**	Neck (Resorptive) Lesion	**R/A**	Restoration/Amalgam
C/H	Calculus/Heavy	**O**	Missing Tooth	**R/C**	Restoration/Composite
D	Discolored Tooth	**OD**	Odontoplasty	**R/I**	Restoration/Glass Ionomer
E	Enamel Defect	**PE**	Pulp Exposure	**V**	Vital Pulpotomy
EP	Epulis	**PU**	Pulpitis	**W**	Worn Tooth
F	Furcation Exposure (F_1, F_2, F_3)	**R**	Rotated Tooth	**WF**	Wear Facet
FX	Fractured Tooth	**RD**	Reparative Dentin	**X**	Extracted Tooth

GINGIVITIS BOX SCORES

I = Thin red gingival line, no bleeding
II = Moderate swelling, "rolled" gingiva, some bleeding
III = Marked swelling, bleeds easily, early pocket formation

DentaLabels **CHARTING TIPS**

DentaLabels **Stick-On Veterinary Dental Charts** have been designed to bring **state-of-the-art** charting to every practice. Thorough charting is an essential part of documenting your findings and following the progress of your treatment.

These tips will help you chart in less than five minutes. For examples, refer to the **Demonstration Chart** and the **Code Key**. Remember — you can devise your own symbols or codes if you prefer.

- Write on chart before affixing it to patient's record
- Refer to teeth by their "Modified Triadan" number (printed on chart) when speaking and writing
- Be systematic — Begin with upper central incisor (101 or 201) Proceed toward back of mouth (101, 102 . . . 110)
- Chart each tooth completely (including Gingivitis Box Score) before moving to next tooth
- Use side (buccal) view to record most pathology. No pathology — No notation
- Use top (occlusal) view to record periodontal pocket measurements
- Make at least four perio measurements — write numbers on chart at site of measurement
- Put an O around a missing tooth
- Put an X through an extracted tooth
- Two person charting is fastest — One to examine, one to chart

CHARTING SYMBOLS

Standard charting symbols include the following:

- Missing teeth are blacked out
- Extracted teeth are marked with an "X"
- Fractured teeth (or those with open pulp chambers) are indicated by a zigzag mark
- Worn teeth with closed chambers are represented by a straight horizontal line
- Periodontal pockets are identified with a closing parenthesis in the area of the pocket
- Carious lesions are identified by a bull's-eye.

This quick visual shorthand on the graphic record is not meant as a substitute for a written record. The Triadan system (DentaLabels) has an extensive list of abbreviations (see p. 17).

is biosorbable, a real plus for the veterinary profession.

Treating periodontal disease to save as many teeth as possible is a lifetime commitment. If an owner is not committed to aggressive therapy, affected teeth should be extracted to avoid chronic infection.

Recommendations:

- Thorough prophylaxis, polish, and root planing
- Heska™ Periodontal Disease Therapeutic

RECORDKEEPING: THE DENTAL CHART

It is imperative to memorize the dental formulas (deciduous and permanent) for dogs as well as each tooth's position in the arch so that accurate dental records can be maintained. Accurate recordkeeping is essential to assess periodontal therapy results, to note potential problem areas, and for legal protection of the clinic (20% of all claims filed against veterinarians are a result of poor recordkeeping).* Examples of two charting systems are shown in the box on pp. 16–17.

Preferably, the dental chart is kept as a cumulative record in each patient chart, thereby encouraging initiation of a treatment plan and ease of follow-up therapy. Rubber stamps and peel-off stickers can be used (bigger is better) for dental charting.

*AVMA Professional Liability Insurance Trust.

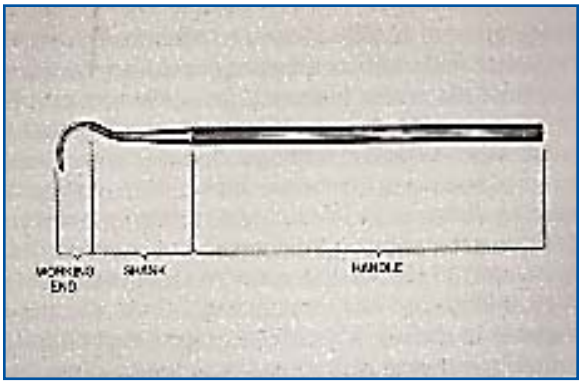


Figure 20. The basic hand instrument.

EQUIPMENT FOR PROPHYLAXIS

Hand Instrument Kit

Three instruments are included in the basic prophylaxis kit: an explorer/periodontal probe, a Jacquette 2/3 modified curved sickle scaler, and a McCall's Starlight 13/14 curette. Hand instruments have three parts (Figure 20): a handle, a shank, and a working end (tip). I use double-ended instruments. Two have mirror image working ends that allow the operator to work around one side of the tooth, turn the instrument end for end, and work around the other side of the tooth.

