# Intraoral Radiographic Interpretation (Part 2): More Radiographic Pathology

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Intraoral dental radiographs are required in order to assess, diagnose, and treat all dental related pathology. The majority of dental pathology occurs subgingivally. The cost of a dental radiograph generator, chairside developer, dental film, developing chemicals and/or a digital dental radiographic system is a cost effective, and a quality medical decision to include in all general practices.

The indication for intraoral dental radiographs is veterinary dentistry. Dental intraoral radiographs should be obtained for periodontal disease (periodontal pockets), endodontic disease (fractured teeth with or without pulp exposure, discolored teeth), missing teeth, tooth resorptive lesions, oral masses, painful teeth, pre-extraction, post-extraction, sinus tracts, fistulas, tooth developmental abnormalities, and nasal discharge. Intraoral radiographs identified 27.8% and 41.7% clinically important findings in teeth without clinical lesions in dogs and cats, respectively (Table 1). Additionally, (50.0% and 53.9%) additional findings and clinically essential (22.6% and 32.2%) findings in dogs and cats with clinical lesions were identified, respectively (Table 2). (Verstraete FJ, Kass PH, Terpak CH. Diagnostic value of full-mouth radiography in cats. Am J Vet Res. 1998 Jun;59(6):692-5. -- Verstraete FJ, Kass PH, Terpak CH. Diagnostic value of full-mouth radiography in dogs. Am J Vet Res. 1998 Jun;59(6):686-91.)

**Table 1: Value of radiographs – No clinical findings present in the patient**

| | Dogs | Cats |
|---|---|---|
| Incidental findings | 41.7% | 4.8% |
| Clinically important findings | 27.8% | 41.7% |
| Radiographs of no value | 30.5% | 53.6% |

**Table 2: Value of radiographs – Clinical findings present in the patient**

| | Dogs | Cats |
|---|---|---|
| Confirmation Only | 24.3% | 13.9% |
| Additional findings | 50.0% | 53.9% |
| Clinically essential findings | 22.6% | 32.2% |
| No Value | 3.1% | 0% |

**Interpretation**

A light box should be available for viewing dental radiographs if a digital system is not being utilized.

1. Be certain that the film is of diagnostic quality
2. Mount the radiographs with a labial mounted technique for viewing
3. Be certain the pertinent anatomy is visible for viewing
4. Examine the entire radiograph
5. Identify normal anatomical landmarks
6. Examine the bone of the mandible and maxilla
7. Examine the crown, cervical region, root, enamel, and dentin
8. Examine the alveolar marginal bone, interproximal bone, furcation bone, lamina dura, and periodontal ligament
9. Examine the endodontic system (pulp horns, pulp chambers, root (pulp) canal, apical periodontium
10. Interpret the radiographic findings in conjunction with the oral exam findings
11. Record the radiographic findings (the roentgen signs) – (e.g. a periapical lucency (rarefaction) can be seen radiographically NOT a periapical abscess)
12. Record the radiographic impression

**Normal radiographic anatomy**

It takes approximately 40-50% mineral loss of tooth and bone structures before radiographic changes can be visualized on the dental film or digital dental radiographic system. Therefore radiographs underestimate the extent of bone loss and pathology and may not always correlate with acute clinical signs. Radiographs are a snap shot in time and recheck radiographs 6-12 months following the initial radiographic image are often necessary to evaluate the progression of disease and/or healing of bone and tooth structures. Finally, radiographs are 2-D representations of 3-D structures. Therefore, overlying structures causing summation and superimposition frequently create artifacts.

In the young patient, the dentin walls are thin and the pulp system is large. The root will not be fully formed until apexogenesis is complete. As the tooth ages, secondary dentin production continues, the endodontic system becomes smaller, and a root is formed.

There is a radiolucent structure around each tooth (lamina lucida) that represents the space of the periodontal ligament. Immediately adjacent to the lamina lucida is the lamina dura (where the periodontal ligament attaches to the alveolar bone). This structure is a radio-opaque structure that loses opacity as the patient ages. The trabecular pattern of supporting bone becomes coarser and less distinct with age. The veterinarian should become familiar with normal structures (e.g., mental foramen, developmental grooves) so as not to mistake them for pathology.

