A review of anatomy is important when considering small animal dentistry. A sound knowledge is the keystone to performing dentistry atraumatically and effectively, for both vets and veterinary nurses.

A carnivore tooth is brachyodont, meaning a short crown: root ratio (compared to hypsodont horses and rabbits). The crown is visible above the gingival margin, the root is attached to the alveolus (socket) via the periodontal ligament. The crown is covered with enamel and the root with cementum and meet at the cemento-enamel junction (CEJ). This is often referred to as the neck or cervical line. Teeth may have one, two or three roots. The area where roots diverge is known as the furcation. The termination of the root is known as the apex. In dogs and cats, there are multiple openings known as the apical delta allowing pulp tissue to enter the tooth. The pulp space contains pulp tissue, and is known as the root canal in the root, and the pulp chamber in the crown. It is less dense than the hard tissues surrounding it, and therefore appears black on radiographs.
There are three hard dental tissues:

**ENAMEL**

This is the hardest tissue in the body and consists of 96% inorganic hydroxyapatite crystals. The crystals are laid down during the bell stage of tooth formation, becoming mineralized and growing in size. Any disruption to this will result in the clinically obvious enamel hypoplasia (enamel thinner than normal) or hypocalcification (poorly mineralized enamel). Affected teeth may potentially wear faster than normal, and allow bacterial entry into the porous dentin. Once formed, enamel cannot be repaired or replaced, and is therefore subject to attrition (wear due to contact with another tooth) and abrasion (wear due to contact with an external object, such as a cage bar, stones, tennis balls etc). Enamel is much thinner in the dog and cat compared to man. (1mm vs 2.5mm+).

**DENTIN**

Dentin is the hard substance making up the bulk of the tooth. It is covered by either enamel or cementum. It consists of 70% inorganic hydroxyapatite crystals. It appears solid, but actually consists of thousands of microscopic dentinal tubules extending from the dentino-enamel junction to the pulp. Within the tubules are cytoplasmic extensions from odontoblast cells lining the pulp space, fluid and nerve fibre endings. This means dentin is a sensitive structure. It also means once exposed, bacteria can potentially invade the dentin and therefore the pulp. As the dentin is intimately associated with the pulp, it is known as the pulp-dentin complex. Various types of dentin exist.

- Primary dentin forms before eruption of the tooth
- Secondary dentin forms after eruption. This is laid down in layers, slowly. As long as the tooth (ie pulp) is alive (vital), dentin will continue to be laid down.
- A young animal therefore has thin dentinal walls and a wide pulp space- this is a very delicate tooth. Care must be exercised when extracting persistent deciduous teeth not to damage the permanent, fragile tooth next to it. An old animal conversely has thick dentinal walls and a thin pulp space. The apex is not fully formed immediately as the tooth erupts. This forms as the secondary dentin is being laid down and is normally completed by 7-8months of age.
- Tertiary dentin is formed as an attempt at tooth repair. If odontoblasts are traumatised (eg by attrition or abrasion) they are stimulated to produce more dentin. This tertiary dentin may be laid down...
rapidly and haphazardly. It stains easily. This causes the brown staining seen on many worn teeth.

This must be differentiated from an exposed pulp (eg due to a fractured tooth). Using a sharp dental explorer probe in the anaesthetised patient will allow you to determine if pulp exposure has occurred. Here, you will feel the probe ‘drop’ into the pulp space. With tertiary dentin it will feel smooth like glass. If the trauma is rapid, the tertiary dentin will not have a chance to form, meaning the pulp may become broached and therefore infected.

In this Xray note the thin dentinal walls of the permanent canine and the ‘open’ apex. The root has not yet fully formed.

CEMENTUM

Cementum is the hard substance covering the root surface. It is roughly 45-50% inorganic. As it is less mineralised than enamel or dentin it is not readily visualised on radiographs. Sharpey’s fibres embedded within the cementum attach the tooth to the alveolus (socket). Cementum is vital and can repair itself if injured.

ALVEOLAR BONE

The bone of the jaws forms the sockets which support the teeth, this is known as alveolar bone. The alveolus consists of three layers. The compact bone lining the socket is known as the cribriform plate. Radiographically this appears denser than the surrounding bone and is known as the lamina dura. This is covered by the periodontal ligament- Sharpey’s fibres are embedded within it. At the top of the socket the cribriform plate meets the cortical bone at the alveolar margin. The cortical bone is covered with periosteum and in between is spongy, cancellous bone.
PERIODONTAL LIGAMENT

This ligament attached the tooth to the alveolus, and provides shock-absorption during chewing. It contains many collagen fibres oriented in various arrangements to withstand masticatory forces. There are also blood vessels, nerves (proprioception, pain, pressure fibres), connective tissue cells and undifferentiated mesenchymal cells. This space is only about 0.25mm wide. Radiographically this space appears black, and should be visible all the way round the root.

PULP

Pulp contains blood vessels, lymphatic vessels, nerves, fibroblasts, collagen fibres, undifferentiated mesenchymal cells and odontoblasts. It is the odontoblasts which produce dentin, but only if the pulp is vital. It is interesting to note the only nerve fibres within the pulp are nociceptors: ie they ONLY transmit PAIN signals. These are of the Aδ or C type. Ie: fast conduction, sharp pain or slow conduction, dull aching pain. An exposed pulp is therefore painful and requires treatment.