Proper Instrument Care

Dull instruments fatigue the operator, burnish calculus on the tooth surface, especially the root, and impair healing of periodontal pockets. Therefore all instruments should be cleaned and the scaler and curette sharpened after each use. Instruments should always be cleaned again after sharpening. For sharpening, use a #299 conical sharpening stone, oilstone oil, and a lens loupe (magnifier). The work area should be well lit.

The curved instrument should be placed in the left hand with the long axis perpendicular to your body and the tip pointing up. The flat facial surface will be horizontal to your body. The lightly oiled sharpening stone should be placed in the right hand perpendicular to the instrument face and parallel to your body and held so that all fingers are on one side and the thumb is on the other, thus allowing the stone to roll between the fingertips and thumb (Figure 21). As the stone is rolled between the fingers, it is brought in contact with the instrument face. Using gentle, even pressure, the hand follows the rotation of the

Figure 21. Proper technique for using an oiled sharpening stone.

Figure 22. Cleaned, sharpened instruments should be placed in their respective instrument trays along with gauze sponges.

instrument tip so that the stone is turned against the curved face of the instrument in a rotate and stop, rotate and stop motion. If this curve is not followed, the tip of the instrument becomes worn. If the instrument has been sharpened regularly, only about 10 to 15 seconds of sharpening strokes are needed on each tip to keep the edges sharp.

After sharpening the instrument, wipe the tip to remove any metal fragments and test the cutting edge for sharpness on an acrylic sharpening stick or acrylic toothbrush handle. If small shavings can be pulled from the stick or handle using a short pulling stroke, the cutting edge is sharp.

The cleaned, sharpened instruments should be placed in their instrument trays and covered with six or seven gauze sponges (Figure 22). Each tray should be wrapped and autoclaved. Every 3 to 4 weeks, instruments should be sharpened using a flat Arkansas stone and oilstone oil to reestablish the correct side angles. The instrument should be positioned so that the heel of the tip touches the stone, closing the angle until the facial angle also touches the stone. Use short, light pull strokes and make sure the cutting angle of the instrument does not change during sharpening. On the last few strokes, roll the toe of the curette so that any metal knurls are removed. A dental hygienist can teach you the finer points of flat stone sharpening.

Powered Scalers

The ultrasonic scaler has long been the most commonly used powered scaler for the removal of supragingival and subgingival plaque and calculus.

Powered scalers are either magnetorestrictive or piezoelectric. Piezoelectric scalers have a vibrating quartz crystal and, although smaller and easier to handle, are more fragile than other scalers. Magnetization scalers are the most common scalers seen in veterinary medicine. The older models contain a ferromagnetic stack (e.g., Cavitrons), and the newer ones (e.g., Odontoson™ [GOOF, Horsholm, Denmark]) contain a ferrite rod. The traditional tip size is 3 mm; the Odontoson™ has a 13 mm active tip. All ultrasonic scalers mechanically remove plaque and calculus by movement of the tip and by cavitration (flow of energized water that cools and flushes debris). Many of these units require adjustment of the power and the water. Frequency on most units is permanently set at 30,000 cycles per second or less; the Odontoson™ is set at about 40,000 cycles per second.

To adjust a Cavitron, turn the unit on and turn the power and water to the lowest setting. Increase the water flow until it reaches 20 drops/minute. Adjust the power setting until all the drops of water are atomized. Ideally, the power should not need to be more than two thirds "on" to atomize all the water. This flow is probably the minimum required to keep the handle and tip cool.*

Next, continue to adjust the power so that the unit is fracturing calculus away from the tooth when light to moderate pressure is

*If the power is fully "on" and all the water drops are not atomized, there may be a broken or bent stack, worn or bent tips, or another problem in the unit itself.

What the Settings Mean

Frequency is the number of times the tip moves per second.
Power controls the distance the tip moves.

ADVANTAGES AND DISADVANTAGES OF SCALERS

Scaler	*Advantages*	*Disadvantages*
Ultrasonic		
Piezoelectric units	Reasonably priced, not readily available	Not as sturdy as other units
Cavitron-like units	Reasonable frequencies Wide price range	Relatively high amount of heat generated can damage sensitive tooth pulp Units should not be used subgingivally without subgingival tips
Odontoson	Lighter in weight and faster than other units Minimal heat generated Longer tip for greater tooth contact Separate ultraslim tip for subgingival scaling	High cost
Sonic/Subsonic	Tips run cooler than ultrasonic units—less risk of tooth damage Can be used safely subgingivally for 5–6 seconds/tooth Convenient—hooks up to high speed line; no need to pump up water tank for pressure Reasonably priced	Slightly longer time needed for prophylaxis (lower frequency) High pitch noise may bother some operators

employed as the side of the tip is in contact with the tooth. This will vary a bit between different operators.

