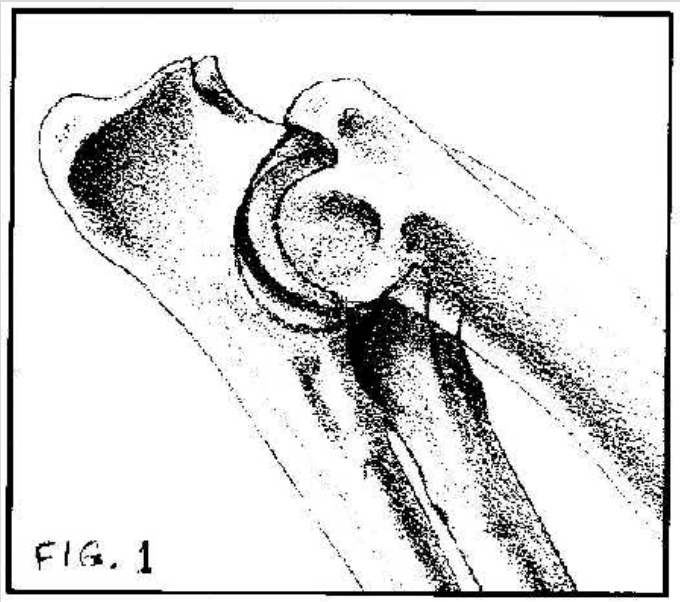
Another Look at Elbows

by Fred Lanting

Preface:

In the Second Quarter 2000, the SENNtinel, official publication of the Greater Swiss Mountain Dog Club of America, carried a reprint on Elbow Dysplasia by Dr. Henry DeBoer, a prolific magazine writer, schutzhund enthusiast, and all-around “working dog guy”. His topic should have been of great interest to Swiss people because ED is at a high incidence in the breed. Unfortunately, there were a couple of minor errors in his piece. Besides clearing up those, I would like to give some additional information on the disorder's) in the elbow. Please look at the drawings first, so you have “map and dictionary” to guide you through the text. The word “process” in this work means a bony “bump or protrusion”. Figures 1 through 3 are main positions used for radiographic views of the elbow.



EXTREME FLEXED MEDIO-LATERAL
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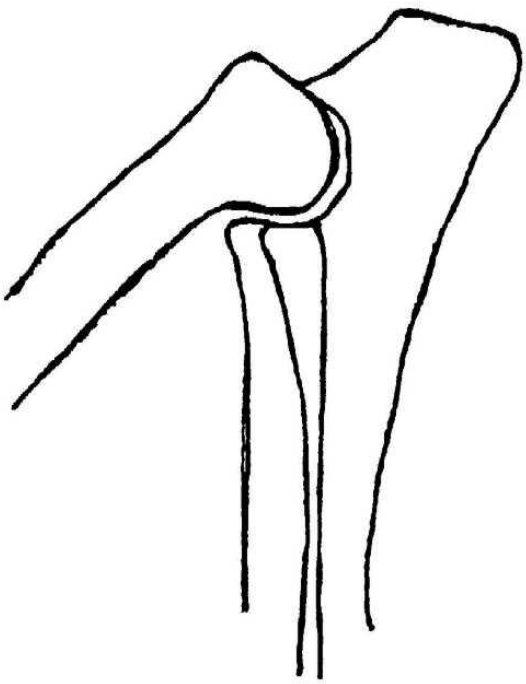
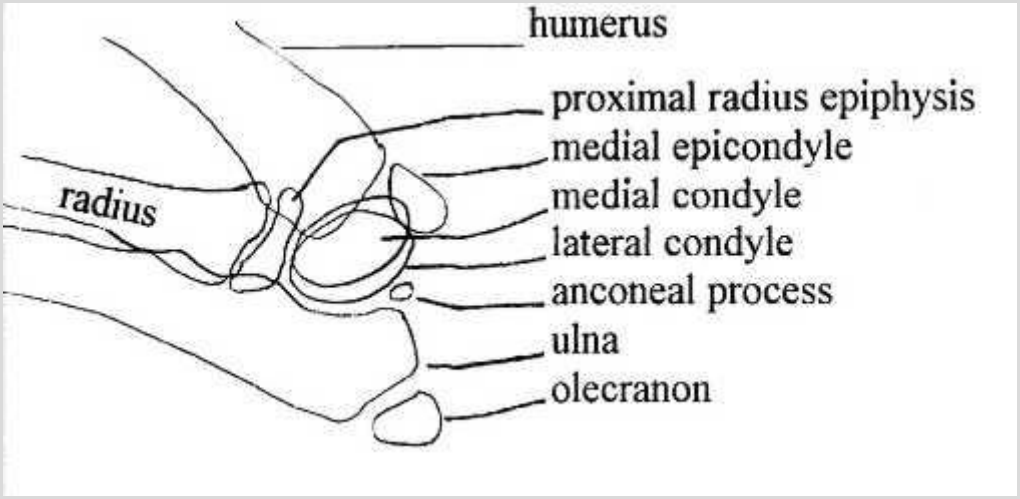


