

Or – Orthopaedics

ARTHROSCOPIC DIAGNOSIS OF ELBOW DYSPLASIA

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What is elbow dysplasia?

“Elbow dysplasia” (ED) is a syndrome that includes several conditions resulting in an incongruity of the joint, eventually leading to degenerative joint disease (DJD). Elbow dysplasia is a common, inherited condition affecting 17% of Labrador retrievers, and up to 70% of Bernese Mountain dogs in the Netherlands. This high prevalence and the devastating effects of elbow

DJD emphasize the need for early diagnosis, individualized treatment and preventive measures. In 1993, the International Elbow Working Group (IEWG) agreed that “elbow arthrosis caused by Fragmented Coronoid Process (FCP), osteochondrosis (OCD), Ununited Anconeal Process (UAP), articular cartilage anomaly and/or joint incongruity is the manifestation of inherited canine elbow dysplasia”.

Conditions included in Elbow Dysplasia:

- Osteochondrosis (trochlea humeri)
- Ununited Anconeal Process (UAP)
- Fragmented Coronoid Process (medial, FCP)
- Incongruity:
 1. Radio-ulnar incongruence
 - a. With or without angular limb deformity
 - b. Short ulna or short radius
 2. Elliptical ulnar notch?
 3. Local incongruity (deformed medial coronoid process)?
- Combination of the above

Why consider arthroscopy for the diagnosis of elbow dysplasia?

The IEWG developed a radiographic protocol and scoring system adopted as a screening system to diagnose ED. The radiographic findings are

scored according to severity of the arthrosis (DJD) and/or presence of a primary lesion (derived from Mark Flückiger, IEWG 2003 Estoril meeting):

Elbow Dysplasia Grading	Radiographic Findings
0 Normal elbow joint	Normal elbow joint, no evidence of incongruency, sclerosis or arthrosis
I Mild arthrosis	Sclerosis of ulnar trochlear notch or, step => 2 mm between radius and ulna or, osteophyte formation less than 2 mm high
II Moderate arthrosis	Osteophyte formation 2 to 5 mm high
III Severe arthrosis or 1° ED	Osteophyte formation over 5 mm high and/or primary ED such as LPA, FMCP or OCD

Radiographs of both elbows should be obtained in all cases diagnosed with elbow dysplasia, because the condition is often bilateral. UAP and OCD are typically diagnosed on radiographs, and do not require advanced imaging.

Radio-ulnar incongruence has traditionally been diagnosed based on standard radiography. Degenerative joint disease secondary to elbow dysplasia is mainly evaluated on hyperflexed lateral, cranio-caudal and craniolateral / caudomedial 15° oblique views. An UAP is best visualized on a lateral hyperflexed radiograph. The craniolateral / caudomedial 15° oblique view improves the visualization of the medial coronoid process compared to the cranio-caudal projection (Wosar et al. 1999). However the sensitivity of conventional radiography to image the medial coronoid process has been estimated to only range from 10 to 62% (Wosar et al. 1999). The effect of radiographic positioning on interpretation of cubital joint congruity has also been studied in normal dogs. The authors of this study compared three mediolateral (45°, 90° and 135° of flexion) and three cranio-caudal views, and concluded that elbow congruity was best assessed on a 90° flexed lateral projection with the beam centered over the joint (Murphy et al. 1998). The superiority of mediolateral over craniocaudal projections to evaluate radio-ulnar incongruence was later confirmed with a surgical model of induced radio-ulnar incongruence in cadaveric forelimbs (Mason et al. 2002). However, radiologists were only able to correctly identify congruent elbows (specificity) in 86% and incongruent elbows (sensitivity) in 78% of specimens. The radio-ulnar step required for each of 4 American College of Veterinary Radiology board-certified radiologists to attain 90% sensitivity ranged from 1.5 to greater than 4 mm. In comparison, the elevation of the coronoid process in relationship with the ulna in elbows with FCP has been reported to vary between 1 and 2 mm (Wind 1986, Trostel et al. 2003). The results of this study did not support the use of standard radiography for evaluation of radio-ulnar incongruence.

Computed tomography has previously been used to help diagnose elbow dysplasia when radiographs did not provide a definitive diagnosis (Rovesti et al. 2002). CT eliminated the false positive results obtained with survey radiographs in the detection of fragmented coronoid process. Compared to standard radiographs, it also provided a better definition of the disease in 46% of elbows examined. CT scan has been reported to achieve the highest accuracy (86.7%) and sensitivity (88.3%) when compared to radiography, xeroradiography, linear tomography and positive contrast arthrography for diagnosing fragment medial coronoid process

(Carpenter et al. 1993). CT imaging protocols have recently been described to measure elbow incongruity (Holsworth 2004, Gemmill TJ et al. 2004). Although the accuracy, sensitivity and specificity of CT to diagnose radioulnar incongruence has not been studied, this technique is currently considered as a gold-standard to diagnose radio-ulnar incongruence, and has been applied in two clinical studies (Gielen 2004, Holsworth 2004, Gemmill et al. 2004, Schulz 2004). Both studies compared radio-ulnar incongruence in normal elbows and in dogs with FCP (Gemmill et al. 2004, Kramer et al. 2004). Unfortunately, the results and conclusions of both studies differed drastically: Gemmill et al. reported that radio-ulnar incongruity exists at the apex of the coronoid process but not at its base, whereas Kramer et al. described exactly the opposite. Both groups used a similar protocol, but the discrepancy between their results may be due to the difference in positioning of the elbow or in interpretation of images: one group measured the humeroradial and humeroulnar joint space (Gemmill et al. 2004), whereas the other measured the actual step between the radius and the ulna (Kramer et al. 2004). Although these studies suggest that the form of incongruency associated with FCP is more complex than a simple proximal translation of the articular surface of the ulna, they also illustrate the need for further evaluation of CT as a diagnostic tool for radio-ulnar incongruence. Ultimately, the ability of computed tomography to diagnose elbow incongruity will remain limited by the lack of visualization of the cartilage, leading to an evaluation of subchondral bone rather alignment of joint surfaces. From a clinical standpoint, this diagnostic tool currently requires general anesthesia of the patient and may not be widely accessible in private practices.

