

# Dental anatomy and pathology

## Geraldine Gorman

Bay of Islands Veterinary Services, Shop 3, Selwyn Road, Paihia, Bay of Islands

### Introduction

Various studies have shown that between 65 and 80% of dogs and cats over three years old have some form of oral disease and periodontal disease is the most common chronic infection seen in both humans and animals.

Because Vet nurses are often the first point of contact between the client or pet and the practice it is essential that you have a basic knowledge of dental anatomy, pathology and procedures if you are to be a useful member of the dental team. In many cases a well-informed vet nurse can actually be a driver of dentistry in the workplace.

### Essential anatomy

Dogs have 42 adult teeth, cats have 30. These are made up of incisors, canines, premolars and molars. Incisors and canines are single while premolars and molars may be single, double or triple rooted.

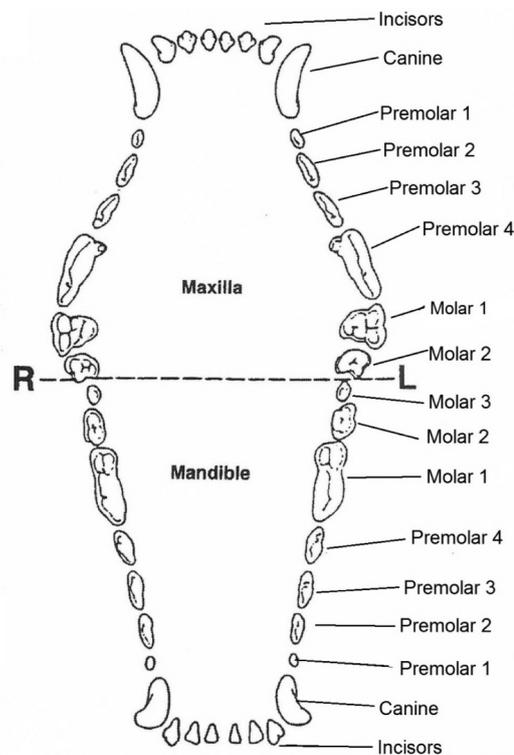


Figure 1. Canine Teeth. Diagram sourced from the Australia Dental Society

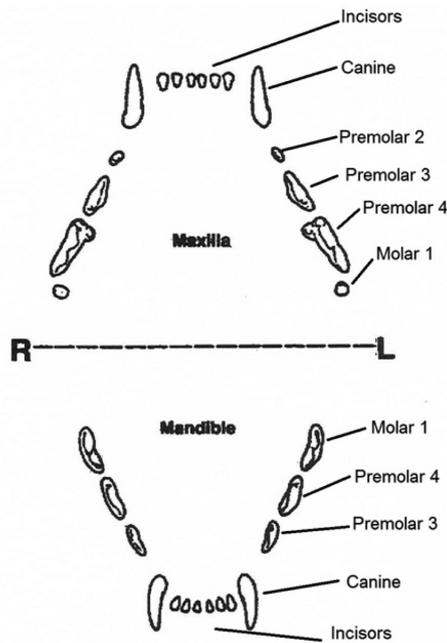


Figure 2. Feline teeth. Diagram sourced from the Australia Dental Society

In cats there are less premolars with the first maxillary (upper) premolar and first and second mandibular (lower) premolars missing. The incisors in both dogs and cats are numbered 1-3 from the centre towards the canine tooth.

### Navigating the Oral Cavity (Wiggs & Lobprise 1997)

**Labial surface:** The surface of the incisors and canines directed toward the lips

**Buccal surface:** The surface of the premolars and molars facing the cheek

**Facial surface:** The labial and buccal surfaces collectively.

**Lingual surface:** Surfaces facing the tongue (mandibular teeth).

**Palatal:** Facing the palate (maxillary teeth).

**Contact or proximal surface:** Collective term for surfaces facing toward adjoining teeth within the same jaw quadrant or dental arch.