The correct technique for using an ultrasonic scaler is a light sweeping stroke across the tooth surface using the *side* of the tip of the instrument (Figure 23). Using the tip of the instrument against the tooth produces a jackhammer effect and can cause significant enamel damage. Scaling should be limited to 15 consecutive seconds per tooth to prevent possible heat buildup inside the tooth and secondary damage to the delicate pulp tissue within the tooth (pulpitis). The ultrasonic scaler should not be used subgingivally because of possible thermal damage to the lining of the gum tissue and deep etching of the cemental covering of the root unless a slimline tip for subgingival scaling is used. The handle of an ultrasonic scaler may become quite hot during a prolonged dental prophylaxis; the tip becomes even hotter.

Many clinics have a combination unit with an ultrasonic scaler and polisher. Some of the polishers have detachable heads to allow use of a latch-type accessory head or a straight nose cone head for sectioning teeth or for odontoplasties or alveoloplasties. The latch-type or right angle head accepts burs with an RA (right angle) designation. The straight nose cone accepts HP (handpiece) burs. The field needs to be manually irrigated when using these burs. Using these designations allows the purchase of various burs from a dental catalog vs. only replacement burs from a starter kit. Speed is usually adjustable for the low speed motor. Around 3,500 rpm should be used for polishing and up to 30,000 rpm for sectioning teeth.

Sonic and subsonic scalers (e.g., Titan-SW® Scaler [Star Dental]) have become popular with some veterinary dentists. Because sonic and subsonic scalers operate at speeds less than 20,000 cycles per second (and, in reality, probably more like 5,000 to 6,000 cycles per second), more time is needed to scale teeth than when using an ultrasonic scaler. Sonic and subsonic scalers run on an air/water line. By definition, this is the high speed line of an air-driven dental unit. Ideally, air pressure should be a minimum of 40 psi for the scaler to work properly. An adjustment may be needed in the airline pressure. It may take slightly longer to scale teeth with a sonic or subsonic scaler, which can slightly increase the cost and anesthetic risk.

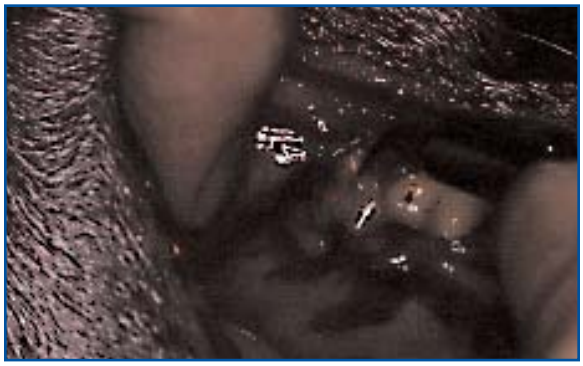


Figure 23. Incorrect use of an ultrasonic scaler. The *side* of the tip and not the *end* of the tip should be used to clean teeth properly. Note: Current research indicates that it is imperative for operator to wear gloves, mask, and protective eyewear at all times when working in dog's mouth.

CAUTIONS

Of increasing concern in the human and veterinary dental fields is infectious disease transmission between patients by contaminated handpieces, burs, and prophylaxis angles. One reason this problem occurs is that dental handpieces may not always be sterilized between patients. One veterinary dental unit is designed to reduce this possibility. The iM3® (iM3®) has a moment button that releases 3 ml of CLS™ (see p. 25) from a reservoir into the air lines. When the handpiece is activated, the CLS™ (a 0.12% chlorhexidine solution approved for use in the unit) flows through the airline and handpiece to clean and disinfect both, capturing any remainder in a suction bottle with a 3µ 3M™ (3M Co.) filter. The iM3® is an air-driven dental unit and has this feature for the high speed lines and three-way air/water syringe.

Air-Driven Dental Units

Air-driven dental units are rapidly replacing ultrasonic scalers and polishers in clinics in which dentistry is becoming a focus of pet health. Air-driven units are equipped with an air compressor that is in a remote location (if the compressor is noisy) or is base mounted (if the compressor is quiet) to power the high and low speed handpieces. Compressed air tanks also may be used. Air-driven dental units have a water reservoir to supply water to the high speed handpiece and three-way air/water syringe. Distilled water is recommended for use in the water reservoir to extend the life of the high speed handpiece by decreasing mineral deposit buildup in the tiny water inlet tube. The high speed handpiece is designed to run at up to 400,000 rpm. The low speed handpiece operates at speeds up to 20,000 rpm in forward (right) or reverse (left) on some handpieces; directional speeds are controlled on the handpiece. A nose cone such as the 4:1 gear reduction green prophylactic nose cone reduces the prophylactic cup speed to 5,000 rpm while the motor runs at 20,000 rpm; the blue 1:1 nose cone (used for sectioning) produces 20,000 rpm at the attachment or bur.

Air compressors and air-driven dental units (some of which are run by compressed nitrogen) require special maintenance. The oil in the air compressor should be checked daily. The air compressor oil recommended by the manufacturer should be used and changed when recommended. (Car oil contains detergents that foam and may cause excess oil to spill into the air reservoir tank.) The air reservoir tank has a drain plug and should be drained at least every month to expel moisture (condensation) and any oil that may have spilled into the reservoir.