ORAL MUCOSA AND GINGIVA

The oral mucosa (OM) is stratified squamous epithelium. It runs from the margin of the lips and lines the oral cavity. It meets the gingiva at the mucogingival junction (MGJ). The oral mucosa is attached to the underlying bone but rather loosely. The gingiva comprises attached gingiva (AG) and the free gingival margin (FG). The attached gingiva is firmly attached to the underlying periosteum of the bone. The free gingival margin is the very edge of the gingiva. It reflects back on itself, before attaching to the tooth, thus creating a gingival sulcus. This is the area probed during oral examination, using a periodontal probe.

INCISIVE PAPILLA is normal in the dog and cat! Do not mistake it for an oral mass. The incisive ducts sit laterally and communicate with the vomeronasal organ.
FELINE MOLAR LINGUAL SALIVARY GLAND - cats have a small salivary gland on the lingual side of the mandibular molar tooth. It should not be mistaken for a tumour, nor damaged during extraction attempts.

**TERMINOLOGY**

- **Palatal** surface of tooth towards palate
- **Lingual** surface of tooth towards tongue
- **Labial** surface of tooth towards lip
- **Buccal** surface of tooth towards cheeks
- **Facial** can be labial or buccal surface
- **Occlusal** surface facing tooth in opposite jaw
- **Interproximal** surface between two adjacent teeth
- **Mesial** surface towards front mid-line
- **Distal** surface away from front mid-line
- **Apical** towards the root
- **Coronal** towards the crown

**TOOTH IDENTIFICATION**

A tooth can either be identified by its dentition/arch/quadrant/tooth, or by using a numerical system known as the modified Triadan system.

- Dentition refers to deciduous vs permanent
- Arch refers to maxillary or mandibular
- Quadrant refers to left or right
- Tooth refers to incisor/canine/premolar/molar plus its number

Eg: Permanent maxillary left 4\textsuperscript{th} premolar

**MODIFIED TRIADAN SYSTEM**

This is a digit numerical system for clearly identifying teeth.

The first digit identifies the quadrant location, and whether the tooth is deciduous or permanent.

1→4: Right maxillary, Left maxillary, left mandibular, right mandibular (permanent)
5→8: Right maxillary, Left maxillary, left mandibular, right mandibular (deciduous)

The second two digits identifies the tooth. The first tooth is the central incisor, the second the middle incisor etc, counting caudally.

The canine is always 4 (eg 104,204,304,404)

The first molar is always 9 (eg 109,209,309,409)

The cat has a reduced dentition and this is reflected in its numbering.

**NUMBER OF ROOTS**

When vets extract teeth, all roots should be removed. To do this, the number and position of roots must be known. Correct sectioning is essential. If these cannot be remembered, refer to a visimodel (clear plastic model showing roots), a dental chart, and ideally *take a radiograph!* Anatomical variations do occur! For instance in 10% cats, the upper third premolar may have 3 roots. It is worthwhile remembering that a human dentist extracting a tooth without a pre-operative radiograph may be considered negligent.

**DOG**

<table>
<thead>
<tr>
<th>One root</th>
<th>All I,C, PM1, mandib M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two roots</td>
<td>All others</td>
</tr>
<tr>
<td>Three roots</td>
<td>Upper PM4, upper M1 and M2</td>
</tr>
</tbody>
</table>

**CAT**

<table>
<thead>
<tr>
<th>One root</th>
<th>All I, C, Upper PM2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two roots</td>
<td>All others</td>
</tr>
<tr>
<td>Three roots</td>
<td>Upper PM4</td>
</tr>
</tbody>
</table>

**PROBING AND CHARTING**

A dental chart forms a medico-legal document. A detailed dental chart should be produced for every patient undergoing dental work. A simple chart showing missing teeth and which teeth were extracted is NOT suitable for a patient’s clinical records. This simplified version may be produced to give to the client however.
Charting is required because:

- It requires a logical examination of all oral and dental structures allowing identification of all pathology present.
- It depicts the level of disease present on a particular day. Thus, disease progression or improvement can be monitored by referring to previous dental charts.
- If there is a client complaint which is referred to the RCVS, any ‘expert witness’ will want to see a well presented dental chart to enable ‘visualisation’ of the disease present, and why treatment was necessary.
- Explaining the chart to the client helps to emphasize exactly what disease is present in their pet’s mouth and to what extent.

Many charts are available, such as those from Pfizer and Dentalabels. These allow identification of the patient. They also depict maxillary and mandibular teeth, usually with 2 views: a view as if you were looking at the pet’s teeth from the side (buccal view) and a view as if you were looking directly onto the tooth (occlusal view). These views allow you to chart pathology that is present all the way round the tooth, for instance a 6mm pocket on the palatal surface of the canine tooth. Calculus and gingivitis may be recorded for every tooth. Missing teeth can be documented, and extractions marked. Other pathology can be documented, such as: gingival recession, gingival hyperplasia, furcation exposure, tooth mobility, periodontal pocket formation, fractured teeth, tooth wear and oral masses.

To perform probing and an oral examination, two pieces of equipment are required:

1) A periodontal probe is a blunt ended hand instrument with markings on the tip to allow measurement of the gingival sulcus or periodontal pocket depth. It can also be used to determine if the furcation is exposed. It is held in the modified pen grip and gently introduced into the gingival sulcus of every tooth, ideally in 6 positions around the circumference. Bleeding on probing is a sign of gingivitis. Abnormal probing depths are noted.

2) A sharp explorer probe. This is only to be used on hard dental tissues, for instance when identifying feline tooth resorption lesions (FORL), dental decay (caries), or to distinguish whether a pulp has been exposed or not. These should never be used on soft tissues such as the gingiva.
References and further reading