**Distal:** Away from the midline.

**Mesial:** Toward the midline.

## Anatomy of a healthy tooth

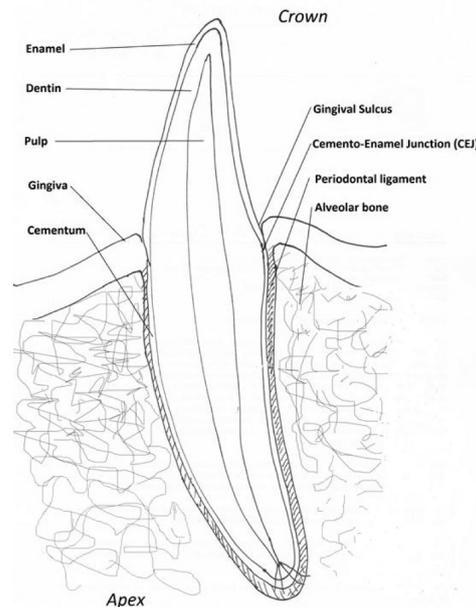


Figure 3. Anatomy of a healthy tooth

The part of the tooth above the gum line is called the crown; the section below the gum line is called the root. Teeth are made up of four tissues: three hard tissues (enamel, cementum, dentine) and one soft tissue (pulp). Enamel, the hardest and densest mineralized tissue in the body, covers the dentine of the crown. Enamel cannot regenerate itself, and in spite of its durability, it can sustain friction-related damage over time. Dentine makes up the bulk of the tooth and is a hard yellow substance which contains perforations called dentinal tubules which run from the enamel to the pulp. There are several types of dentine, which keep developing as long as the tooth is alive. Cementum is the layer covering the root surface to which the periodontal ligament is attached. The point at which the enamel of the crown meets the cementum of the root is called the cementsoenamel junction, or CEJ; the line formed by the CEJ is known as the neck and is usually under the gingiva in a normal tooth. Pulp is the central layer inside the pulp cavity. It is composed of live tissue that contains nerves, blood and lymphatic vessels, several types of connective tissue and certain other substances. The nerve cells in pulp are primarily sensory nerves responsible for transmitting pain. The sulcus, also called the gingival sulcus or gingival crevice, is the normal shallow space between the gingiva and the tooth. Alveolar bone forms the sockets for the teeth. The periodontal ligament consists of collagen fibres attaching the teeth to alveolar bone. Gingival margin refers to the crest of the gingiva around the tooth. Coronal refers to the direction toward the crown. Apical refers to the direction toward the root tip. The apical delta consists of openings through which vessels and nerves pass into the tooth. The periodontium consists of the tissues supporting the teeth, including the cementum, periodontal ligament, alveolar bone and gingiva.

### Tooth development

Animals with two sets of teeth, one deciduous and one permanent are diphyodonts. Humans, cats, dogs, and most domesticated animals are diphyodonts. Monophyodonts, such as rodents and dolphins, have a single set of permanent teeth throughout their lifetimes. Polyphyodonts e.g. sharks and crocodiles have teeth that are replaced continually.

Eruption is a process that starts with the formation of the tooth bud and ends when the tooth appears in the mouth. In most dogs and cats, the deciduous teeth are fully erupted by two months of age, and usually by 6 months they're replaced by permanent (secondary or adult teeth).

At eruption, the dentine is thin, the pulp large and the apex (root tip) is open. The tooth at this stage is weak and easily fractured. New dentine is laid down rapidly in the first two years of life, strengthening the tooth and narrowing the pulp cavity until the apex closes. A study by Gary Wilson indicated that apical closure occurs in most dogs between seven and 10 months of age. This is significant when dealing with fractured teeth in young

dogs in which endodontic therapy is being considered. In young dogs which have an open apex the fractured tooth will remain vital for up to two weeks whereas in an older dog with a closed apex the fractured tooth may have already suffered pulp necrosis and death by 48 hours.

## Occlusion

Occlusion refers to the relationship between the teeth of the mandibular arch and the maxillary arch. In a normal occlusion the following occurs:

- **Incisors:** Maxillary incisors should overlap the mandibular incisor in a scissor bite.
- **Canines:** Mandibular canines should be positioned midway between the upper corner incisors and canines when the mouth is closed. Preferably, lower canines should not touch either upper tooth.
- **Premolars:** Premolars should form a 'shear' mouth; the lower premolar cusps should point to the interproximal spaces (spaces between teeth) between the molars on the maxilla and vice-versa. The upper fourth premolar should be lateral, and facing the cheek, to the lower first molar.