Pressure of the high speed handpiece is usually adjusted to 30 psi at full speed. Manufacturer recommendations on the care and maintenance of all equipment should be followed to ensure better service and to maintain warranty.

A number of high speed handpieces are available for use with air-driven units: handpieces that require a chuck to tighten the friction grip bur; pushbutton handpieces; and latch-type handpieces; handpieces that have a swivel base; handpieces equipped with microheads; and handpieces with a 45 degree angle to the head. Fiberoptic handpieces are equipped with one or two lights to illuminate the work area. Each type of handpiece has advantages and disadvantages. For example, a pushbutton, swivel, fiberoptic handpiece provides superior visibility and ease of handling and is my choice of handpieces; it is also one of the most expensive. An in-line oil and water filter should be added (if it is not standard) between the air reservoir tank and the fiberoptic handpiece, as moisture and oil will significantly shorten the life span of the handpiece and interfere with composite bonding materials. Most high and low speed handpieces can be steam sterilized, although manufacturer recommendations must be followed.

At the end of the workday, the air compressor should be turned off and disconnected if feasible. The pressure in the air reservoir tank should be

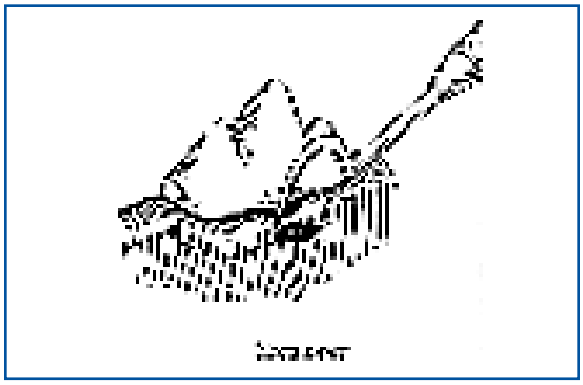


Figure 24. Explorer tip within gingival sulcus.

released (to room pressure, "0") and the pressure in the water reservoir dissipated. Such preventive measures keep the unit in good working order for long periods.

Daily maintenance of handpieces significantly increases the life span of the units. The smaller of the two large holes of the handpiece (high speed, low speed, or sonic) is the air drive hole where the handpiece lubricant is applied. The handpiece is run for about 1 minute with a bur or bur blank in place every day it is used. The directions on the care and use of all dental equipment should be read carefully. If in doubt, call the distributor or manufacturer for more information.

THE BASIC DENTAL PROPHYLAXIS

Dental prophylaxis (teeth cleaning) consists of the following:

Basic Steps

- Brushing
- Charting the teeth
- Removing plaque and calculus from supragingival and subgingival tooth surfaces (and between roots)
- Root planing the tooth roots and performing subgingival curettage
- Polishing the teeth
- Flushing away all debris (irrigation)
- Drying the teeth
- Applying 1.23% acidulated phosphate fluoride gel and wiping it away after 4 minutes

Special Options

- Formulating a periodontal disease treatment plan
- Periodontal flap surgery
- Extractions
- Hemisection
- Root canal
- Pulpotomy
- Odontoplasty
- Alveoplasty

Client commitment to follow-up dental care (including expense) must be determined before the treatment plan is executed. *If the owner is not willing or able to reschedule the patient for repeat dental prophylaxes every 6 months or so and provide daily home care, many otherwise salvageable teeth should be extracted to prevent chronic infection.*

The basic steps of exploring and probing the gingival sulcus, removing calculus, polishing, and flushing take about 25 minutes for a patient with minimal dental disease (mild gingivitis) under optimal working conditions. Patients with extensive dental disease may require 1½ to 2 hours or more of treatment. To perform the initial steps of exploring/probing, scaling, and polishing, the technician should adopt a routine: front to back upper and lower buccal arches and opposite lingual arches are checked, cleaned, and (if disease is minimal) polished at that time; the patient can then be turned and the routine repeated. Remember that the endotracheal tube should be disconnected and reconnected each time the patient is repositioned to decrease tracheal irritation and possible kinking of the tube.

There are many types of dental hand instruments; the use of only the three basic ones mentioned in the equipment section (see p. 18) is described here. The explorer/periodontal probe is a double-ended instrument used to examine the gingival sulcus. To examine the tooth surface within the gingival sulcus, the explorer is held with a feather grasp. A gentle grasp permits tiny vibrations to be felt as the explorer tip (shepherd's hook) is moved across hidden irregularities on the tooth (usually root) surface and within the gingival sulcus (Figure 24), which should be examined each time a prophylaxis is performed. Such detailed examination is invaluable in the detection of subgingival calculus and erosions in the canine patient (HSI #100-0805).

On the opposite end of the explorer is the periodontal probe. The Probex 1/23 explorer/periodontal probe is calibrated in increments of 1, 2, 3, 5, 7, 8, and 9 mm. The probe is inserted gently into

Figure 25. Periodontal probe inserted into gingival sulcus.

