# PROCEEDINGS

## 21th annual meeting of the

## INTERNATIONAL ELBOW WORKING GROUP

**Wednesday October 11th, 2006**
**Prague, Czech Republic**

# WELCOME ADDRESS

During the last ice-time, some 40,000 years ago, contact between wolf-like dogs and man occurred since both lived in the same habitat, with similar hunting strategies and preys. Domestication of dogs started 15,000 years ago in East Asia, according to DNA-analysis as performed in 650 dogs representing all dog populations around the world (Science, 2002). In Germany, near Bonn, a mandibula of a dog has been found of 14,000 years old. From findings dating from the Mesolithicum (8800-5000 b.C.), dogs started to help during hunting by surrounding, catching, and retrieving the prey and by guarding the house. From pieces of art of Roman origin it is known that around the year 0, different types of dogs were bred for different purposes like hunting, carrying or guarding life stock, and as companion animal. Kings and nobleman exchanged and donated rare and useful dogs all over Europe; these were especially hunting dogs as first described by the French Gaston Phoebus in his *Livre de la Chasse* (1387). During the second half of the 19th century, dog shows were organized and the need grew for standards to judge the exterior of dogs. In 1897, *Les races de Chiens* by the Count of Bylandt (1860-1943) was published containing the standards of all known breeds of the world. In the beginning, breeding and showing dogs was a sport of the upper-class but starting at the economical welfare following World War II, the public wanted also to have pure bred dog, fitting to the character, the social image and the housing circumstances. Breeding was more directed to the exterior rather than to working abilities and efforts were undertaken to breed according to the standards or even more extreme, i.e., smaller, larger, more bradycephalic, more skin wrinkles et cetera. Since only 10-15% of the total population of a breed is used for breeding, often with the champion males as the only studs, it is obvious that in less than one century many breeds reveal homozygosis for a lot of genes, coding for exterior and diseases alike. This may be the explanation why so many dog breeds suffer from heritable diseases almost typical for their breed. It might be that many breeding dogs of popular breeds developed in Eastern Europe independently from Western Europe, and thus contain a different genetic make-up. Exchange of 'fresh blood' can be of benefit for both the Eastern and Western European dog populations. However, awareness of the most important genetic diseases and screening of the potential breeding dogs before mating is a prerequisite for improving the genetic pool.

Elbow dysplasias, including at least five different entities, are recognised in an increasing number of dogs in Europe and the United States of America, This is especially seen in the most popular dog breeds since Tigari published his findings in the mid-1970's. In 1989 the International Elbow Working Group (IEWG) has been established by veterinarians and breeders with great concern for this disabling skeletal disease, in order to form a platform to exchange knowledge, experiences, and scientific data. The IEWG, appointed as an affiliate of the World Small Animal Veterinary Association (WSAVA), has its annual meeting preferably in conjunction with the annual WSAVA-congress. Last year, in addition, IEWG organised a film-reading session with veterinarians, originating from more than 20 countries, who are involved with FCI-screening for dysplasias.

The IEWG is privileged that the organising committee of the 31st WSAVA congress in Prague offered their hospitality to allow the 21st IEWG-meeting to take place as a pre-WSAVA-congress meeting. This makes it possible for IEWG to be in contact with veterinarians of the Eastern European countries and exchange ideas on the most relevant aspects of ethiology, clinical and radiological signs, therapeutic measures and actual screening programmes regarding elbow dysplasias.

On behalf of the Board of IEWG and the sponsors Pfizer Ltd and Iams Pet Food, I welcome the participation of veterinarians of all countries both at the seminar of IEWG during the world congress as at the webpage of IEWG (www.iewg-vet.org**)** in order to reach the goals of IEWG and thus diagnose, treat and abandon elbow dysplasia in our dog populations.

Prof. dr. H.A.W. Hazewinkel,
pressident IEWG.

The International Elbow Working Group
acknowledges the financial support by

**The Iams Company**


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# PROGRAMME IEWG 2006 PRAGUE MEETING

Wednesday October 11th 2006
Prague Congress Center
Czech Republic

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| 8.30 - 9.00 h | Registration and welcome | |
| 9.00 – 9.45 h | Clinical investigation and etiology of Elbow Dysplasias | Dr. Hazewinkel |
| 9.45 – 10.45 h | Elbow Dysplasia: correct radiographic technique and film interpretation | Dr. Flűckiger |
| 10.45 – 11.15 h | Break | |
| 11.15 – 12.15 h | Therapy of Elbow Dysplasia: conservative, arthrotomy and arthroscopy | Dr. Meyer-Lindenberg |
| 12.15 – 13.00 h | Screening programme for Elbow Dysplasia | Dr. Hazewinkel |

# List of speakers

**Dr. M. Flückiger**, Prof., Dr.med.vet., Dipl. ECVDI.
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# Clinical investigation and etiology of Elbow Dysplasias

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## Introduction

The elbow joint develops from five centers of ossification, i.e. the medial and lateral condyle, the medial epicondyle, the proximal radial epiphysis and the anconeal process, although the latter is not a secondary ossification center in all breeds. During post-natal growth, the mineralization of these centers can be followed with radiographs, and is delayed with increased calcium intake[1].

The causes of elbow arthrosis can be divided into hereditary, traumatic, nutritional and a combination of these. The hereditary causes of arthrosis are especially the developmental diseases known as elbow dysplasias (ED), including the ununited anconeal process (UAP), the fragmented coronoid process (FCP), osteochondritis dissecans (OCD) and elbow incongruity (INC). Traumatic causes of osteoarthrosis of the elbow joint include articular fractures and luxations, or both i.e., Monteggia fracture-luxation. Combinations of hereditary and trauma are: avulsion of the medial humeral condyle and fractures of incompletely fused condyles. Here, a review is given of the clinical investigation and the hereditary aspects of each of the entities of Elbow Dysplasias, which are part of the screenings protocol according to the International Elbow Working Group [www.iewg-vet.org].

## Clinical Investigation of Elbow Dysplasias

### Ununited anconeal process

The UAP was discovered first, most probably due to its large size and obvious radiological appearance. The anconeal process develops as a secondary ossification center in some large breeds of dogs and can be separated at the cartilaginous border up until the dog is 5-6 months of age. The most frequent aetiology is elbow incongruity (INC) as in chondrodystrophic breeds (including Bassets) and in the radius curvus syndrome of long legged dog breeds. The latter can be the result of high calcium and phosphorus intake as has been shown in different studies[2]. The radius curvus syndrome can also be the result of trauma to the distal growth plate of the antebrachium with early growth arrest, especially of the ulna. Also an oval shape of the semilunear notch may be responsible for anconeal separation, as described especially in German Shepherd dogs[3]. The dog shows discomfort, lameness or shortened step, swelling of the elbow joint which is not warm or painful, but with pain and crepitation upon passive movements, especially during hyperextension of the joint.
Radiologically the UAP can easily be diagnosed, but special care should be paid on the primary lesion (incongruity of the elbow, growth arrest of the ulna) and/or the presence of other abnormalities (especially FCP)

### Fragmented medial coronoid process

The medial coronoid process of the ulna is the medial margin of the radio-ulnar joint and can be partially or totally fragmented (FCP) or insufficiently ossified (i.e., chondromalacia). It can be seen together with elbow incongruity (INC), i.e., a relative shortened radius. The combination FCP plus INC is frequently seen in Bernese Mountain Dogs (almost in 80% of the cases of ED) and to a much lesser extent in Labradors (approximately 5% of the cases of ED). When the coronoid breaks off from its origin and is slightly displaced, it can cause an erosion on the opposite site. Consequently the dividing cartilage cells of the humeral condyle (who normally will develop into bone by endochondral ossification) will be damaged. As a

result, dividing cartilage cells will but rubbed off, no cartilage and thus consequently no bone will be formed. This erosion is visible on radiographs, and is referred to as a "kissing lesion"[4]. Upon clinical investigation, dogs reveal lameness (in case of unilateral FCP) or shortened step (in case of bilateral FCP), supination and pointing forward of the affected leg in standing position is often noticeable, slight swelling of the elbow joint, and pain and crepitation especially when supination and pronation are forced with an extended and flexed elbow joint. Lameness can objectively be determined by the use of force plate techniques and thus surgical or dietary intervening can be evaluated[5,6,7,8] .