Normal anatomical landmarks visualized include the radiolucent mandibular canal, mental foramen (rostral, middle, and caudal), and mandibular symphysis. Particularly, the middle mental foramen can be superimposed on the apex of the mandibular canine tooth and/or 1$^{st}$ and 2$^{nd}$ premolars and misinterpreted as pathology. When in doubt, take a second film at a different angle. If the radiolucency stays with the tooth it is likely pathology; if it moves away, it is likely the normal foramen. In the maxilla, the nasal structures, nasopalatine foramen, and intersections between the maxillary bones are visualized.

**Roentgen sings of periodontal disease**

Radiographically there will be loss of the marginal bone, loss of the lamina dura, widening of the lamina lucida (periodontal ligament space), and horizontal and vertical bone loss due to the resorption of bone. Horizontal bone loss occurs when the cortical supporting bone around the tooth and adjacent teeth is lost at a similar rate. If the soft tissue does not recess at a similar rate as the bone, a suprabony periodontal pocket will be formed. Vertical bone loss occurs when there is one area of bone loss around a tooth with adjacent supporting bone and mineralized tooth structures remaining more coronal. Vertical bone loss results in infrabony pockets (single wall defect, two wall defect, three wall defect, and four wall defect).

**Lesions of endodontic origin**

Endodontic disease can result in changes within and around the tooth. Fractured teeth with pulp exposure are infected and require treatment. However, trauma that does not create pulp exposure (uncomplicated crown fractures) can still lead to endodontic disease due to irreversible pulpitis, permeability of dentin tubules to oral bacteria and toxins, and root fractures.

A peri-radicular (periapical) lucency is a classic bone change seen with endodontic disease. Additional changes in the bone can included a widened lamina lucida (particularly apically), peri-radicular radio-opacities and sclerosis, external inflammatory root resorption, and/or non-continuous lamina dura. The tooth may have arrested development when compared to the contralateral tooth and a wider endodontic system is evident. Additionally, pulpitis can lead to mineralization of the root canal system and narrowing compared to the contralateral healthy tooth. There may be internal resorption or external resorption present. External resorption is more common and involves inflammation causing radiolucent defects of the root (particularly the apex of the tooth). Internal resorption occurs within the endodontic system and can be radiographically discerned form external resorption by changing the angle of the radiographic beam. Internal resorption will stay with the root canal system and the normal tapering lucency, and definition of the root canal system, will be lost in the region of the resorption.

Radiographic lesions of endodontic origin include: no radiographic changes (early lesions), widening of the apical periodontal ligament space, loss of apical lamina dura, diffuse irregular periapical lucency, distinct periapical lucency, diffuse area of radiopacity - sclerosing (condensing) osteitis, root tip resorption, internal resorption, external inflammatory tooth resorption, arrested tooth development, and/or accelerated tooth mineralization (dystrophic mineralization, pulp obliteration).

**Tooth resorption**

Tooth resorption lesions can be divided into stages and types. Types refer to the radiographic appearance and are crucial for treatment planning. Type 1 is generally associated with periodontal disease or apical periodontitis from endodontic disease. There will be a normal root opacity/density with a surrounding lamina lucida and usually a definable root canal. With Type 2 (replacement resorption), the teeth have undergone significant resorption and have a different opacity/density. There is loss of the lamina lucida and dentoalveolar ankylosis is present. There may be no discernable root structure present. These teeth are not associated with periodontitis. Type 3 is when one root is Type 1 and one root is Type 2.

**Oral neoplasia**

In general, and with exceptions, most malignant tumors invade bone whereas most benign lesions do not. Aggressive lesions have rapid changes, indistinct edges with multiple areas of lysis, wide reactive zones, cortical lysis, and periosteal layers of opacity. The associated teeth are usually floating in position resulting in increased tooth mobility, and tooth resorption is irregular and may have a spiked appearance. Nonaggressive lesions tend to displace teeth and mobility is variable. The rate of change of the bone is slow with a well-defined area of lysis with distinct narrow margins. A uniform periosteal reaction is present.

**References available upon request**