Figure 26. The Jacquette 2/3 scaler is used to remove supragingival calculus from the tooth crown.

the gingival sulcus parallel to the long axis of the tooth and moved within the sulcus (Figure 25) to measure gingival sulcus depth all the way around each tooth and thereby detect any variation in depth that might indicate pathologic involvement (e.g., periodontal pocket). At least six measurements should be made. The explorer/probe is used throughout the prophylaxis to assess the subgingival area. Some periodontal probes have color-coded rings of certain widths (usually 3 mm) that facilitate reading pocket depths.

The angle of the periodontal probe where it joins the shank can be positioned against a tooth to test for mobility. If movement is believed to be excessive (remember that some movement is normal), an adjacent tooth should be tested. In many miniature and brachycephalic breeds the lower incisors may not be in individual bony sockets but may be suspended in connective tissue and be quite mobile normally. These teeth can be distinguished from unhealthy teeth by measuring the depth of the gingival sulcus and exploring for subgingival calculus. Disease, such as renal or nutritional disease secondary to hyperparathyroidism, can cause calcium resorption from the arch and can also render teeth mobile.

The Jacquette 2/3 scaler (HSI #100-9848), a hand instrument used to remove supragingival calculus from the tooth crown, is a mirror image, double-ended modified curved sickle scaler (Figure 26). The triangular cross-section and sharp tip immediately identify this instrument as one to be used only on the tooth crown. A firm modified pen grasp is used by positioning the thumb and index finger to hold the instrument at the junction of the handle (central section) and the shank (thin, curved section; Figure 27). The pad of the middle finger is placed firmly against the

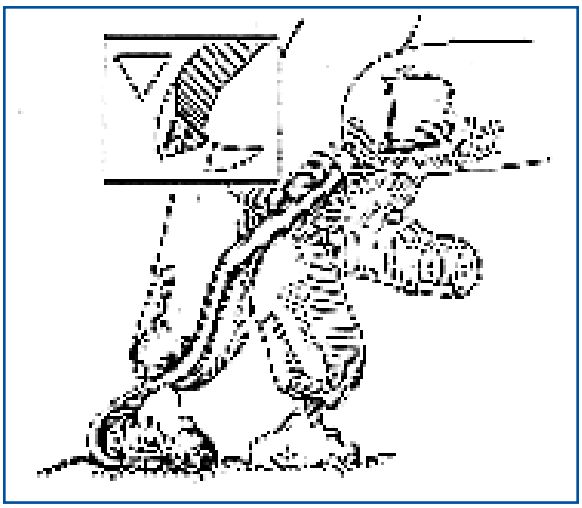


Figure 27. Scaler held in modified pen grasp.

shank as close to the working tip as possible. The ring finger is placed on a tooth or firm structure nearby to serve as a fulcrum.

The instrument is placed so that the inside curve of the tip conforms closely to the curve of the tooth. The cutting edge is placed beneath the calculus, the angle is closed to 45 to 90 degrees to the tooth surface (the tendency to pull parallel to the tooth surface results in an inefficient cutting angle), and a sharp, firm pulling stroke is used to dislodge the calculus. The instrument must be gripped tightly enough to blanch the fingertips slightly; otherwise, the pulling force will not be sufficient to remove the calculus. The tip of the Jacquette 2/3 scaler can be used to clean between incisor teeth and the contact points of molar teeth. Supragingival scaling can be supplemented by using ultrasonic, sonic, subsonic, rotosonic, or the Odontoson™ ultrasonic scaler.

After supragingival calculus has been removed, subgingival calculus is removed. Ultra-

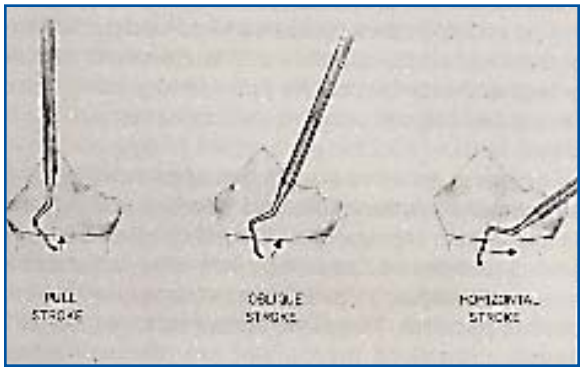


Figure 28. The McCall's Starlight 13/14 curette is an atraumatic instrument for use within the gingival sulcus.

Figure 29. Subgingival curettage is removal of diseased lining of the gingival sulcus.

sonic scalers fitted with slim subgingival tips or sonic or subsonic scalers can be used for preliminary removal of subgingival calculus and are followed by use of hand curettes. Hand curettes can be used for the entire subgingival phase of the dental prophylaxis. The explorer is used to determine whether removal of subgingival calculus is complete.

