

# Canine Elbow Dysplasia

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## Introduction

Elbow dysplasia (E.D.) is an all encompassing term, comprehensible to breeders and dog owners, that includes a number of conditions affecting the elbow joint and all leading to varying degrees of osteoarthritis. The Elbow Dysplasia Panel grades the radiographs on the presence of osteophytes as a sign of arthritis irrespective of the cause. This is in contrast to the clinician who needs to make a definitive diagnosis to assist in the therapeutic decisions that need to be made.

## Pathophysiology

Osteochondrosis, the disturbed endochondral ossification of articular or physal cartilage, is the most likely underlying cause for all the conditions causing elbow dysplasia. In osteochondrosis normal cartilage development and maturation fails in the hypertrophic zone resulting in thickened hyaline cartilage. In the physis this may lead to delayed closure and irregular growth rates of the long bones of the elbow leading to incongruity in the joint and excess force being applied to the medial coronoid process (M.C.P.) causing fragmentation thereof, erosions of the medial humeral condyle or pressure on the anconeal process preventing physal closure. In the articular cartilage the thickness of the hyaline cartilage may prevent adequate diffusion of synovial fluid into the basal cell layers causing necrosis of these cells. This in effect creates a space between the subchondral bone and hyaline cartilage and if trauma is applied will fracture and present the signs of osteochondritis dissecans (O.C.D.).

Elbow dysplasia is a multifactorial, polygenetic developmental condition affecting many large breeds. There is a definite breed predisposition with German shepherd dogs (G.S.D's) suffering more from Ununited Anconeal Process (U.A.P), Labradors and Golden Retrievers more inclined to get combined O.C.D. and Fragmented Medial Coronoid process (F.M.C.P), Rottweilers get a high incidence of Elbow dysplasia but rarely get O.C.D. and Bernese mountain dogs a combination of F.M.C.P and incongruity usually associated with more severe arthritis than other breeds. The condition is more likely to effect males than females which indicates that there may be a sex linked gene or more likely is due to their faster growth and larger size.

There is a strong genetic component as surveys have shown that breeding with dysplastic parents produces a much higher incidence in the pups than if only one of the parents were effected and an even lower incidence if both parents were clear. The more severe the arthritis in the parents the higher the incidence of dysplasia in the offspring.

The environmental factors predisposing to elbow dysplasia are high calcium diets and rapid growth and maturation. The genetic potential for growth and appetite are inherited and possibly as with Hip Dysplasia and O.C.D. of the shoulder joint, the largest and fastest growing pups seem to have a higher incidence of orthopaedic problems.

## Clinical Symptoms

Clinical lameness may present any time from 6 months of age in the case of O.C.D. up to 12 months for Ununited Anconeal Process (U.A.P.) and F.M.C.P. Symptoms are more noticeable with a uni-lateral lesion as the dog will have a noticeable limp which appears to be worse after rest in the beginning and later worse after exercise. When the lesions are bilateral the symptoms may be overlooked by the owner. Usually the dog will present with a stilted stiff forelimb gait in an attempt to limit elbow flexion during locomotion. In many instances the dogs are only presented much later in life once moderate to severe arthritis has developed.

## Diagnosis

Radiographs are still the most cost effective method of evaluating the elbow joint although Computer Tomography (C.T.) and Magnetic Resonance Imaging (M.R.I.) scans will demonstrate the primary pathology more clearly. Their costs prohibit their routine use although they have been used extensively in institutions researching this condition.

If a lame dog is presented it is advisable to radiograph the shoulder as well as it is sometimes difficult to differentiate between a shoulder or elbow pain and in the case of Rottweilers it is necessary to radiograph the palmar metacarpal area to exclude sesamoid bone pathology.

The Elbow Dysplasia Panel follows the guidelines set by the International Elbow Working Group (I.E.W.G.) and which has been adopted by the World Small Animal Veterinary Association. This requires that one

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flexed medio-lateral radiograph be submitted for each elbow at one year of age. This will be assessed for arthrosis and be graded from one to three depending on the severity of the changes.

To evaluate the joint for the primary pathology, more exposures will need to be taken.

- Slightly flexed (110 degrees) medio-lat view: (Fig 1A). This allows for the most accurate evaluation of joint congruity. The x ray beam needs to be focused over the medial epicondyle. The medial coronoid process can be seen superimposed on the proximal radius with its cranial tip level with the prox. radial physis.
- Maximally flexed med-lat view (as required for the E.D. panel) (Fig 1B): Here the angle of flexion is about 45 degrees. This view gives maximal exposure of the anconeal process and allows optimal evaluation for U.A.P. and early osteophyte development on the dorsal aspect of the anconeal process. This view does not allow easy evaluation of the coronoid processes or for O.C.D. of the medial condyle.
- Maximally extended, med-lat with 15 degree supination (Fig 1C): This view gives a true lateral view of the med. coronoid process. This view exposes the cranial border of the med. coronoid process in over 90% of cases compared to only 50% in the other med-lat views.
- True cranio-caudal view (Fig 1D): Good view to evaluate for osteochondritis lesions and for osteophytes on the med. aspect of the med. epicondyle and med.coronoid process.
- Pronated cranio-caudal view (about 15 degrees pronation) (Fig 1E): This view skylines the med.cor.process and med. humeral condyle making it difficult to see cleavage lines in the coronoid process but allows the best exposure for O.C.D. of the medial condyle.