The FCP can be seen on radiographs, sometimes in combination with as osteochondrotic lesion (or kissing lesion), elbow incongruity (too short radius) or an UAP (see above)

**Osteochondritis dissecans**

Osteochondrosis (OC) is a disturbance of the process of endochondral ossification, i.e., the process of cartilage growth and maturation and the transformation of cartilage into subchondral bone. Numerous clinical and laboratory investigations have demonstrated that excess food intake, and especially high calcium and phosphorus intake, increases the frequency and the severity of osteochondrosis in the fast growing puppy[2]. In some cases of OC, fissure lines will develop in the thickened cartilage which eventually leads to a cartilage flap; this stage is called osteochondritis dissecans (OCD).
The clinical signs resemble those of FCP. Lameness, joint swelling, outward rotation of the paw, slight crepitation and pain reaction during flexion and extension, specially painful when radius-ulna is extended and exorotated (supinated) in the elbow joint at the same time Anteriorposterior and oblique radiological views will reveal an indentation in the medial humeral condyle, resembling the "kissing lesion" described above.

**Incongruities of the joint surfaces**

Incongruity of the elbow joint (INC) is the situation where the joint surface of the humeral trochlea is not parallel with the joint surface of both the radius and ulna. INC can be due[5] to:
(1) a relatively short ulna as compared to the length of the radius, and may coincide with UAP or distractio cubiti (i.e., pressure of the radius to the intact and united anconeal process)
(2) a relatively short radius; this may coincide with FCP (as frequently seen in Bernese Mountain dogs
(3) a relative oval shape of the trochlear notch; this may coincide with UAP and/or FCP[3]

INC itself will also cause OA due to the fact that only a smaller than normal area bears the body weight, and thus is under constant high pressure. With clinical examination it is hard to diagnose INC per sé: more the secondary signs (FCP, UAP) give the abnormal findings. The clinical signs can be very obvious as in nutritional induced (bilateral) radius curvus syndrome, or very obscure as in the short radius or oval shape INC.
With strict ML views, especially the extended view when incongruity of the bony structures can be visualised, an incongruity of the cartilaginous joint surfaces can be expected to be present.

**Osteoarthrosis**

Osteoarthrosis (OA) of the elbow joint can be caused by developmental diseases grouped together under the name of "Elbow Dysplasias" (i.e., UAP, FCP, OCD, INC) as well as by a variety of less frequent occurring diseases including avulsions, joint instability following ligament rupture (or iatrogenic desmotomy) or (intra-)articular fractures [4].
The International Elbow Working Group (IEWG) has defined degrees of OA, based on the size of the osteophytes at distinct sites on ML and dorsoventral radiographs. Details are given at the web site of the IEWG (http://www.iewg-vet.org/). The size of osteophytes generally increases at older ages and is influenced by different circumstances including differences in environment (i.e., nutrition and activity of the dog) and perhaps in the genotype.

Since it has been reported in follow-up studies that dogs will develop a higher grade of OA with or without surgery[6], some advocate to be reluctant in performing surgery.[9] In case of lameness, NSAIDs (eg. Rimadyl 2 times daily 2 mg/kg body weight) plus restricted weight bearing activity but frequent swimming can be prescribed. It is our experience in follow-up studies that surgery till 2 years of age is beneficial in >70% of the cases, whereas surgery in dogs older that 2 years, the prognosis quickly decreases to a 30% beneficial. This can be explained by the development of irreversible, secondary cartilage erosions in older animals, whereas the mechanical hindrance is removed in young dogs before these erosions are developed.

## Etiology of Elbow dysplasias

This can be divided into genetic, environmental, nutritional and mechanical (traumatic) influences.

**Genetic influences**
Purebred dog populations represent genetically closed populations, in which high selection intensities and subsequent high levels of consanguinity are common. When only few of the members of the breed (e.g. mainly the champions) are used for reproduction, than a genetic bottle neck is created unintentionally but surely, reducing the genetic heterogeneity. It is to be expected that this selection procedure, which is common place in many breeds, may lead to increasing incidence of genetic diseases when the selected breeding stock by chance carried the genetic risk factor for ED or any other genetic disease. When the genetic risk factor has a dominant inheritance pattern leading to clinical signs before breeding age, than the dog and its parent(s) can be discarded from reproduction, like in chondrodysplasia [10,11] (Carrig et al, 1988). But in case the genetic risk factor has a recessive or polygenetic inheritance pattern, has a variable pattern in penetration, or is based on a genetic diseases with a high influence of environmental aspects than, especially when manifest at older age, the entity has all chances to spread around in the population before being recognized. This is especially so, when there is a lack of adequate disease registration within the breeders club. In such diseases, the spread of the disease allele can be considerable before these diseases are recognized as genetic diseases within certain breeds [12,13].

Although ED occur in well described breeds, not each form of ED is seen in all of them:
Incongruity of the elbow joint (INC) due to a radial overgrowth is seen in Bernese Mountain Dogs in 80% of the dogs with osteoarthrosis in the elbow joint. In a survey of a large group of Bernese Mountain dogs this type of incongruity was seen in all cases with elbow lameness in conjunction with a fragmented coronoid process[14]. Population analyses revealed that the disease was introduced right after WW II by a limited number of founding fathers and from there introduced in the breed.
Fragmented coronoid process of the medial aspect of the ulna is seen in many breeds and in large percentages, up till 50% of the screened population.[14,15] The heritability estimates are between 0.24-0.43 for Bernese Mountain Dogs, 0.77 for Labradors and 0.45 for Golden Retrievers [16,17]. For Retrievers, these figures are for osteochondritis dissecans of the medial humeral condyle (OCD) plus FCP, and thus found to be polygenetic in addition to multifactorial. [17,18]. For FCP and OCD alone, these figures are not calculated yet.
The ununited anconeal process (UAP). It is seen in chondrodystrophic breeds (like Bassets) [5] and as part of elbow incongruity in certain breeds[3] as well as due to nutrition induced or traumatic radius curvus syndrome.[5,19]

DNA-analysis focussed on collagen candidate genes in Labradors with FCP, did not reveal any indication of the involvement of these candidate genes in this skeletal disease. Genome wide scan, using 300 polymorphic markers is more promising with the possible abnormal locus at the first and thirteenth chromosome warrants further research using microsatelite

markers. [20] It is to be expected that DNA-analysis of the population will detect dogs with the affected gen(s) who did not brought the disease to expression (due to optimal environmental circumstances) or are heterozygous for the disease. DNA-analysis of the potential breeding stock will fore come a lot of frustration for breeders who now experience positive offspring of negative parent dogs and thus a slow decrease of the incidence of these hereditary diseases in next generations.