The McCall's Starlight 13/14 (HSI #808-9066) curette (my favorite) is a half-moon in cross-section and has a smooth rounded toe (Figure 28). This gently curved instrument can be immediately identified as an atraumatic instrument for subgingival calculus removal for 4 to 5 mm pockets. A modified pen grasp is used to hold a curette. The toe (tip) of the instrument is inserted gently into the gingival sulcus, the blade is positioned underneath the calculus and closed to a 45 to 90 degree angle to the tooth surface, and a sharp, firm pulling stroke is used to dislodge the calculus (a pushing stroke is never used). After all subgingival calculus (which is often black) has been removed, the surface is root planed.

Root planing, performed with a curette, consists of using 10 to 20 short overlapping horizontal, oblique, or pulling strokes over the same area until the surface of the root is glassy smooth. The entire pocket is root planed. All areas within the pocket area are rechecked with the explorer tip and by visual examination of the root surface while a stream of compressed air is directed into the gingival sulcus. Small pieces of missed calculus show up as white specks. Inadequate root planing is the most common mistake made in treating periodontal disease. Intermittent flushing with 0.12% chlorhexidine is beneficial to the tissues.

Figure 30. A rubber polishing cup smooths any irregularities.

Subgingival curettage (removal of diseased lining of the gingival sulcus) is partially accomplished during root planing (Figure 29). If the patient has a history of refractory periodontal disease, however, an effort should be made to denude the sulcular lining. The easiest, fastest, and safest way to complete subgingival curettage is by using a safe-tip diamond curettage bur (iM3 FG Bur Kit) in a high speed handpiece. Alternatively, the cutting (closed angle) edge of the curette is turned toward the sulcus lining. The index finger is pressed against the gum directly over the pocket area. Firm pressure is applied as the curette is scraped against the sulcular lining for at least 10 strokes, which should be sufficient to remove any necrotic debris attached to the sulcular lining.

An integral part of the dental prophylaxis is polishing the teeth. Polishing decreases the surface area of the tooth by smoothing any irregularities just as sanding smooths a piece of wood. Plaque does not accumulate as rapidly on nor does calculus attach as firmly to a smooth tooth surface.

CHLORHEXIDINE SOLUTIONS

- A 0.12% chlorhexidine gluconate solution can be made by adding 15 ml of Chlorhexiderm™ (DVM Pharmaceuticals) to 1 gallon of distilled water. It is used for manual irrigation.
- CLS™ (iM3), a 0.12% chlorhexidine gluconate concentrate with cutting and lubricating properties, is designed for use in the iM3® dental unit or with manual irrigation. It has a mint fragrance.
- CHX® (VR_x) is a 0.12% chlorhexidine gluconate concentrate that does not need to be diluted. It is used for manual irrigation.

A rubber polishing cup on a prophylaxis angle in a low speed handpiece can be used to polish the teeth (Figure 30). The speed of the handpiece should be between 3500 and 8000 rpm; light pressure (enough to flare the polishing cup) should be applied for 5 to 7 seconds per tooth for a maximum of 15 seconds. More than 5 or 6 seconds, firmer pressure, or an inadequate amount of prophylactic paste can cause heat buildup and subsequent damage to the pulp. Commercially prepared prophylactic paste can be used. The appropriate amount should be removed from the jar or tube with a clean tongue depressor to prevent contamination of the remainder of the paste. A small amount of fine or flour grit pumice can be made into a fairly thick paste by adding water or 0.12% chlorhexidine (10:1) solution. Chlorhexidine ruptures bacterial cell walls and bonds to the mucous membrane, which prohibits the attachment of bacteria to tissue for up to 24 hours. Fluoride interferes with this bonding mechanism, and many commercial prophylaxis pastes contain fluoride. This is one reason I prefer pumice powder. If the prophylaxis paste is spread evenly over the teeth and the polishing cup applied, there is less tendency to spatter the paste. The area within the gingival sulcus and exposed root surfaces should also be polished. Many veterinarians use a new disposable prophylactic angle for each prophylactic procedure to prevent disease transmission.

After the entire surface of all teeth is cleaned and polished, the oral cavity (including the gingival sulcus) is thoroughly irrigated (Figure 31) with a 0.12% chlorhexidine solution (see box above). A three-way air/water syringe or 30 ml syringe with a blunt 18 gauge needle is used to flush away the debris, especially from the gingival sulcus.

Figure 31. The oral cavity should be irrigated with a 0.2% chlorhexidine solution after the teeth have been cleaned and polished. Note: Current research indicates that it is imperative for operator to wear gloves at all times when working in dog's mouth.

After thorough flushing, the teeth are air dried and checked again for any missed calculus, which will appear as white specks on the tooth surface. A diluted plaque-revealing solution, such as Reveal™ (Schein), can be applied; any missed plaque will stain red. Care should be exercised when applying this solution, however, because it can stain hair or clothing.