In cats, the normal incisor and canine occlusion is the same as that of dogs, but the premolar and molar occlusion differs slightly

- The buccal surface of the first mandibular molar occludes with the palatal surface of the maxillary fourth premolar, and the maxillary first molar does not occlude with any other tooth.
- The normal occlusion is referred to as a scissors bite

Brachycephalic animals have short, wide muzzles e.g. boxer. Mesocephalic animals have muzzles that are of medium length and width e.g. Labrador. Dolichocephalic animals have long, narrow muzzles e.g. greyhound.

## Periodontal disease

The periodontium is made up of the gingiva, cementum, alveolar bone and the periodontal ligament i.e. tissues that support teeth. Periodontitis and gingivitis are both periodontal diseases. The primary cause of gingivitis and periodontitis (PD) is bacteria. Plaque is a thin, sticky film containing bacteria, food, bacterial by-products, cells, and saliva which adheres to the tooth's surface. Plaque may not be visible without using a disclosing agent. Ultimately plaque becomes calcified by minerals such as calcium and phosphorus in the diet and becomes calculus (tartar). Whereas plaque is easily removed or disturbed by mechanical means, calculus is more firmly adherent to the tooth surface and can only be removed by professional descaling. The calculus provides a rough surface on which plaque continues to accumulate. At this point, dental disease can be reversed by removing the accumulated plaque and calculus. Both plaque and calculus cause gingivitis. Gingivitis is inflammation of the gingiva and is the earliest sign of disease. Animals with untreated gingivitis may develop periodontitis. The inflammatory reaction of the animal to the bacteria, bacterial products and toxins result in destruction of the periodontal ligament and alveolar bone. The result of untreated periodontitis is ultimately loss of the affected tooth. Thus, gingivitis is inflammation that is not associated with destruction (loss) of supporting tissue. It is reversible. In contrast, periodontitis is inflammation where the tooth has lost a variable degree of its support (attachment). It is irreversible. However periodontitis is not a continuous non-stop process but rather a process that is characterised by periods of active tissue destruction and then periods of quiescence. All areas of periodontal disease in an animal's mouth may not be at the same stage at the same time. An animal with periodontal disease may not have active periodontitis all the time.

Although the primary cause of periodontitis is bacteria, there are secondary factors that can contribute to the severity of the disease such as tooth crowding, retained deciduous teeth, malocclusions, systemic illnesses e.g. renal failure or diabetes mellitus or Feline Immunodeficiency Virus (FIV) in cats. Since smaller breeds of dogs tend to have more overcrowding, retained deciduous teeth and malocclusions, we usually see more periodontal disease in these dogs. Diet may also be a factor in that normal chewing has a beneficial effect in cleaning the teeth but many commercial pet foods require minimal chewing. Abnormal chewing habits e.g. in dogs with skin disease or behavioural problems may also be predisposed to periodontal disease by excessive wear or by hair impaction around the teeth causing gingivitis.

## Signs of periodontal disease

- Swelling and inflammation of the gingiva (gingivitis)
- Gingival recession

- Gums that bleed easily when probed
- Halitosis (severe bad breath)
- Plaque and calculus deposition
- Debris accumulation around teeth
- Purulent exudates (oozing pus)
- Tooth mobility
- Tooth loss

#### Four Stages of Periodontal Disease (PD)

Healthy gingiva can be graded as PD 0. Periodontal disease is graded:

- **Stage 1 (PD 1)** (gingivitis) appears as a redness of the gingiva with no attachment loss.
- **Stage 2 (PD 2)** (early periodontitis) shows an increase in inflammation and oedema. In stage 2 there will be less than 25% of support loss when probed.
- **Stage 3 (PD 3)** (moderate periodontitis) occurs when there is a moderate loss of attachment or moderate pocket formation with between 25-50% support loss. Furcation exposure and mobility may be present. The gingiva will bleed upon gentle probing at this stage.
- **Stage 4 (PD 4)** (advanced periodontitis) occurs when there is breakdown of the support tissues with severe (>50% support loss) pocket depth or recession of the gingiva.