### **Fragmented Medial Coronoid Process**

This is the most common entity causing elbow arthrosis in the dog. It appears to be caused by a combination of osteochondrosis of the cartilage of the coronoid process with delayed ossification of chondrocytes and an increased vulnerability to fragmentation, and osteochondrosis of the physes of the long bones of the elbow causing an overgrowth of the ulna with the majority of weight carried on the relatively small surface of the coronoid process, leading to fracture and fragmentation. This asynchronous growth between radius and ulna may only occur as a phase during a growth spurt that most pups experience. If this occurs relatively early (under six months of age) fragmentation will probably occur. but if it occurs later will most likely cause erosions on the primary weight bearing surface of the medial

humeral condyle only as the coronoid process has had more time to ossify and is therefore less likely to fracture.

The true cranio-caudal, pronated cranio-caudal and supinated med-lat are the best views for evaluating the med coronoid process. The fragments are rarely seen on radiographs as they may be small, hidden between the proximal radius and ulna, minimally displaced or may only be fissured. The condition can often only be diagnosed by eliminating the other causes of elbow dysplasia and by the presence of osteophytes around the medial aspects of the medial epicondyle and medial coronoid process.

Treatment: Surgical removal of the fragments and curettage of the 'kissing lesions' (cartilage damage) on the humeral condyle combined with a sliding or transverse osteotomy of the proximal ulna, if a step exists between the weightbearing aspects of the proximal radius and ulna, is the treatment of choice. Correcting the incongruity is probably more beneficial than the removal of the fragment itself.

### **Erosive Cartilage Lesions**

May present as the 'kissing lesions' described above or they may occur on their own without fragmentation of the coronoid process. They are usually only diagnosed during surgery to evaluate the medial coronoid process and are never seen on radiographs.

Treatment is the same as described for fragmented med coronoid process.

### **Osteochondritis Dissecans of the Medial Humeral Condyle**

Osteochondrosis of the hyaline cartilage of the medial condyle with fracture of the cartilage and creation of a flap of cartilage, which is usually attached at one edge, is the probable aetiology. The defect is easily seen on the true cranio-caud and pronated cranio-caud view. This lesion may be seen as early as 5-6 months of age and is often seen in combination with fragmented medial coronoid process (Labradors, Golden Retrievers and Bernese mountain dogs). If O.C.D. occurs on its own the resulting arthrosis is much milder than in the situation where O.C.D. and F.M.C.P. occur together.

Medial arthrotomy with removal of the fragment and curettage of the lesion is the treatment of choice. The medial coronoid process must be evaluated during arthrotomy.

### **Ununited Anconeal Process**

The G.S.D. is the breed most effected by far, and it is often bilateral with one leg clinically worse effected. The anconeal process has its own centre of ossification in large breed dogs, which is usually closed at 5 months of age. If unsure, a comparison with the other

elbow is beneficial. The extended and flexed med-lat exposure usually demonstrates the lesion clearly.

Osteochondrosis of the physes of the long bones of the elbow joint causing overgrowth of the radius relative to the ulna, the opposite of what occurs with F.M.C.P., leads to a ventral displacement of the anconeal process and a concomitant increase in pressure exerted from the floor of the olecranon fossa of the humerus onto the anconeal process, preventing normal closure and causes the anconeal process to separate from the ulna.

Treatment that has been utilized in the past involves removal of the ununited process or fixation with a lag screw. Removal of the process supposedly increases the instability of the joint while fixation of the process was intended to reduce the instability. Lag screw fixation usually hastens the onset of arthrosis and the severity thereof, probably as a result of the incongruity that caused the condition in the first place and the malformation that usually occurs in the anconeal process. Recent research indicates that it is beneficial to perform a sliding or transverse proximal ulna osteotomy which corrects the incongruity and allows the anconeal process to reattach itself. This technique is only recommended if the anconeal process is still firmly attached to the ulna and the dog is under 8 months of age. The later this procedure is done the lower the chance of fusion. In the chronic joint this is of no benefit and removal of the process is most likely to bring about an improvement clinically although the arthrosis will progress, albeit at a slower rate.

### **Elbow Incongruity**

If the incongruity develops before 6 months of age it could lead to U.A.P., F.M.C.P. and cartilage erosions but if it occurs after 6 months, may occur on its own and lead to arthrosis of the elbow joint.