**Environmental influences**

From the heritability estimates it can be concluded that other factors may play a significant role in the manifestation of ED. From different studies it became clear that breeding with ED-negative dogs (based on radiological screening) will decrease the incidence of ED considerably when compared with breeding of positive x positive, or positive x negative, or negative x unknown [15]. ED in Labradors (and in Golden Retrievers to a lesser extend) is seen more frequent in male than in female dogs, although it can be expected that environmental factors do not differ to such a degree between genders. We calculated that, in case ED follows the hereditary pattern of a variability in expression of a major, dominant gene, the penetration of FCP in male Labradors is 70% and in female dogs is only 28%. In other words, in a Labrador with the disease allele for FCP, this disease comes to expression in 70% of the males and only in 28% of the females, thus a phenotypical negative female has a larger chance to pass the genes to the next generation than a negative male Labrador, even when screened carefully [21]. For breeders this is important information, since it warrants not only the screening of the breeding stock, but also of related animals (i.e. littermates) and offspring, which might tell more about the genetic make-up of a particular dog than the radiograph of its own elbow joints.

**Nutritional influences**

From a variety of studies it became clear that nutrition has a major impact on skeletal development. Food with a high calcium content has proven in field studies [22] as well as in standardised laboratory circumstances [2,23] that high mineral intake will cause disturbances in endochondral ossification. This makes the skeleton more vulnerable to mechanical influences like over weight as well as to OCD lesions. More recently, it became clear that vitamin D intake increased to a level that it will not lead to hypervitaminosis D (with calcification of soft tissues), will also disturb endochondral ossification by direct influence and not by increasing intestinal calcium absorption. [24] High food intake and thereby excessive calcium and vitamin D intake does also lead to osteochondrosis. [25,26] High calcium or high vitamin D intake will cause retained cartilage in growth plates and thus a disturbance of growth in length of the fast growing growth plates, in particular of the distal ulna and distal radius. Disturbance of growth in length may lead to radius curvus syndrome or short radius syndrome, respectively. Elbow incongruity in case of radius curvus syndrome may coincide with UAP, whereas incongruity with a shortened radius may coincide with FCP.

These findings are of great value for owners of a single dog, who want to prevent ED to develop in their pet by providing an optimal environment to mature. A high quality dog food prepared particularly for puppies of large breeds should be provided, characterized by a lowered (~1.0% calcium of dry matter base) calcium content and a controlled vitamin D content (~500 IU/ kg food). It has been shown that an increased protein level of high quality, typical for the better puppy diets, does <u>not</u> have a negative influence on skeletal development whereas it is of importance for soft tissue growth and immunological defence systems. [27]

**Mechanical influences**

Traumatic injury of growth plates, especially Salter Harris type V fractures, may disturb growth in length of either the radius of the ulna and as such may be responsible for the overloading of ulna or radius, respectively. In case the coronoid is mainly cartilaginous or the anconeal process is still separated from the olecranon by a cartilaginous layer (< 5 months of age), this can result in a FCP or UAP, respectively. Only seldom, there can be an indication

of a traumatic fracturing of the anconeal process or of a coronoid process in adult dogs, while both age and history will differ from that of ED in young, fast growing dogs.

Not too much is known yet about the influence of loading on skeletal development in dogs. It is known that unloading will cause both disuse osteoporosis as cartilage degradation, especially in young fast growing individuals. Some of most compelling evidence that supports a causal relationship between cartilage function and form comes from animal experiments in which the joint loading is either increased or decreased above normal levels. Increasing the functional loading of joints though moderate exercise causes an increase in articular cartilage thickness, proteoglycan content, and mechanical stiffness of the tissue, though strenuous exercise can lead to the formation of cartilage lesions. [29] In a large, well-controlled study in fowls and beagle it became clear that a functional adaptation of joint cartilage to weight bearing occurs during the first months of life and is important for the development of resistance to injury during later life. [30,31] Immobilization or other means of joint unloading has lead to a thinning and softening of the uncalcified part of articular cartilage, an increase in subchondral vascular eruptions, and a decrease in proteoglycan content. The structural and biochemical changes associated with joint unloading can only partially be reversed when the joint is remobilised. Physiologic joint loading results in functional adaptations that increase the resistance of the cartilage and are beneficial to the overall health of the tissue. The areas of enriched proteoglycan content are logically the areas most resistant to the degenerative changes of a joint during osteoarthritis. [29]
Further research is needed to learn more about the optimal weight bearing or training activities of young, fast growing animals to develop optimal functional adaptation. Joint incongruity as seen in Bernese Mountain dogs, with constant overloading of the remaining weight bearing surface, i.e, the contact area of the humero-ulnar joint, can hold responsible for the fragmentation of the apex of the medial coronoid process, although Bernese Mountain dogs with a FCP without INC can be seen in approximately 20% of the Bernese with ED. Based on the findings of Gemmill et al, 2005, it can be assumed that the radius is too short rather than the ulna too long.[32] The FCP in Labradors, Golden Retrievers and Rottweilers, characterized by a fragmentation of the coronoid process at the radio-ulnar joint is still unknown, however the anatomical study of Wolschrijn & Weijs (2004) in coronoid processes of Golden Retrievers pups may give an indication. [33] An anisotropic structure of the trabeculae with an orientation in the direction of the proximodistal axis of the ulna is already present at 6 weeks after birth. This primary alignment is perpendicular to the humeroulnar articular surface, matching the direction of the compressive forces applied to the medial coronoid process by the humeral condyle. The secondary alignment appears at 13 weeks after birth and is directed along the cranio-caudal axis of the medial coronoid process, toward the attachment of the annular ligament. Excessive pulling force of this ligament might be responsible for the fragmentation of the coronoid process in Retrievers. Vulnerability of the growing bone at the site of the coronoid process along the split lines is also supported by the work of Kunzel and co-workers. [34] In any case, it is very unlikely that normal weight bearing even during playing can be hold responsible for the FCP frequently seen in particular breeds. It can although express an abnormal micro-architecture of the joint causing shearing forces with fragmentation of bone fragments.

## Conclusion

In summary, elbow dysplasias (including UAP, FCP, OCD and INC) could spread among certain dog breed, due to the use of a limited amount of breeding dogs affected with a disease allele which comes not to expression in all cases. Based on the heritability estimates as published in veterinary literature, environment will play a significant role in cases the genotype comes to expression. Since dietary intake of calcium and vitamin D may cause disturbances in endochondral ossification and thus play a role in the occurrence of UAP, FCP, OCD and INC, unbalanced diets or excessive food (and thereby mineral) intake should be avoided, with feeding a diet with guanteed a limited amount of these constituents. Although trauma may play a role in the occurrence of FCP along the split lines in possibly

young skeleton with delayed modelling, the preventive or causative influence of physical activity or over-use on elbow joint development in dogs is still largely unknown. Only supra-national and secure registration of well defined disease entities and breeding measures based upon the findings of this screening will decrease the incidence of elbow dysplasias until DNA-screenings techniques have been developed.

## Literature


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# Elbow Dysplasia: correct radiographic technique and film interpretation

(Official IEWG - Requirements for the Screening Procedure)

Prof. Dr. Mark Flückiger, Dr.med.vet., DECVDI, Dysplasia Committee, Tierspital 8057, Zürich, Switzerland

## Radiographic technique

1.Minimal age for routine screening is 12 months
Check specific breed-club requirements! Some ask for older animals!
Dogs with elbow lameness should always be radiographed, regardless of their age!

2. Both elbows are radiographed

3. Rare Earth screens with a speed of 200 or less are recommended

4. The elbow is placed directly on the cassette, no grid is necessary for the examination (radiographs of very large dogs may profit from using a grid)

5. Each elbow is radiographed separately, the beam is collimated, this improves image quality

6. The mediolateral projection is taken with the elbow in flexed position (45° opening angle) resulting in concentric superimposition of the medial and lateral part of the humeral condyle.

Note: The MCP is best identified on a mediolateral 15° oblique view with the elbow extended and 15° supinated. Good results are achieved with a kV-setting of 60 or more and rather low mAs-settings (mAs product depending on film-screen-system and focus-film-distance).