#### Diagnosis and treatment of periodontal disease

Periodontal disease is diagnosed based on clinical findings (gingival inflammation, attachment loss) and radiography. The treatment of periodontal disease is aimed at controlling the cause of the inflammation, i.e. dental plaque. Conservative or cause-related periodontal therapy consists of removal of plaque and calculus, and any other remedial procedures required, under general anaesthesia, in combination with daily maintenance of oral hygiene. In other words, the treatment of periodontal disease has two components:

1. Professional periodontal therapy
2. Maintenance of oral hygiene

Professional periodontal therapy is performed under general anaesthesia and includes supra- and sub-gingival scaling, root planing and tooth crown polishing. We often refer to this as a 'Scale and Polish'. Extractions may also be necessary for teeth with advanced periodontal disease to return the mouth to a healthy state. Maintenance of oral hygiene is performed by the owner and is often called home care. Its effectiveness depends on the motivation and technical ability of the owner and the cooperation of the animal. Institute regular check-ups to assess progress and motivate owner.

#### Goals of treatment of periodontitis

The goal of periodontal therapy is to halt disease progression and prevent further tissue destruction at those sites already affected whilst also preventing disease occurrence at unaffected sites. Plaque removal is essential in preventing and controlling periodontitis. Plaque removal can be accomplished by a combination of mechanical and chemical plaque reduction techniques, dietary manipulation and regular professional periodontal therapy. However, the removal of supragingival plaque has little effect on established subgingival plaque. After the initial periodontal assessment, a treatment plan should be formulated, that will address the patient's disease and the owner's concerns. Of course, no treatment plan can be formulated without a detailed discussion of homecare/ plaque control with the owner. Homecare and the continuing removal of plaque remains the cornerstone of periodontal disease prevention/control.

#### Other dental diseases

##### Tooth trauma

**Tooth fracture** is a very common finding in Veterinary practice and it is frequently ignored. If the pulp is exposed some form of endodontic treatment will be required. For a recent fracture in a mature tooth (closed apex) a vital pulpotomy with pulp capping can save the tooth if performed within 48 hours of the fracture. In an immature tooth with open apex (determined by radiography but usually in dogs less than 10 months of age), there is a window of about two weeks in which to save the tooth by pulp capping. This is a simple procedure which can be done in general practice. If the time since the fracture is unknown or longer than above, the tooth needs root

canal therapy. This is usually a referral procedure in NZ. The option is extraction. All fractures involving pulp exposure should be treated as they are painful and lead to tooth root abscesses or other complications.

**Avulsion** refers to teeth that have been completely knocked out of the socket.

**Luxation** is when the tooth is still within part of the alveolus.

Avulsed teeth should be temporarily stored in milk and brought with the animal to the clinic as soon as possible if there is to be an attempt to replace it. Replacement involves splinting and antibiotics. Remember that this tooth is dead and will require endodontic treatment (root canal therapy), so unless the owner is open to referral for this there is no point in saving it.

**Worn teeth** should not be confused with fractured teeth but they can look similar. The pulp is not exposed because the trauma has occurred slowly enough for a new layer of protective dentin to be laid down over the pulp and prevent entry of infection. Examination with a dental explorer can differentiate them from fractured teeth with exposed pulp.

### **Resorptive lesions**

These are very common in cats (40% have them) and are also known as FORLs – Feline Odontoclastic Resorptive Lesions. These very painful lesions are often seen at the cement-enamel junction and are covered by granulation tissue from the gingival margin. The process starts in the cementum of the root and progresses to involve the dentine of the root and the crown, eventually reaching the enamel. The enamel is either resorbed or it fractures off and a cavity becomes clinically evident. Some affected teeth undergo ankylosis where the cementum of the root becomes fused with the alveolar bone, making extraction extremely difficult. The only treatment for this extremely painful condition is extraction or occasionally amputation of affected teeth. Dental radiography is essential to decide on the best option.

### **Retained deciduous teeth**

These are especially common in small breeds and should always be removed because they lead to overcrowding, periodontal disease and sometimes malocclusions. There should never be a deciduous tooth and permanent tooth occupying the same position and it is unlikely that the deciduous tooth will 'fall out' unaided if it has not done so when the permanent tooth has already erupted.

### **Malocclusions**

This is one of the most under diagnosed problems in veterinary dentistry even though it can cause pain, periodontal disease, trauma to soft tissue and difficulty eating. Often the treatment will be extraction but other options are available if referral is an option.

### **Neoplasia**

Tumours of the oral cavity are common, many are malignant and many are not discovered until quite advanced. Therefore every mass in the mouth demands immediate investigation if treatment is to be an option. In dogs the most common oral malignancy is the melanoma, followed by squamous cell carcinoma and fibrosarcoma. In cats it is the squamous cell carcinoma which is most common.