Endodontics is the branch of dentistry that deals with the internal anatomy of the tooth. Enamel, produced by ameloblasts, is the hard tissue covering the crown of the tooth. Cementum is the hard tissue covering the root surface. The dentin is the layer of the tooth between the enamel and cementum and the pulp cavity. Dentin is porous with approximately 45,000 dentinal tubules per square mm in coronal dentin. The dentinal tubules contain fluid and nerve tissue. The dental pulp is the innermost layer of the tooth and contains nerves, blood vessels and connective tissue. The pulp chamber lies within the crown and the root canal lies within the root. The pulp communicates with the rest of the body through the apical delta at the tooth apex.

When a tooth first erupts the pulp cavity is very large, the dentin layer small (primary dentin) and the apex is open. As the tooth continues to mature odontoblasts contained within the pulp cavity produce secondary dentin which results thickening of the dentin layer of the tooth and a decrease in the size of the pulp cavity.

Endodontic disease may occur in teeth affected by attrition or abrasion, fractured teeth, discolored teeth, periodontal disease, caries, and tooth resorption as a result of inflammation or avascular necrosis of the pulp tissue. Clinical signs of endodontic disease may include facial swelling, draining tracts, gingival swelling, pulpal granulomas, or draining tracts in the gingival tissues or the patient may be asymptomatic.

Attrition is the normal wear on the crown due to mastication from opposing teeth while abrasion is the mechanical wearing of the teeth by abnormal stresses (tennis balls, frisbees, bones). Teeth affected by abrasion or attrition should have smooth margins, horizontal loss of tooth structure and a dark center (tertiary dentin). As the wear breaks through the enamel and exposes dentin the odontoblasts produce tertiary or reparative dentin.

Discolored teeth result from trauma or and an ischemic event. Only 40% of discolored teeth have radiographic evidence of endodontic disease yet 92% of these teeth are non vital. As the pulp tissue breaks down, the inflammatory mediators leak out the apical delta, leading to periapical periodontitis. Discolored teeth should either be extracted or have root canal treatment.

Fractured teeth can be identified by an irregular enamel surface, asymmetry of the crown with the contralateral tooth, a difference in crown length and possibly pulp exposure. Evaluation of a fractured tooth includes a visual exam and must also include intraoral radiographs to determine if there is radiographic evidence of endodontic disease. Infection in the root canal system may result in periapical changes which initially cause a widening in the periodontal ligament space at the tooth apex. As the lesion progresses a distinct halo of bone loss at the apex may be visible. Remember, bone loss at the apex of the tooth does not indicate a non vital tooth. Radiographs also assist in determining the extent of maturation of the pulp cavity.

The following classification system is utilized by the AVDC to describe fractured teeth in dogs and cat:

- Enamel Infraction (EI) – a crack in the enamel that does not enter the dentin or result in any loss of tooth substance
- Enamel Fracture (EF) a fracture in which the crown substance that is lost is limited to the enamel
• Uncomplicated Crown Fracture (UCF) is a fracture involving the enamel and dentin and does not expose the pulp
• Complicated Crown Fracture (CCF) is a fracture involving the enamel and dentin and exposing the pulp
• Uncomplicated Crown Root Fracture (UCRF) is a fracture involving the enamel, dentin and cementum but not exposing the pulp
• Complicated Crown Root Fracture (CCRF) is a fracture involving the enamel, dentin and cementum exposing the pulp
• Root Fracture (RF) is a fracture involving the root

An uncomplicated crown fracture the exposes dentin may cause tooth sensitivity and may allow bacteria to infect the pulp tissues. If the dental radiographs show no abnormalities then the dentin may be sealed with a dentin sealant. Radiographs should be taken in a year to evaluate the health of the tooth and periapical tissues to insure that bacteria did not invade the pulp before the dentinal tubules were sealed.

Teeth with complicated crown fractures have exposed pulp. The pulp becomes inflamed, leading to irreversible pulpitis, and the pulp dies. Inflammatory mediators escape from the root canal into the periodontal ligament through the apical delta and cause localized osteolysis. Radiographically these lesions appear as lucencies around the tooth apex. Often there are no external clinical signs of infection. Treatment of complicated crown fractures may include vital pulp therapy, root canal treatment or extraction. Doing nothing is NOT a treatment option.

Vital pulp therapy is the treatment for a fractured tooth in an immature dog or cat (less than 18 months of age) with pulp exposure of less than 48 hours. The advantage of vital pulp therapy is that it allows for root end closure and continued dentinal production.

Root canal treatment of fractured teeth with pulp exposure is the treatment of choice in a mature dog or cat for ‘strategic’ teeth. The strategic teeth include the maxillary fourth premolars, mandibular first molars and canine teeth in a dog and the canine teeth in a cat. Root canal treatment preserves the tooth, alleviates discomfort and removes infection from the tooth and from the periapical tissues. Duration of pulp exposure is not a factor to consider when considering root canal therapy for a tooth. Infection can be (and often is) present at the tooth apex. Contraindications to root canal treatment include fractured tooth roots, concurrent periodontal disease which compromises tooth integrity, teeth with internal resorption, sclerotic or inaccessible canals, severe apical changes involving more than a third of the root.

Fractured deciduous teeth must be treated and usually extraction is the treatment of choice. Fractured deciduous teeth have pulp tissue exposed which contains nerve tissue. Extraction of the fractured deciduous tooth will eliminate patient discomfort and eliminates the potential for infection of the associated permanent tooth bud.

Root fractures are only detectable clinically if the coronal segment is displaced or there is mobility of the tooth crown. Fractured tooth roots may be difficult to detect with intraoral radiographs unless displacement exists. If the root is fractured in the coronal two thirds of the tooth the treatment is extraction. If the fracture is in the apical third of the root, extraction of the apical portion and surgical endodontic treatment is a treatment option to save the tooth. Root fractures, if stable and uncontaminated, will heal unaided with the pulp remaining vital.

A thorough oral exam must be a part of every physical exam. Fractured teeth, discolored teeth and teeth with abrasion or attrition must be evaluated clinically and with intraoral radiographs to determine the appropriate treatment.