Fluoride application has several beneficial effects:

- It decreases tooth sensitivity (helpful after root planing or if roots are exposed)
- It is antibacterial and therefore decreases the rate of plaque reformation.
- It is antiosteoclastic.

Acidulated phosphate fluoride gel (1.23%) (HSI #100-0797) should be applied to clean, dry teeth. The teeth are completely coated with the gel. After 4 minutes the gel is removed and the patient is allowed to recover. After completing the prophylactic procedure, the dental chart should be updated, radiographs can be taken, and any scheduled extractions or treatment can be done.

RADIOLOGY*

Intraoral radiographs are an important area for veterinary dentistry. They are helpful in diagnosing pathology from tumors to unerupted teeth.

*For more details, see Mulligan TW, Aller MS, Williams CA: *Atlas of Canine and Feline Dental Radiography.* Trenton, NJ, Veterinary Learning Systems, 1997.

Figure 32. A variety of toothbrushes and applicators can be used as part of the home care program.

The film I prefer to use is VDFS (Veterinary Dentistry Film System [Hawaii Mega-Cor Inc., Aiea, HI]) which comes in #2 and #4 sizes and self-develops in the pack in 30 seconds. Another important feature is that each film is numbered. There should be no lost films when using this system. It is best to use a dental x-ray unit, but the films can be used with a standard unit if necessary.

When exposing dental films for a standard x-ray unit, the following setting should be used:

- (D) film speed = 100 mA
- Focal distance = 12 inches
- 1/10 to 1/20 second exposure
- 65 kVP for a small dog to 95 to 100 kVP for a large dog

HOME CARE

Maintaining the health status of the oral cavity after a dental prophylaxis requires daily home care for best results. A number of products are available for dental care of the pet at home.

Toothpastes and toothbrushes are obvious choices for pets, because these items are usually handy to owners. Numerous dental studies have shown that mechanical removal of plaque by a toothbrush is the most important phase of plaque removal and that use of a dentifrice is an added benefit.

A child's or adult's soft-bristled toothbrush, special soft-bristled toothbrushes or fingerbrushes (St. Jon Laboratories), and sponge applicators can be used. Some owners elect to use cotton swabs (one for each quadrant of the mouth) to gain control over oral disease (Figure 32).

If a toothbrush is selected, it can be used with water, antiplaque solution, or dentifrice or can be used dry and cleaned later. Malt-flavored and poultry-flavored enzymatic dentifrices (C.E.T.®—VR_x) are well accepted by many pets. I prefer to dispense poultry-flavored toothpaste for young animals or animals with minimal dental disease.

Only two solutions—0.12% chlorhexidine gluconate and Listerine™ (Warner-Lambert)—have American Dental Association approval as being effective against organisms that cause plaque in humans. Products that contain chlorhexidine gluconate include Peridex® (Procter & Gamble) and CHX® products (VR_x). Because chlorhexidine ruptures bacterial cell walls and bonds to oral tissue where bacteria like to attack, it offers some protection from bacterial attack for several hours if applied before fluoride treatment (which, as mentioned, interferes with the effectiveness of bonding).

Another solution and gel that I like to use are in the Maxi/Guard line of products (Addison Biological Laboratory). These products contain zinc ascorbate, which I have found to be effective in helping to heal oral tissue. Alternating chlorhexidine and Maxi/Guard is a good combination.

In addition to the benefits listed on p. 00, fluoride has been shown to be effective in fighting cavities by forming an almost impervious calcium-fluoride bond with the tooth structure, thereby making it very resistant to the acidic by-products of the bacteria that cause tooth decay.

Virbac® (Fort Worth, TX) has a line of dental home care products, some of which contain sodium hexametaphosphate, a proven calculus inhibitor. Stannous fluoride gel in a 0.4% concentration (Pet-Gel [HSI #103-5565]) is available for home use. Weekly application of 0.4% stannous fluoride gel seems to be especially beneficial for dogs with exposed roots and recurrent stomatitis. In addition to the fluoride, the stannous (tin) molecule is also antibacterial.

Stomadhex™ (ImmunoVet) is a bioadhesive patch that slowly releases chlorhexidine to the oral tissues. Designed to be used the first 10 days after a prophylaxis procedure, it can also be used periodically to supplement brushing.

Never recommend or dispense literature that recommends the use of baking soda and salt to brush a pet's teeth, as this mix may contain too much sodium for the pet's system. **Many pets**

Figure 33. During the introductory phase of home care, gauze can be wrapped around the owner's finger and used to wipe the teeth.

Figure 34. Initially, keeping and using the toothbrush in a location that is identified with owner companionship may expedite the learning phase. Cleaning sessions can be moved to a more suitable room (e.g., bathroom) after the pet has accepted the procedure.

that need daily toothbrushing may have or may be predisposed to heart disease, and extra sodium could have life-threatening side effects.

