# **Radiography of Developmental Orthopedic Disease in Small Animals**

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Development orthopedic disease is a category of diseases that affect young animals. These range from structural and function abnormalities with genetic/hereditary, nutritional, metabolic, presumed infectious and idiopathic basis. It is important to recognize these diseases from a prognostic perspective and to guide breeders in selection of breeding stock.

This lecture will focus on helping clinicians with the interpretation of radiographic changes that will be present for the common developmental orthopedic diseases. The reading list below provides excellent reviews of common DOD.

#### Basic radiographic interpretive principles

Identify the location of the lesion. Most lesions occur where growth is most rapid, at secondary centers of ossification or affect articular cartilage

- a. Is the lesion diaphyseal, metaphyseal, physeal or epiphyseal?
- b. Is the lesion affecting the articular margin?
- c. Is the lesion generalized affecting all similar anatomic structures (e.g. all epiphysis) or is it bilaterally symmetrical (e.g. in cases of osteochondrosis)?

Identifying the anatomic location will help develop a reasonable list of differential diagnoses. Remember there may be more than one lesion. Additionally the common DOD in young animals if often accompanied by secondary changes of osteoarthrosis. In severe cases, the radiographic signs of osteoarthrosis will dominate.

### **Categories of DOD**

- 1. Hip dysplasia: Excellent radiographic positioning is mandatory to accurately detected subtle changes. Heavy sedation or short acting anesthesia is recommended. These abnormalities are characterized by joint incongruency and early signs of osteoarthrosis. In cases of hip dysplasia, identification of the dorsal acetabular margin and coverage of the femoral head by the acetabulum is an important criterion. Hip dysplasia is most likely associated with joint laxity (functional) and the PennHip method assessing the distraction index is most useful. The OFA hip extended ventrodorsal view of the pelvis and hips only assesses structural conformation and can be normal even in cases where severe joint laxity is present, resulting in a false negative result.
- 2. Elbow dysplasia: Excellent radiographic positioning is mandatory to accurately detected subtle changes. Heavy sedation or short acting anesthesia is recommended. While the OFA requires only a flexed lateral view, it is this author's opinion that orthogonal views are a minimum for assessment of the complex elbow joint. At referral institutions, CT is replacing radiography in the assessment elbow incongruency. However radiography is still useful as a screening test. Components of elbow dysplasia include joint incongruency ( humero-radial, humero-ulnar and radio-ulnar articulations), medical coronoid disease, osteoarthrosis (cranial margin of the radial head, sclerosis of the trochlear notch of the ulna, proximal margin of the anconeal process of the ulna), ununited anconeal process, and osteochondrosis of the distomedial margin of the radius and ulna secondary to premature closure of the distal physes causing joint incongruency (cases of trauma).
- 3. Osteochondrosis: The most commonly accepted theory of causation is a failure of endochondral ossification of the articular cartilage. This may be due to trauma, or rapid growth causing loss of nutritional support to the thick cartilage. As cartilage is not radiopaque, a typical OC lesion appears as a concave subchondral defect in the articular margin. Sometimes cartilage fragments may "break" off and become mineralized within the joint, appearing as intra-articular mineral bodies ("joint mice"). Not all intra-articular mineral bodies are OC lesions. Common sites are the caudal aspect of the humeral head, distal articular margin of the humeral trochlea, medial trochlear ridge of the talus and femoral condyles. OC lesions are typically bilateral, although only one limb may be symptomatic. Chronic cases are associated with periarticular new bone formation (osteoarthrosis).
- 4. Panosteitis: Unknown etiology. Affects the endosteal and medullary component of long bones (humerus, femur, radius and ulna, tibia). It appears as focal intramedullary soft tissue opacities with loss of normal trabeculation and in severe cases, endosteal and periosteal proliferation. Panosteitis has a good prognosis and all animals will "grow out" of the disease. It often has a waxing and waning course, affecting multiple limbs at different times. Commonly encountered in young animals (5-12 months) but can occur in animals as young as 2 months or as old as 7 years. Pain is localized to the diaphysis of the affected long bones and not the joints. Histologically these lesions are characterized by edema but not inflammation hence the term Panosteitis is a misnomer. A similar lesion is seen in horses and is called enostosis.

- 5. Hypertrophic osteodystrophy: Affects the metaphyseal region of the long bones, commonly affecting the distal radius and ulna. Not to be confused with hypertrophic osteopathy which is associated with neoplasia, infection or inflammation in the thorax or abdomen. HOD lesions are characterized by regions of lysis that parallel the normal physis, usually proximal to the physis creating the "double physis" sign. The margins of the lytic region are irregular and ill-defined, with irregular cortical margins and in severe cases periosteal new bone formation. Histologically these lesions are characterized by necrosis and inflammation. These dogs are rapidly growing large breed dogs, and they are systemically ill. They often present for pyrexia, vomiting, diarrhea and anorexia and swelling associated with the joints. The challenge if often pain control and maintaining a positive nutritional state. In severe cases, angular limb deformities and permanent swelling is the result. Some cases are so ill, euthanasia may be considered for humane reasons. In a few cases canine distemper virus has been isolated from the lesions.
- 6. Legg-Calve-Perthes disease (Avascular necrosis of the femoral head): A disease of small/toy breed dogs, associated with trauma and interruption of the vascular supply to the femoral head, secondary to joint swelling. Initial trauma may go unnoticed but as the proximal femoral epiphysis becomes necrotic, it collapses and creates pain and lameness. The femoral head and neck remodel and the hip joint develops osteoarthrosis. Early stages show only mild lucency of the femoral head, and with chronicity, alterations in contour and sclerosis occur. In young obese male neutered cats a similar condition has been observed. Femoral head and neck excision is the preferred treatment.
- 7. Chondrodysplasia: A broad category of DOD that includes diseases that affect the epiphysis, physis, metaphysis or all. These are usually generalized, and can be seen in the axial and appendicular skeleton. These may be due to nutritional factors (Vit D deficiency, nutritional hyperparathyroidism), endocrinopathies (hypothyroidism, acromegaly), metabolic derangements (mucopolysaccharidosis) and idiopathic/genetic causes (Scottish fold osteochondrodystrophy).

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