7. Additional views such as

- mediolateral view in neutral position (approx. 110° opening angle) and
- **craniocaudal view with 15° limb pronation** (and, if possible, 15° beam angulation in proximal direction) are **strongly recommended**

8. Radiographs are permanently marked including the date of the examination, the identity of the dog, the identity of the owner of the dog and the clinic taking the films

## Film interpretation procedure

9. Radiographs for elbow disease are screened by qualified persons. An open list of qualifiedpersons has been filed at the FCI office by the advisory panel of the scientific committee of the FCI

10. If the radiographic findings are ambiguous, a repeat examination is indicated after 3 months

11. A possibility for appeal prior to release of the results is provided

12. Results of the evaluation are open to researchers, dog owners and breeders

13. Radiographs will be archived at an appropriate location for 10 years

## Film Interpretation

Radiographic findings vary depending on etiology, severity, and duration of ED and breed. The radiographic diagnosis of ED is based on the presence of arthrosis and/or a primary lesion such as

malformed or fragmented medial coronoid process (FCP)
ununited anconeal process (UAP)
osteochondrosis of the medial humeral condyle (OCD)
marked incongruity of the articular surface with step formation and/or subluxation (INC).

Additional findings (of various etiologies and varaible relevance) such as

periarticular mineralisation (mineralisation/avulsion of flexor tendons at the medial epicond.)

DJD of unknown origin

any other abnormality noted should preferably be reported as well.

## Radiographic findings indicative of FCP (Fragmented Medial Coronoid Process)

Mediolateral radiograph

- Increased subchondral bone opacity (sclerosis) at the base of the coronoid processes,
  loss of trabecular pattern
- Step of > 2 mm between radius and ulna
- Blurred cranial edge of the medial coronoid process. Note: A flap or fragment is rarely seen!
- Reduced radiographic opacitiy of the medial coronoid process
- New bone formation anywhere on the elbow joint such as
  dorsally and laterally on the anconeal process,
  on the lateral humeral condyle
  on the medial humeral epicondyle (check also for flexor mineralisation/avulsion)
  on the cranial border of the radius
- Uneven width of the joint space between humerus and radius.

Cranio-caudal radiograph:

- Bony irregularity and/or new bone formation on the medial border of humerus and ulna
- A bony fragment is rarely seen!
- Step between radial and ulnar subchondral bone plate
- Humeroradial joint space medial wider than lateral, particularly in Bernese Mountaion Dogs
- OCD or kissing lesion: subchondral bone defect in the medial humeral condyle with or without subchondral sclerosis. A bony fragment is rarely seen

Beware of artifact: The sagittally running radiolucent line within the MCP on a slightly pronated projection usually represents the edge of the ulna and not a fissured PCM!

## Radiographic findings with OC/OCD (Osteochondrosis, Osteochondritis dissecans)

Typical findings are

- Defect in articular surface of medial humeral condyle, best seen either on the craniocaudal or mediolateral extended view
- A bony flap or fragment is rarely visible
- The defect may be missed on technically suboptimal films !!

## Radiographic findings with UAP (Ununited Anconeal Process)

- Irregular radiolucent vertical line between anconeal process and ulna after 18 weeks of age
- Irregular shape, opacity, and outline of the anconeal process
- Progressive DJD depending on duration of process

## Scoring

The elbow findings are scored according to the severity of the arthrosis (DJD) and/or presence of a primary lesion using the IEWG (Int. Elbow Working Group) protocol

| **Scoring for Elbow Dysplasia** | | **Radiographic Findings** |
|---|---|---|
| **0** | Normal elbow joint | Normal elbow joint,<br>No evidence of incongruency, sclerosis or arthrosis |
| **I** | Mild arthrosis | Sclerosis of ulnar trochlear notch and/or<br>Step =/> 2 mm between radius and ulna and/or<br>Presence of osteophytes less than 2 mm high |
| **II *** | Moderate arthrosis | Presence of osteophyte 2 to 5 mm high |
| **III *** | Severe arthrosis | Presence of osteophytes more than 5 mm high |

***** In many countries the presence of a primary lesion such as UAP, FCP, OCD, or severe INC of more than 2 mm automatically results in a score III, the suspicion of such a lesion in a score II, irrespective of the severity of arthrosis present. However, in some countries the presence of a primary lesion with no secondary arthrosis formation will result in a score 0 !! For USA please refer to www.offa.org.
A score Borderline between I and II for undetermined cases is alloted in some countries.

## Literature


- http://www.ncbi.nlm.nih.gov/entrez/query.fcgi (Enter: Elbow dysplasia dog)
- Morgan JP, Wind A, Davidson A: Hereditary bone and joint diseases in the dog, schlütersche 2000. ISBN 3-87706-548-1. An excellent book!

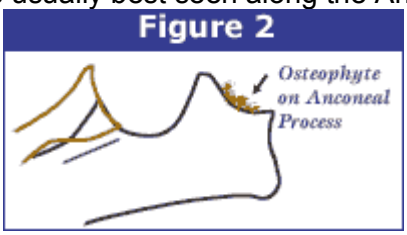
## Correct Elbow Positioning and Angulation for ED Scoring

Mediolateral projection

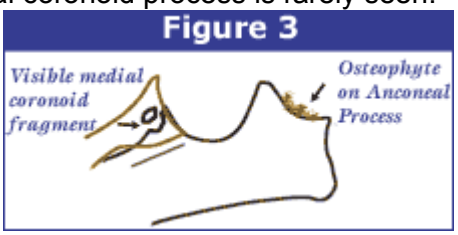
Craniocaudal 15°,pronated projection

The following figures 2-4 are taken from OFA: Evaluating the Elbow

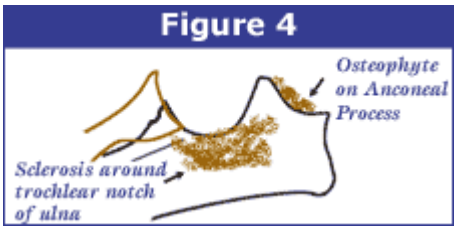
Early arthrosis formation is usually best seen along the Anconeal Process:




The fragment off the medial coronoid process is rarely seen:



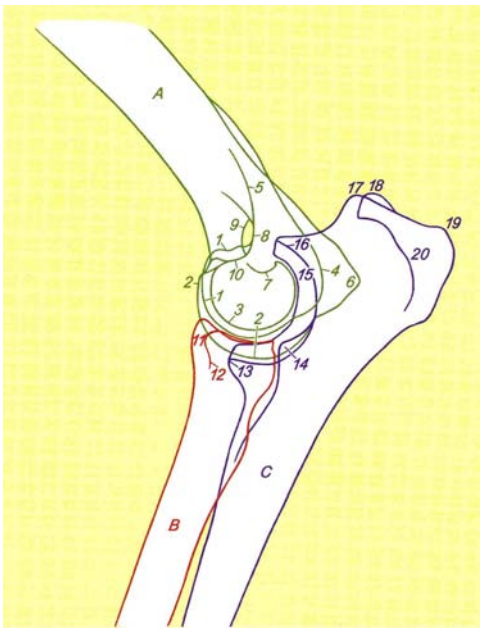

Common findings in dogs with FCP are sclerosis of its base and osteophytes on the anconeal process:



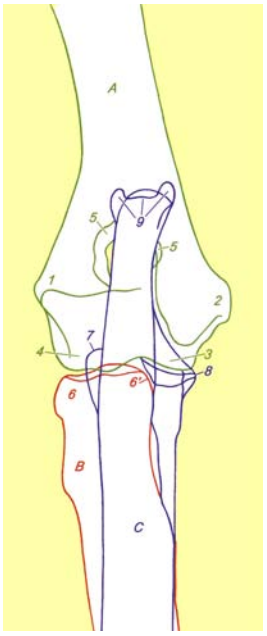
## Normal Elbow Joint

(from Waibl et al.: Atlas of Radiographic Anatomy of the Dog, Parey 2003)

Mediolateral view




Craniocaudal view




Caution: This diagram shows no pronation.

