Radiographic Diagnosis of Canine Elbow Dysplasia

Tonya C. Tromblee, DVM, MS, DACVR
Diplomate of the American College of Veterinary Radiology, Dr. Tromblee practices at the Massachusetts Veterinary Referral Hospital.

Canine Elbow Dysplasia (CED) refers to a group of developmental abnormalities of the elbow that causes progressive osteoarthrosis. It is one of the most common causes of lameness in dogs. Canine elbow dysplasia encompasses four primary lesions: fragmented medial coronoid process (FCP), ununited anconeal process (UAP), osteochondrosis (OC) and/or osteochondritis dissecans (OCD), and joint incongruity (JI). All forms of CED share a complex, multifactorial etiology which is influenced by genetic predisposition, nutrition, trauma and other factors affecting skeletal growth. Nonetheless, there is general agreement that disturbed endochondral ossification, asynchronous growth of the radius and ulna, and trochlear notch dysplasia play major roles in the pathophysiology of CED.

Canine elbow dysplasia typically affects juvenile large or giant breeds but can also occur in medium-size and chondrodystrophic breeds. It is bilateral in 33-80% of cases, and multiple forms are often found concurrently within the same joint. Clinical signs typically manifest between 5 and 12 months of age, however, some dogs may not exhibit lameness until well after 24 months, by which time degenerative changes may be quite advanced. Yet in other cases there may be little or no degenerative changes which may lead to misdiagnosis. Because osteoarthrosis is irreversible, a delayed diagnosis has a negative effect on prognosis. Yet, the lack of correlation between the severity of clinical signs and radiographic findings can be a great source of frustration for the veterinarian. Nonetheless, good radiographic technique and thorough scrutiny of the films will enhance diagnostic certainty for CED.

Normal Radiographic Anatomy of the Canine Elbow

Because of its complex articulation, knowledge of normal anatomy is essential. In the mediolateral view, the normal elbow appears as a set of concentric, parallel rings. The smallest circle represents the narrowest part of the trochlea humeri as it articulates with the trochlear notch. The larger ring is a continuous arc formed by the trochlear notch, lateral coronoid process, and articular surface of the radial head. The width of the humeroradial joint and humeroulnar joint should be nearly equal. The Medial Coronoid Process (MCP) articulates with the widest part of the trochlea humeri; it can be difficult to evaluate because it summates with the radial head and proximal ulna. The MCP slopes cranio-caudally at 45º from the ulna and should be slightly concave in contour. The apex of the MCP should appear as a sharp point that is level with the proximal physeal scar of the radius. Trabecular detail of the ulna caudal to the MCP and trochlear notch should be clearly visible. The anconeal process of the ulna should appear as a 'beak-like' point with a slightly concave margin. It is partially obscured by the medial epidontyle on extended and
standard mediolateral views. Sesamoid bones within the tendon of origin of the supinator muscle may be present along the lateral aspect of the joint on craniocaudal views. These can be unilateral or bilateral, but are not considered a cause of lameness and should not be confused with an FCP or joint mouse.

**Radiography of the Elbow**

High quality, properly positioned radiographs remain the most cost-effective method of diagnosing elbow dysplasia. Even if lameness is unilateral, radiographs of both elbows are strongly recommended because of the high incidence of bilateral disease. Conventional radiographs should be obtained with a non-grid table-top technique, low kVp and high mAs exposure, with detailed film screen combination and tight collimation. Standard radiographic projections of the elbow include the 90° flexed mediolateral and craniocaudal views. True lateral positioning is essential for the mediolateral view and the x-ray beam should be centered at the medial epicondyle. For the craniocaudal view, the x-ray beam should be angled 10-15° toward the humerus to best display joint surfaces.

The standard mediolateral view (90° flexion) provides good overall evaluation of the MCP and joint congruence but the anconeal process is often obscured by the medial epicondyle. Maximally flexed mediolateral projections (45° inside angle) have the highest sensitivity for UAP and early osteophyte formation and are also recommended for routine screening. However, this view does not contribute to the evaluation of FCP or JI when compared to other views. The craniocaudal view is useful for evaluating the medial aspect of the joint for OCD or kissing lesions of the trochlea humeri, but fragments of the MCP are rarely demonstrated in this view. A supplemental view that may be useful to highlight OCD or FCP lesions is the 20°-craniolateral-caudomedial oblique projection because it reduces superimposition with the ulna.

**Fragmented Medial Coronoid Process**

Fragmented Medial Coronoid Process (FCP) is the most common form of CED but is also the most challenging to diagnose. Survey radiography is insensitive for the detection of discrete MCP fragments. Fragments cannot be visualized radiographically unless they are mineralized, displaced, and/or the x-ray beam is parallel to the plane of cleavage. The lack of identification of an MCP fragment on survey radiographs does not exclude the diagnosis of FCP; when in fact, the absence of a normal appearing MCP is highly indicative of FCP.