The slightly flexed med-lateral and true cranio-caudal views are the best to evaluate congruity of the joint. On the lateral view the aspects to evaluate are the position of the medial and lateral coronoid processes and the joint spaces between the radius and humerus and the ulna and humerus. The dorso-cranial aspect of the medial coronoid process lies level with the proximal radial physis and the lateral coronoid lies on a level with the caudal level of the proximal radial articulation. (see diagram 1). The joint spaces need to be close and even throughout the joint. Diagram 1 also illustrates the common areas where osteophytes develop in the early stages of E.D.

### **Discussion**

Elbow Dysplasia is inherited as a multifactorial poly-genetic trait. Radiographic studies need to be performed at 12 months of age and submitted to the E.D. panel where the radiographs will be evaluated for signs of arthrosis and be graded from 0 (normal) to 3 depending on the severity of the arthrosis. This is based on a protocol approved by the International Elbow Working Group and approved by the World

Small Animal Veterinary Association. If the initial radiographs are only submitted later they may give rise to false positive results as the dogs may show mild signs of arthrosis caused by wear and tear rather than elbow dysplasia. If dogs are presented younger than 12 months with clinical lameness, they need to be radiographed as soon as possible as early detection of the lesions have the best prognosis for surgical repair.

Rottweilers have the highest incidence with Bernese mountain dogs developing the most severe arthrosis. G.S.D. usually suffer from U.A.P. while Labradors and Golden Retrievers typically develop F.M.C.P. or O.C.D. or a combination of the two. Males are effected more frequently than females. Breeding affected dogs produce more affected pups than breeding with clear dogs. In a breed survey on G.S.D.s by the G.S.D.Council of Australia, by 1995 they had screened 1787 dogs with 61% normal, 14% borderline, 18% grade 1, 1,9% grade 2 and 0,7% grade 3. By 1997 a further 680 dogs were assessed with 70% normal, 20% grade 1, 7% grade 2 and 2% grade 3 with all U.A.P. graded 3.

In the progeny screening, by 1997 there were 283 progeny from parents which had been graded normal and 82% of them graded normal and 18% affected while in the 238 progeny from parents where only one parent was normal and the other parent was affected (grade 1 or 2) only 60% were normal and 40% were affected. They also found that in their survey on 3140 dogs that some sires produced a higher incidence of E.D. than others. Other surveys around the world have found similar trends proving that it is possible to reduce the incidence of E.D. by selective breeding.

Studies in young growing Great Danes has revealed that an excess of dietary calcium intake during growth disturbs the process of endochondral ossification in the growth plate and in the synovial cartilage. As this is the pathology leading to elbow arthrosis, diet cannot be excluded as a contributing factor in the development of elbow dysplasia. Feeding dogs a high protein diet did not cause any irregularities in the growth of long bones. With the advent of the newer "high tech". diets, care needs to be taken that the recommended daily intake is not exceeded. The potential for growth and appetite are inherited and some pups seem to grow very quickly and mature young. Being overweight during the period of maximal growth could predispose a dog to developing orthopaedic disease. It is recommended that breeds predisposed to orthopaedic diseases should be fed a balanced diet with calcium levels of 0,8 to 0,9 % dry matter basis.

In an effort to reduce the incidence and maintain the goodwill of the breeders it would seem prudent to allow breeding where only one of the parents was affected with E.D., no worse than grade 1. As E.D. screening has only been introduced very recently and many of the older breeding dogs have never had the benefit of radiographs taken at a year of age, it seems

unfair to eliminate them from the breeding pool on the basis of a grade 1 evaluation at the older age as trauma and general wear and tear also lead to arthrosis. As the years go by and the older dogs retire from breeding the rules can be changed to reduce this debilitating condition even further.

In the past few years we have seen a radical increase in the number of lame dogs suffering from E.D. even considering that many cases in earlier years were either misdiagnosed or not diagnosed at all, and this coincides with a period where there has been much research into canine nutrition and many new hi-tech diets have been launched and marketed through Veterinary practices as the ultimate diets for the growing dog. This is also a period where the author has noticed an increase in the tendency of breeders to breed related dogs. Breeding related dogs is contrary to what occurs in nature, and should be discouraged. There seems to be a bias among breeders to breed related parents in an attempt to produce uniform litters with similar characteristics of body shape, temperament, coat type etc. In Holland, breeds like the Bernese mountain dog have 100% penetration for elbow dysplasia and 50% penetration in Labrador Retrievers. Not enough research has been conducted into the penetration levels in the most commonly affected breeds in different geographic areas. Countries like Australia and New Zealand are at greater risk due to their geographic distance from the traditional breeding countries of the breeds commonly affected and their stringent quarantine regulations, which make the importation of new bloodlines very expensive and difficult. Breeding with related (even distant) parents will increase the incidence of many medical conditions like E.D.

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