Apply 15° pronation for ED scoring!

Legend

| | |
|---|---|
| A | Humerus |
| B | Radius |
| C | Ulna |
| 2 | medial humeral condyle |
| 3 | lateral epicondyle |
| 6 | medial epicondyle |
| 13 | medial coronoid process |
| 14 | lateral coronoid process |
| 16 | anconeal process |
| 3 | medial humeral conyle |
| 7 | lateral coronoid process |
| 8 | medial coronoid process |

# Elbow Projections for ED Grading

mediolateral view
45-60° opening angle
MANDATORY

mediolateral view
15° supinated
OPTIONAL

# Elbow Projections for ED Grading

mediolateral view
90° opening angle
OPTIONAL

craniocaudal view
15° pronated
HIGHLY RECOMMENDED!

# Therapy of Elbow Dysplasia: conservative, arthrotomy and arthroscopy.

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## Introduction

Diseases of the elbow joint are very common causes for forelimb lameness in various breeds of dogs. In young growing dogs of medium and large breeds, developmental disorders, such as elbow dysplasia (ED), are the most common causes. ED is not an independent term for one disease like hip dysplasia (HD), but ED is used as a generic term for several diseases, such as fragmented medial coronoid process of the ulna (FCP), ununited anconeal process (UAP), osteochondrosis dissecans of the medial humeral condyle (OCD) and elbow incongruity associated with premature closure of a growth plate. These conditions leads to changes of the the articular cartilage, synovial tissue, synovial fluid, and the periarticular tissue, due to the effects of destructive enzymes, joint instability or incongruity and results in most cases in progressive joint capsule thickening and osteoarthrosis (OA).
In some cases the condition appears to be well tolerated as long as the joint is not overstressed. But often locomotor dysfunction increases, when the dog becomes older. The speed with which these defects worsen depends on the degree of the original mechanical fault and on the level of stress on the joint, which is related to the size and weight of the dog and its activity.
The diagnosis of ED is based on physical, orthopedic and radiographic examinations. There is no direct relationship between the underlying disease, the severity of OA and the degree of lameness. It is not finally solved, why some dogs with severe OA remains clinically inapparent for years. Sometimes a sudden trauma, such as fall or jump, injured the joint and may be the point that the condition changes from non-inflammatory to inflammatory. When such a case becomes clinically lame it is probably because an already vulnerable joint has been suddenly overstressed, and the resultant inflammation superimposed on the chronic degenerative changes makes matters worse.
The diagnosis of the underlying cause of ED can sometimes be difficult, as for example in joints with advanced OA. In this context, additional techniques, such as arthroscopy, computed tomography or magnetic resonance imaging can be helpful.

## Therapy of elbow dysplasia

The treatment of ED depends on the underlying cause of the disturbance, the degree of lameness, the overall condition of the patient (e.g. overweight, age, health), the attitude of the owners and can either be conservative or surgical or both. The chosen treatment should help to relieve pain and allow an approximated normal activity of the dog.
In several dogs, the diagnosis of ED is a casual finding during routine screening and because of the lack of clinical signs they do not receive any treatment.
In the young or middle aged dog with ED and forelimb lameness of different degree, the treatment is surgical in the majority of the cases.
In older dogs with ED and different degree of OA, the treatment protocol depends on the individual case. When the underlying cause for the lameness and the OA is clearly visible on the radiographs (e.g. UAP), the treatment is surgically in most cases.
If the dog is overweight, has an occasional lameness after exercise and/or severe OA and/or the underlying cause is not clearly visible and, in addition, the owner dislikes

surgery, the treatment protocol is conservatively first. When there is no response to this treatment regime and the lameness and pain persists or worsened, further investigations are performed to detect and treat surgically the underlying cause.
The success rate of surgical treatment of ED depends on the complete diagnosis before surgery, on atraumatic surgical approach and on the sensible aftercare by the owner. Because OA progression in ED is an early process, the results of surgery are better in early stages of the disease.

**Conservative treatment**
The conservative ED management consists of three main components:

1. weight control (reduction of body weight with dietary management)
2. exercise restriction / physical therapy
3. medical treatment

Current medical treatments often involve a wide variety of non-steroidal anti-inflammatory drugs (NSAIDs – e.g. Rimadyl®, Metacam®) or combination of phenylbutazon and prednisolone (Phen-Pred®), slow acting, disease modifying OA agents (e.g. nutraceuticals, chondroprotectives - e.g. Hyaloronic acid i.v.) or corticosteroids to decrease pain and inflammation. The use of these agents is complicated, and concrete guidelines are almost impossible to draw from the current literature. Because relief of pain and increased joint function due to drug therapy can result in excessive use of degenerated joints, any treatment protocol must be tempered with controlled levels of exercise to avoid accelerated joint destruction. Conservative treatment of ED (and OA) is not curative, only symptomatic, and progression of disease in unavoidable.

**Surgical treatment**

**Ununited anconeal process**
Surgical treatment of an UAP consists of either removal or fixation of the anconeal process. The therapy generally recommended in the literature and in textbooks is the removal of the UAP through a lateral or caudolateral approach in order to eliminate irritation caused by the isolated bone fragment. In many cases this leads to a temporary improvement of clinical symptoms. In most cases, the long term results are reported to be unsatisfying, because patients are not always completely free of lameness and the lacking of the anconeal process causes instability of the joint which leads to OA. Because of the mainly unsatisfying results after removal of the UAP, attempts were made to improve these results either by screw fixation of the UAP or proximal osteotomy of the ulna. The results of these therapies were in the majority better than those, which were achieved by removal of the anconeal process, but were not consistent and not yet optimal. The optimal treatment protocol for UAP in young dogs is a combination of fixation of the UAP and osteotomy of the ulna and depends on the individual case.

**Surgical procedure for fixation of UAP:** For fixation the UAP, the elbow joint is approached from caudolateral. Before arthrotomy, the elbow joint is examined arthroscopically from the medial side. The joint cartilage and the mobility of the anconeal process were assessed.
In cases, in which the anconeal process is not movable, a proximal osteotomy of the ulna is performed without fixation of the anconeal process. In cases, in which the anconeal process is movable, the fragment is fixated in addition to an osteotomy of the ulna, independent whether a step between radius and ulna is present or not.
For this procedure, the patient is positioned in dorsal recumbency on the operating table and the affected limb is fixed in cranial direction. After surgical preparation the UAP is positioned towards dorsal that the necrotic material is removed from the apophyseal disc using a curette. After this cleaning up the gap is provided with 4 or 5 punches of

cancellous bone material as required, which could be obtained from the olecranon with help of a trepan. The anconeal process is then repositioned and temporarily fixed by reposition forceps. With the help of a drill guide a hole is drilled from the caudal aspect of the olecranon to the tip of the anconeal process as tap hole and than to the apophyseal gap as gliding hole. The length of the gliding hole could be determined from outside with a screw depth gauge and marked on the drill. The fragment is fixated with a 2.7 mm or a 3.5 mm cortical screw. In addition a Kirschner wire has to be inserted in an angle of 10-20° to the screw to ensure rotational stability. In cases with an intra articular step between ulna and radius, a proximal ostectomy of the ulna is subsequently performed with resection of a 0.5 to 1 cm slice of bone. In cases without a step formation, the ostectomy could be done in the middle or distal third of the ulna.