Arthroscopic evaluation of the elbow also requires general anesthesia but it allows unparalleled visualization of joint surfaces (Schulz 2004). In addition, arthroscopy is minimally invasive and can be combined with surgical treatment of the lesion. One study found no difference in post-operative gait analysis of normal dogs undergoing arthroscopic versus open exploration of the elbow (Bubenik LJ et al, 2002). However, two other studies documented improved function in dogs immediately after and over the 21 months following arthroscopic treatment of FCP, compared to arthrotomy (Schwarz et al. 1993, Meyer-Lindeberg A et al. 2003). Arthroscopic management of FCP therefore appears to minimize post-operative pain compared to open arthrotomy, but further studies are needed to long term benefits on degenerative joint disease.

What arthroscopic technique can be used to diagnose FCP and radio-ulnar incongruence?

The dog is placed in dorsal recumbency with a sandbag on the lateral aspect of the affected elbow. An assistant maintains the limb in position over the sand bag to provide adduction throughout the study. A 2.7mm arthroscope may be used in large breeds, although atraumatic insertion of the scope between the humeral head and the ulna may be difficult, especially in dogs with radio-ulnar incongruity. A 1.9mm 30° fore obliquescope is therefore preferred. The entire joint is first explored through a medial portal, including the anconeal process, the medial and lateral coronoid processes, the medial and lateral aspects of the

humeral condyle and the entire radial head. A systematic evaluation of all compartments of the elbow is crucial to complete the diagnosis of elbow dysplasia. The egress portal consists of an 18-gauge needle directed in the joint pouch just proximal to the anconeus. An instrument portal located in the region of the medial collateral ligament allows triangulation of a graduated hook-probe. The probe can be used to mobilize a fragmented coronoid process, cartilage flap in OCD and appreciate radio-ulnar incongruence.

The arthroscopic appearance of OCD, UAP and FCP are well established. In fact arthroscopy has allowed the identification of variation in appearance of FCP:

Arthroscopic appearance of fragmented coronoid process (FCP) in dogs:

- Fragment on the medial margin of the medial coronoid process (MCP)
- Erosion of the lateral rim of the MCP
- Incomplete fragmentation (fissure)
- Fragment in situ
- Minimally migrated FCP
- Fully migrated FCP (joint mouse)
- Chondromalacia – Eburnation of the MCP

Elbows with FCP should be carefully evaluated for degenerative joint disease (especially cranial to the radial head), cartilage lesions on the opposing articular surface of the humerus (“kissing lesions”) and incongruity (Figure 1). Unfortunately, objective assessment of elbow incongruity via arthroscopy has not been fully investigated.

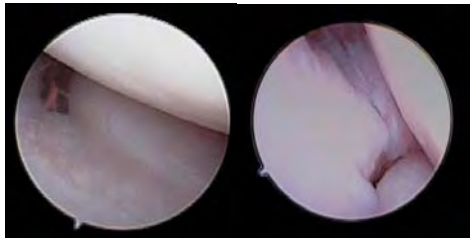


Figure 1: Arthroscopic evaluation of radio-ulnar incongruity in two dogs with medial FCP. Both images show the humeral condyle (triangle), the ulna commissure and lateral coronoid process (arrow) and the radial head (block arrow). Left: congruent radio-ulnar junction. Right: radio-ulnar incongruence.

We have recently studied the predictive value of arthroscopy to diagnose experimentally induced radio-ulnar incongruity (Wagner K et al. 2006). A surgical model of radio-ulnar incongruence was used to shorten the radius by 1, 2 and 3 mm increments in cadaveric forelimbs obtained from adult Labrador Retrievers. Radio-

ulnar incongruence was blindly evaluated via computed tomography (CT) and arthroscopy before and after each modification. Radio-ulnar incongruence was measured arthroscopically with a graduated probe at 3 levels in each study: the commissure of the medial and lateral portions of the coronoid process, the apex and the mid-body of the medial coronoid process. The distance between the ulnar and radial surfaces in unmodified elbows was equal to 1.18 ± 0.13 mm on CT. The overall sensitivity of arthroscopy was 85% and 95%, when the radius was shortened by 1mm versus ≥ 2 mm, respectively. The specificity was equal to 50%. The ability to detect mild incongruity (1 mm step) was greater at the ulnar incisure than at other locations. Although pronation subjectively appeared to modify the appearance of the radio-ulnar junction, this factor was not found to affect the overall predictive value of arthroscopy. Intra-articular pressure did not affect the examination. In this study, we found arthroscopy to be very sensitive for detection of radio-ulnar incongruence, especially at the ulnar incisure. The greatest sensitivity obtained at the ulnar incisure is due to the relative ease of identifying landmarks compared to the mid body and apex of the coronoid. The low specificity of the technique (i.e. our ability to correctly identify unmodified elbows as congruent) reflects the physiological degree of radio-ulnar incongruence previously reported in dogs, and confirmed by the CT measurements in our study. The clinical relevance of a mild radio-ulnar incongruence

remains unclear in a normal elbow. However, a diagnosis of mild incongruity in the presence of other signs of elbow dysplasia would support adjunctive osteotomies / ostectomies to modify the distribution of loads in the diseased joint. Further studies correlating radiographs, arthroscopy and computed tomography in clinical cases of elbow dysplasia are warranted to validate these findings.

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