Radiographic diagnosis of FCP is made on the basis of secondary osteoarthrosis and the exclusion of other forms of CED. Characteristic radiographic features consistent with a diagnosis of FCP include: loss of MCP detail, a blunted or indistinct MCP, subchondral sclerosis of the trochlear notch, and periarticular osteophyte formation along the anconeal process, medial epicondyle, medial coronoid process, and proximal radius. Chronic FCP may be associated with 'kissing lesions' which are subchondral erosions of the trochlea humeri caused by mechanical interference from an abnormal or fragmented MCP. Radiographically, it is indistinguishable from an OCD lesion and is visible on standard or oblique craniocaudal views. Degenerative changes are typically apparent in most dogs with FCP by 7-12 months of age and progress with age even if they are clinically sound. By the time lameness develops, degenerative changes are usually quite extensive.

However some dogs with FCP may have little or no evidence of osteoarthritis. Mild sclerosis caudal to the MCP has been reported as the sole radiographic abnormality in adult dogs (>24 months) with surgically confirmed FCP. Therefore, the absence of abnormal findings does not rule out elbow disease. In such cases with demonstrable elbow pain, alternative imaging with computed tomography or MRI may be indicated.

**Osteochondrosis and Osteochondritis Dissecans**

Osteochondrosis (OC) is the failure of endochondral ossification of epiphyseal cartilage as a result of non-differentiating chondrocytes. Retention of proliferating chondrocytes leads to focal thickening of cartilage and subsequent ischemic necrosis. Fissuring of diseased cartilage occurs under the stress of weight-bearing or trauma to form a cartilaginous flap which is then known as osteochondritis dissecans (OCD).

The trochlea humeri is the most common site of OCD in the canine elbow. Survey radiography is less sensitive for diagnosing early or subtle OCD lesions because they are often masked by degenerative changes. In the craniocaudal view, chronic lesions appear as focal flattening or concave radiolucent
subchondral defects of the trochlea with or without surrounding sclerosis. Depending on the location within the condyle, lesions may be more conspicuous in the 20º-craniolateral-caudomedial oblique projection. Subchondral defects are more difficult to detect in the lateral view, but trochlear flattening can be detected with proper radiographic technique.

Ununited Anconeal Process (UAP)
Classic UAP is a disease of large breed dogs in which the anconeal process fails to fuse with the proximal ulna. In predisposed breeds, the anconeal process (AP) develops as a separate center of ossification which, fuses to the proximal ulna by 20 weeks of age. If radiographic union is not present by this time, spontaneous fusion will not occur.

Ununited anconeal process is characterized by a persistent, vertically-oriented radiolucent fissure between the AP and proximal ulna on lateral views. The diagnosis can only be confirmed in dogs greater than 20 weeks of age. Osteoarthrosis often develops early because of increased elbow instability. Although the diagnosis seems straightforward, the radiolucent fissure is sometimes obscured by exuberant osteophyte formation or by the medial epicondyle in mediolateral projections. Therefore, maximally flexed mediolateral views are also recommended for evaluation of UAP.

Joint Incongruity
Incongruity of the elbow joint is considered a common denominator in dogs with CED. Trochlear notch dysplasia and asynchronous growth between the radius and ulna are predisposing factors for FCP and/or UAP because they redistribute weight-bearing forces onto the developing MCP and anconeal process. Early diagnosis is crucial because corrective surgery can be performed before the onset of osteoarthritis or FCP. However, an accurate diagnosis is challenging because it is influenced by the severity of incongruence, positional obliquity and interpreter experience. The 90° flexed mediolateral projection is considered the most precise view for evaluation of joint congruence.

Incongruity is recognized as widening or lack of parallelism between articular surfaces. Humeroulnar incongruity is recognized as widening between the trochlear notch and humeral condyle. Widening of the humeroradial joint often coincides with radioulnar incongruity. When both are present, an articular ‘step’ is created between the lateral coronoid process and the radial head. Depending on which bone is shortened, the MCP will be displaced above or below the physeal scar of the radius.
Happy New Year from Mass Vet!

We hope you had a wonderful holiday season and are ready to launch into a new year full of new adventures in 2007. We're rolling out new initiatives and services at Mass Vet all the time, but even as we continue to expand, we never want to outgrow our personal touch. If there is anything we can do for you, please don’t hesitate to call.

Our new 2007 CE Lecture series for Veterinarians can be found on our website at www.intownvet.com/intown/seminars.html

Upcoming Veterinarian CE Lectures:
- Tues. January 16, 2007 at 7pm at Mass Vet Referral Hospital in Woburn
  The Fundic Examination & Ocular Pharmacology presented by Ruth Marrion, DVM, PhD, DACVO

- Tues. February 20, 2007 at 7pm at Mass Vet Referral Hospital in Woburn
  Diagnostic Imaging of Canine Elbow Dysplasia presented by Tonya Tromblee, DVM, MS, DACVR

Upcoming Technician CE Lectures:
- Tues. Feb. 6, 2007, at 7pm at Bulger Animal Hospital in North Andover
- Thurs. Feb. 8, 2007 at 7pm at Massachusetts Veterinary Referral Hospital in Woburn
  Anesthesia for the Veterinary Technician presented by Krista M. Vernaleken, VMD

For more information on Technician CE Lectures, please contact Betsy Hensley at bhensley@intownvet.com