**Results:** In a prospective trial over seven years, the treatment results of 44 joints from 41 dogs with an UAP were investigated. In 35 joints, the anconeal process was stabilised with lag screw and pin, because there was no fibrous connection between the anconeal process and the ulna. Additionally, in all of the cases an ulna ostectomy was performed. In nine joints, the connection of the anconeal process to the ulna was firm and only a proximal ulna ostectomy was performed. The anconeal process had fused with the ulna in all joints with one exception. Long-term follow-ups were performed clinically and radiologically in 43 joints (40 dogs) after an average of 20 months. 83.7% of the cases (n=36) did not show any lameness after the combined therapy with fixation of the UAP and osteotomy of the ulna (n=28) or ulna ostectomy alone (n=8) and were assessed as ´good`. Six dogs (5 with fixation, 1 with ostectomy alone) showed some degree of lameness after heavy strain and were only be evaluated as ´satisfactory`. One dog still had a striking low- to medium grade lameness, so that the result was regarded as ´unsatisfactory`. A minor increase of OA was noted in only nine joints.
The results shows, that a proximal osteotomy of the ulna alone is sufficient in cases, in which the anconeal process is not movable during surgery. In case of a loosened UAP, the treatment is successful, when a fixation of the isolated fragment is performed simultaneously with a proximal osteotomy of the ulna.

**Surgical procedure for removal of UAP:** The benefit of a fixation of the anconeal process is questionable in older dogs and in those with advanced OA. In those cases, the UAP is removed via a “mini” medial approach. Before surgery, the elbow joint is examined arthroscopically from the medial side to investigate the situation in the joint and to diagnose and treat a possible coexistent FCP or OCD. If no arthroscopic equipment is available, the investigation of the medial part of the elbow joint for coexisting FCP and removal of the UAP can also be done by arthrotomy from the medial side.
The medial aspect of the elbow is clipped and after aseptic preparation of the surgical site, the dog is positioned in lateral recumbency on the side of the affected not fixed limb without fixation of that limb. The contralateral limb is positioned caudodorsally along the trunk. The surgical site is covered with an adhesive plastic wrap and the dog is covered with sterile surgical drapes. The skin incision extends in a curve caudal to the medial epicondyle from 10 cm proximal to 5 cm distal to the medial epicondyle. The superficial fascia is transsected at the same length. The course of the ulnar nerve in conjunction with the collateral ulnar artery and vein along the antebrachium is traceable and palpable under the antebrachial fascia. Caudal to the ulnar nerve, the deep fascia is incised distally above the medial epicondyle and proximal along the cranial edge of the medial head of the triceps brachii muscle, extending to the angles of the original skin incision. After mobilisation the connective tissue, the medial head of the triceps brachii muscle is retracted caudally and the connective tissue together with the nerve and blood vessels cranially. Using a scalpel, the anconeal muscle is separated from the epicondyle. The joint capsule is incised half of the length of the fossa olecrani and directed caudally towards the anconeal process. Inevitably, the olecranon ligament, which is embedded in this part of the joint capsule, has to be transsected. The incision of the joint capsule is extended and

a self-retaining retractor inserted. In a partially flexed position, the anconeal process is now directly visible. If the anconeal process is already detached, the isolated bony fragment can easily be removed from the joint using an elevator or a blunt rasp. In cases where the anconeal process is still connected to the olecranon by connective tissue, a thin cannula is passed into the remaining physeal plate to localise its position. The anconeal process is then mobilised by use of a rasp or a thin chisel.
To inspect the distomedial part of the joint, the incision in the joint capsule is extended along the caudodistal edge of the medial epicondyle. Prior to this, the ulnar nerve and the accompanying blood vessels are further bluntly dissected distally, and the caput ulnare of the flexor carpi ulnaris muscle is separated from the caudal edge of the superficial digital flexor muscle and retracted. With the elbow in an extended position, the medial coronoid process can directly be inspected from a caudomedial angle by internally rotating the forearm and carefully opening the joint over the ridge of the table. The overall view is facilitated by retracting the distal angle of the incision. If an FCP is diagnosed, the fragment can be removed from the caudomedial (fragment removal only) or a medial approach to the joint (resection of the cranial tip of the coronoid process together with the FCP using a chisel), as described below. For this purpose, the skin incision has to be extended distally. After this procedure, the joint capsule is sutured in simple interrupted stitches with absorbable suture material. The wound edges of the fascia, subcutis and skin were closed according to routine procedure.

**Fragmented medial coronoid process of the ulna and osteochondrosis dissecans**
Surgical therapy is most often recommended in the literature for treatment of FCP and OCD. In spite of surgical treatment, OA continues at a more or less progressive pace. The prognosis concerning the improvement of lameness depends upon when surgery is performed and the degree of pre-existing OA. It is considered to be ´good` if surgery is performed at an early stage, i.e. when OA has not yet set in or is at a low level. However, it is unfortunately difficult to make an early diagnosis as the fragment itself can rarely be identified radiographically. Therefore, some authors recommend a diagnostic arthrotomy in predisposed dog breeds with persistent lameness and pain in the elbow joint, even if changes are not visible or are only minor on the radiographs. Arthroscopy is recommended as an alternative method for the early diagnosis of FCP. This minimal invasive method is clearly superior to other screening procedures (radiography, computed tomography) in these circumstances. In recent years, arthroscopy has not only been used as a diagnostic measure but also for surgical removal of FCP.

**Arthrotomy for removal of FCP and OCD:** For the conventional removal of the FCP, a medial approach to the elbow joint between the pronator teres and flexor carpi radialis muscles is performed without cutting the medial collateral ligament. After opening the joint capsule and inner rotation of the lower front limb, the medial coronoid process is removed with the help of a sharp spoon or with an osteotome. If an additional OCD is present, the flap is removed and the cartilage bed is curetted. After rinsing the joint with sterile lactated Ringer's solution, the wound is sutured in a routine manner. After surgery the elbow joint is bandaged for one to two days. In cases of a ´step` of more than 2 mm, a proximal osteotomy of the ulna is performed additionally.

**Arthroscopy for removal of FCP and OCD:** Arthroscopic surgery was carried out from the medial side of the joint. An arthroscope with a diameter of 2.4 mm and a 25° cranial-oblique view angle is used. Before the arthroscope is introduced, the joint is punctured with a needle on the medial site, proximally between the humeral trochlea and the olecranon in a craniolateral direction. The joint is distended with about 5-10 ml of fluid. The needle is retained in place and serves as lavage needle later. The site for the introduction of the arthroscope is 1 cm distal and 0.5 cm caudal to the medial humeral epicondyle. First, the correct puncture site (joint space) is checked with the help of a second needle. Then a stab incision with a scalpel (nr.11) is performed at this location and the trocar sleeve with the mandrin is inserted into the joint. This insertion can be

supported by abduction of the elbow joint over the ridge of the table and additional inner rotation of the leg by the assistant. Afterwards the mandrin is replaced by the arthroscope and the lavage system is connected. The pressure for the lavage should range between 100 and 150 mmHg. Arthroscopic findings are documented with a colour image printer.
Is the diagnosis of FCP or OCD confirmed a further portal for the surgical instruments becomes necessary. The instrumental portal is located 1-1.5 cm cranial to the arthroscope, directly caudal to the medial collateral ligament. Here also the puncture is performed with the help of a needle and when the correct location is confirmed, the stab incision is made for the surgical instruments. A trocar sleeve is not necessary for this portal. For the extirpation of the FCP and the OCD various grasping forceps, a retrograde scalpel and a motor driven shaver with different burrs are used. The arthroscopical removal of the OCD is done with the help of grasping forceps. Then the necrotic bone material underneath is removed by the shaver.
Then the joint is thoroughly flushed again and the skin incisions are closed. Usually a dressing is not applied after surgery. In cases of a ´step` of more than 2 mm, a proximal osteotomy of the ulna was performed additionally without opening the joint. In cases with osteotomy of the ulna a bandage was applied for one to two days.