After you have reviewed the various home care products and methods with the owner, you should caution the client to introduce the pet slowly and gently to the home care procedure selected. Behavior modification may be needed for the animal to accept dental home care. For example, the owner should gradually introduce the pet to muzzle manipulation (even the gentlest animal can be provoked to bite). Also during the introductory phase, a strip of nylon stocking, gauze strip, or old bath cloth (Figure 33) can be wrapped around the owner's index finger and used to gently wipe one or two teeth after the pet has become accustomed to having its muzzle manipulated. Most owners like to use a fingerbrush. Because many pets are most at ease in the owner's lap, keeping a toothbrush and towel next to the chair where the pet and owner sit together may expedite the learning phase (Figure 34). Cleaning sessions can be moved to a more suitable location, such as the kitchen or bathroom, after the animal has completely accepted the procedure.

Some clients cannot brush their pets' teeth. To them we extend complimentary toothbrushing. Everyone on the staff has an opportunity to brush a pet's teeth and see the positive results!

Other owners may be unable to care for the dental needs of a pet because of too many other household pets, uncooperative pets, or time limitations. One option is to purchase chewing devices or treats such as Pedigree® Dentabones™ (Kal Kan) that may be beneficial in removing plaque. Pedigree® Dentabones™ have been proven to remove tartar and plaque and significantly reduce gingivitis and halitosis.

Regardless of the specific home dental care plan adopted, owners must be advised that a thorough basic prophylaxis provides about 10% of a pet's dental needs and responsible home care represents the other 90%. If the owner can brush or wipe the outside of the upper cheek teeth, about 75% of calculus formation can be controlled. Faithfully performing home dental care coupled with regular prophylaxes can usually ensure the pet's oral health.

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APPENDIX: USEFUL PHONE NUMBERS

Addison Biological Laboratory: 800-331-2530
DentaLabels: 800-662-7920
Dynamite Marketing: 800-697-7434
Hawaii Mega-Cor, Inc: 800-369-7711
Henry Schein Company, Inc.: 800-872-4346
iM3®, Inc: 800-664-6348
VR$_x$: 800-969-7387

GLOSSARY

alveolar bone: the thin layer of bone around the tooth root.

alveolar bone plate: cortical bone of the face.

alveolus: tooth socket.

apical: toward the root.

buccal: facing the cheek.

caudal: located more towards the tail.

cementonenamel junction: the area where the cementum covering the root surface and the enamel covering the tooth crown meet.

cementum: bonelike tissue covering the surface of the dentin of the root and to which the periodontal ligaments insert to hold the tooth in place.

collagen: a protein substance found in the connective tissue underlying the gingiva and the major component of the periodontal ligament; its building blocks are vitamin C.

coronal: toward the crown.

crestal bone: the bone on the surface between teeth (dental ridge).

crown: the upper part of a tooth, covered with enamel.

cusp: a projection such as that found on the crown of a tooth.

deciduous: subject to being shed at maturity, deciduous teeth are also called primary or milk teeth.

dentin: the bulk of the tooth; a living tissue that surrounds the pulp cavity and is covered by enamel (crown) or cementum (root).

dentinal tubules: channels in dentin that converge toward the tooth pulp; they carry nerve endings and probably nutrients in the dentin.

endodontic tissues: tissues, nerves, blood vessels, and lymph channels making up the pulp.

exothermic: referring to the dissipation of heat.

furcation: the area where the roots divide on a multirooted tooth.

gingivitis: inflammation of the gingiva.

gingivostomatitis: inflammation of the gingiva and oral mucosa.

hyperemic: characterized by an excess of blood; reddened.

hyperplastic: referring to abnormal growth caused by multiplication of normal cells.

interradicular: between the roots.

lingual: pertaining to the tongue or toward the inside of the mouth.

lingual frenulum: the fold of mucous membrane that attaches the tongue to the floor of the mouth.

lower arch: mandible.

mandible: lower arch; also called the lower jaw.

mandibulectomy: surgical removal of the mandible.

maxilla: upper arch.

mesial: situated toward the middle.

oblique: slanted.

occlusal surface: the surface of teeth used for chewing, rudimentary in the cat.

odontoclastic: referring to a cell involved in the resorption of cementum.

orthodontic button: a metal square with a raised mushroom-shaped projection used to cement to a tooth or teeth to be moved orthodontically.

osteomyelitis: inflammation of bone caused by a pyogenic (pus-producing) organism.

palatal: referring to the palate; also used to refer to the lingual surface of a maxillary tooth.

periodontal ligament: the connective tissue that attaches the tooth root to the alveolar bone and surrounding connective tissue.

periodontitis: inflammation of the tissues around teeth.

stomatitis: inflammation of the oral mucosa.

symphysis: a site of union; the mandibular symphysis is the joint between the two halves of the mandible**.**

temporomandibular joint: the joint that connects the mandible to the skull.

trabecular: referring to small, fine bone structures within cortical bone plates.

upper arch: maxilla.

vertical ramus of the mandible: the portion that forms the temporomandibular joint and the angle of the mandible.

zygomatic arch: the bone forming the lower external orbit.