**Results:** In a retrospective trial over eight years with 518 joints from 421 dogs with FCP (75 joints with an additional OCD), 247 were treated by conventional arthrotomy and 271 joints were treated by arthroscopy. 429 cases were re-evaluated by clinical and radiographical examination or by means of a questionnaire at an average of 22 months after surgery.
42.4 % (81/191) of the cases treated by arthrotomy did not show any lameness, 29.3% (56/191) showed temporary lameness after rest or heavy exercise and 28.3% (54/191) showed constant lameness, which had however been reduced by surgery in 14 of these cases. 60.1% (143/238) of the cases treated by arthroscopy did not show any lameness, 29.4% (70/238) showed temporary lameness after rest or heavy exercise and 10.5% (25/238) showed constant lameness, out of which four cases had improved after surgery. In cases treated by arthroscopy the period of convalescence was shorter. Differences between these methods were not observed with respect to the development of osteoarthrosis. The results of the study show that arthroscopy, with its minimal invasive character, gives better functional results than conventional arthrotomy. However, the development of secondary osteoarthrosis cannot be avoided by either method.

**Elbow incongruity**

For the treatment of elbow incongruity it is important to know the underlying cause of the disturbance. Elbow incongruity can happen in many variations and can have different underlying causes, e.g. trauma, a hereditary disease, a combination of both, nutritional imbalances or others. It develops in the growth period and almost only affects large dog breeds, with the exception of traumatic causes.

**Variation of incongruity**

The incongruity is a step between the radius and ulna, with either the radius being too short or the ulna too long, or the other way around. The two most common changes are however a relatively too short radius, the so called" short-radius-syndrome" or a relatively too short ulna, also called a "short-ulna-syndrome". On the other hand, incongruity can be the result of a malformed, too narrow, trochlear notch (dysplasia), so that the humeral condyle does not fit exactly into its opposite joint surface and is displaced cranially.
The consequences of incongruity are also variable and partly depend on the stage of growth at which the changes occur. Knowledge about the causes and consequences is important for the treatment regime.
As a result of the short-ulna-syndrome**,** the relatively too long radius pushes the humeral condyle more and more against the anconeal process. This may lead to an UAP, if the

physis has not closed yet. If the anconeal process has already fused, however, there is a distractio cubiti with its resulting consequences.
However, if there is a short-radius-syndrome, this can lead to a FCP, since the main weight load is then on this part of the joint. It is speculated that a FCP or an OCD occur more easily if the cartilage layer is thickened. That is the case in the younger dog. With progressed ossification (ossification of the medial coronoid process of the ulna is completed at about 20-22 weeks), however, cartilage or bone erosions occur much more often in the area of incongruity. Pronounced distractio cubiti can result in a real fracture of the medial coronoid process.
If the incongruity is a consequence of a dysplasia of the trochlear notch (oval or elliptic shape), on the other hand, the medial coronoid process of the ulna bears more weight and this results in a subchondral sclerosis. As a result of the close contact of the humeral condyle to the medial coronoid process and the anconeal process, the consequence can be a FCP, an OCD and/or an UAP, depending on the time of occurrence. Another possibility are abrasions of the cartilage and in severe cases of the subchondral bone layers.

**Surgical treatment**
The treatment of elbow incongruity depends on the specific type of the incongruity, the degree and the age of the patient. It depends on the individual case.

**Short-ulna-syndrom:** In cases of short-ulna-syndrome, the treatment depends on the age of the patient. Young patients with up to eight months of age with an UAP without or with only minor arthrosis were treated as described above. When the UAP is loosened, the small piece of bone is stabilised with implants. In addition a proximal oblique ostectomy of the ulna is performed. The aim of the proximal ulna ostectomy is to restore the joint congruity and to relieve pressure on the anconeal process during healing. The width of the ostectomy depends on the age of the patient. When the UAP is tightly in place, a proximal ostectomy of the ulna is performed as a single measure. However, the disadvantage of the proximal ulna ostectomy is, compared to ostectomy in the middle or distal third of the ulna, a more pronounced and prolonged postoperative lameness period and more callus formation.
In older dogs with UAP and advanced arthrosis or in joints with an additional FCP, the UAP (and, if present, the FCP) is removed via a “mini” medial approach.
In joints with short-ulna-syndrome without an UAP, which is very rare, a proximal ostectomy of the ulna is performed as a single measure to reduce the step and decrease pressure on the anconeal process.
**Short-radius-syndrome:** Treatment strategy in the short-radius-syndrome depends on the degree of step formation. In many cases there is also a FCP.
In cases of less pronounced step formation of up to about 2 mm, this is resolved by removing the (cranial) part of the medial coronoid process (coronoidectomy) arthroscopically with a thin chisel together with the FCP. In cases of a step formation of more than 2 mm, which is often the case in Bernese mountain dogs, a proximal osteotomy of the ulna is performed with resection of a small slice of bone in addition to the arthroscopic excision of the FCP. The ostectomy is done approximately 3 cm below the level of the radial head with an angle of about 45° from caudal and proximal to cranial and distal. The width of the removed bone must be sufficient to allow the radius and distal part of the ulna to move proximally until the radial head articulates normally with the lateral aspect of the humeral condyle. In addition, the pull of the triceps brachii muscle allows sliding and tilting of the proximal ulna fragment, decreasing the pressure on the coronoid process. The oblique direction of the osteotomy prevents intense dislocation of the proximal part of the ulna.

Regarding the treatment results of 17 dogs with a step of more than 2 mm, nine had clinically good results. In six cases the result was satisfactory and in two dogs unsatisfactory.
Severe steps (up to about 1cm), as it can be the case in traumatically caused physial disturbance, a lengthening osteotomy of the radius is performed followed by plate fixation. If concurrent FCP is present, it is first removed arthroscopically.

**Dysplasia of the trochlear notch:** In cases of dysplasia of the trochlear notch and FCP, this is arthroscopically removed together with the part of the medial coronoid process lying caudal to FCP (coronoidectomy) to prevent further abrasions. Sometimes there is no obvious step formation visible radiographically, but a dysplasia of the trochlear notch is suspected, the diagnosis can be confirmed by arthroscopy and is treated in the same manner.
If there are obvious abrasions in the medial joint area on the humeral trochlea and the medial coronoid process without a FCP, the incongruity is resolved either by osteotomy and removal of the affected part of the medial coronoid process with the aid of a thin chisel or the abraided areas are remove a little further with a shaver to prevent further abrasions and to enable the resulting of replacement cartilage.
Regardless of the chosen treatment method in the cases with abrasions without additional FCP (n=29), a good result was achieved in 46% of the cases. In 48% of the cases, the result was satisfactory and in the remaining 6% it was unsatisfactory. Ostectomy of the medial coronoid process did not lead to improved clinical results compared to currettage of the affected area.
If there is a an UAP and a FPC as a result of dysplasia of the trochlear notch, both bone fragments are removed, since fixation of the anconeal process does not appear practical due to the existing incongruity.

# Screening programme for Elbow Dysplasia

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The Netherlands

## Introduction

From a variety of scientific studies the hereditary aspects of elbow dysplasias (i.e., fragmented coronoid process [FCP], osteochondritis dissecans [ocd], ununited anconeal process [uap], and elbow incongruity [inc]) has been demonstrated. Although the pathophysiology of the different entities (why the coronoid breaks off, how inc occurs) has not been elucidated, and the mode of heritance is not known for most of the entities of ED, it has been shown in different breeding programmes that exclusion of the positives helps to decrease the incidence of ED in well described populations.
Veterinarians know the limitations of visualisation the genotype by radiographs, but realize that it is so far a technique which is available, affordable, and acceptable for most dog owners. Although it is less reliable than the more invasive arthroscopy or the more expensive CT-scanning, screening large numbers of dogs have been proven to help breeders to lower the incidence of ED in the populations. DNA-screening techniques are not available yet.

## How many radiological views are in use?

From studies published by different radiologists it can be learned that more views of the elbow joint reduces the amount of false negative diagnoses, reason why radiological investigation of patients with elbow lameness is performed by making two or more radiological views.
In order to discriminate between good and bad elbows at a screening programme both

1. the primary entity of ED (FCP, OCD, UAP, INC) and
2. the degree of arthrosis (absence or presence in different degrees) are looked for according to the protocol of the IEWG.

It is of help to realize that there may be more reasons to develop OA than ED alone (*false positives*), Contrarily, with increasing frequency old dogs (>3 years of age) are seen with elbow lameness, total free from OA in the elbow joint (*false negatives*), but positive on bone scanning and/or CT-scanning for FCP which restore after surgical removal of the FCP.
In some screening programmes it was decided to limit the amount of view to one, i.e., mediolateral view with a flexed elbow joint. This is the view with the greatest chance to visualize osteophytes when screening takes place at old age (allowing osteophytes to develop). This view might be sufficient when screening is performed in a large part of the population of the breed (to compensate for the significant amount of false negatives) especially of breeding stock ánd offspring (to draw conclusions from the occurrence of positive offspring from seemingly negative parent animals). This is for example the case in Sweden. In Sweden the incidence of ED in Rottweilers decreased from 85% in 1979 to 25% in 2004 and in Bernese Mountain dogs from 52% in 1985 to 18% in 2004, by this mass screening system extended to input from reports from veterinarians and assurance companies on arthroscopy or arthrotomy findings in these breeds (Dr. Audell, personal communications München 2005). In Sweden >80% of the breeds are screened !

In other countries where there is a less mass screening, more precisely radiographs should be judged, in order not to overlook ED in the screened dogs.The German group (i.e., Germany, Austria, Switzerland) and also France grade both the primary lesion

(including FCP, OCD, UAP, and INC) as to the grade of OA, so they look at a minimum of 2 (ML and AP), but preferably more (including APMO) views (see Table).

The screening of elbow joint for elbow dysplasias is voluntary in many other countries, and is organised by the national Kennel club, a breeder club or just on an individual basis by a certain owner or breeder. When organised by a breeders organisation, this organisation can provide an official registration form to veterinarians on their request, can organise independent screening by a skilled screening panel, can mail the (digitalized) radiographs to the panel and can register and distribute the results to owner and breeder clubs.

Different screening systems in Europe with scoring according to IEWG standard

| **Country** | **1 view (ML flexed)** | **2 views (ML and AP[MO]** | **3-4 views** | **OA score** | **Primary lesion score** | **Amount of dogs** |
|---|---|---|---|---|---|---|
| Sweden | + | | | + | | 11,000 per year |
| Norway | + | | | | | 4,000 per year |
| Germany Austria France | | | Mlflexed, ML neutral, AP | + | + | 25-40% of breed |
| Germany | | | ML flexed | | | German Shepherd dog |
| Italy | | | + | | | 2 screening panel systems; 1200 per year |
| UK | + | | | | | 1230 per year |
| Netherlands | | | MLflexed& neutral, APMO, AP | + | + | 800-1000 per year |
| Servia | | ML&AP | | + | + | |
| Slovakia | | ML&AP | | + | + | |

## What is the minimal age for screening?

For the breeds at high risk for ED (i.e., Labradors, Golden Retrievers, Rottweilers, German Shepherd dogs, Bernese Mountain Dogs, New Foundlanders and other breeds) >2 views radiological views are advisable, i.e. mediolateral (ml) extended and flexed, anterior-posterior and anterioposterior-oblique (apmo).
The minimal age for dogs is 12 months (In the USA 24 months) whereas for large breed dogs it can be synchronous with HD-screening (i.e., 18 months in many FCI-contries). For other breeds which are not at risk for ED according to national or international reports, only two views can be required, i.e., ml-extended and apmo. On request of breeder clubs a special screening program can be installed.

## Who is entitled to read films for screening?

The film reading is performed in many countries by one to three veterinarians, either together or in sequence, and are preferable registered specialists in radiology or orthopaedic surgery. This panel should check the quality of the film regarding exposure, positioning, and completeness of the set. Screening for ED includes screening for the primary pathology (fragmented coronoid process, osteochondritis dissecans, ununited anconeal process, incongruity, and other entities including the avulsion of the medial

humeral condyle), and/or for the grade of osteoarthrosis (OA) according to the guidelines as given by the IEWG in this proceedings and on its web page: http://www.iewg-vet.org/archive/2004/Prcdgs2004_2.pdf, (contribution of Dr Flückiger). The possibility for appeal should be offered.

## Does the screening panel give breeding advises?

It is the responsibility of the individual breeder clubs to implement the results of screening into their breeding program. Consequences drawn from it are democratically decided for by the members of the breeder clubs and the outcome depends on many factors, including the incidence of ED within the breed.
Too many breeder clubs do not take their responsibility yet in respect to screening for ED, despite the fact that it is frequently diagnosed in their breed. Future awareness of potential buyers, the guarantee sellers have to give by law for their product (including dogs), and the governmental attention for breeding healthy animals will persuade breeder clubs to make use of the infrastructure which is present in many countries these days.

## Is radiological screening for ED the most sensitive method?

Until DNA-screening techniques for screening different entities of ED in different breeds are developed, breeders can make use of sophisticated and non-invasive imaging techniques, although it may include a certain percentage of false negatives. The most practical technique until now is making and screening several radiological views together with open registration of results, offspring control, and consequent implementation of the results in breeding programs. In orthopaedic practices more sophisticated techniques including bone scintigraphy and CT-scanning, or more invasive techniques as arthroscopy or arthrotomy are performed. These methods are not in use in screening programmes. Till DNA-screening techniques are developed, the veterinary profession has to uniform the screening methods to solve the paradox that the better the screening, the more likely to be positive, and thus the greater the chance to be excluded from breeding and the harder to sell the dog or its offspring. Certification should at least make the way and quality of screening transparent and IEWG likes to assist the veterinary profession in this. Veterinarians associated with the WSAVA are in the strong position to implement the certificate (see copy) as has been designed for dog owners when dogs are sold within or outside the country, to offer insight to the potential buyer if the animal has been tested and if so, according which protocol.

# International Elbow Working Group

The International Elbow Working Group [IEWG] was founded in 1989 by a small group of canine elbow experts from the USA and Europe to provide for dissemination of elbow information and to develop a protocol for screening that would be acceptable to the international scientific community and breeders.
The annual meeting is organized for the purpose of exchanging information and reviewing the Protocol. All interested persons are invited to attend the meeting and to participate in its activities.
The IEWG is an affiliate of the WSAVA.

**IEWG meetings were held in**

| | |
|---|---|
| 1989 | Davis |
| 1990 | San Francisco |
| 1991 | Vienna |
| 1992 | Rome |
| 1993 | Berlin |
| 1994 | Philadelphia |
| 1995 | Konstanz |
| 1996 | Jeruzalem [cancelled] |
| 1997 | Birmingham |
| 1998 | Bologna |
| 1999 | Orlando |
| 2000 | Amsterdam |
| 2001 | Vancouver |
| 2002 | Granada |
| 2003 | Estoril |
| | Bangkok |
| 2004 | Rhodes |
| 2005 | Amsterdam |
| | Mexico |
| | Munich |
| 2006 | Prague |

**IEWG 2006**

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