Figure 2. Flexed Lateral View (45°)

Figure 3. Neutral Lateral View (85-120°)

The most obvious of the errors was when Dr. DeBoer said that the coronoid process (like the anconeus) starts as a separate bone centre with a growth plate, and that it unites with the rest of the ulna in the same manner. This was an initial assumption `way back in the beginning, when the most authoritative orthopedics researcher and surgeon Sten-Erik Olsson first saw (in adult dogs) that there was a

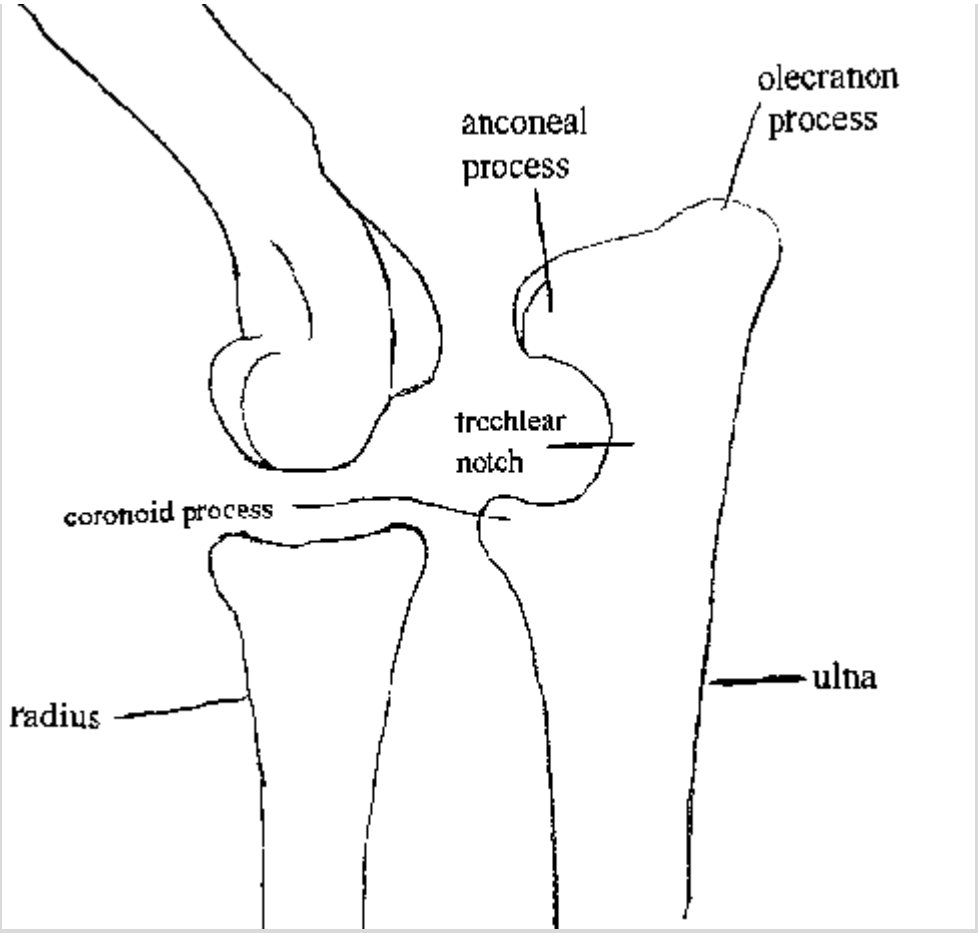
fragment in the coronoid-radius area of the elbow, not visible of nearly any radiograph. Finding that piece upon necropsy, and knowing that the anconeal started as a separate bone centre in the embryo and growing puppy, it was natural for him to think that the coronoid process did, too. He first reported the disease as "ununited medial coronoid process". However, he quickly found it not to be the case. Rather, the coronoid ossifies (changes into bone tissue) from the embryo's cartilaginous part of the main ulnar shaft itself. See **Figure 4.** Since the first assumption got into print, and was misunderstood by lay readers as an infallible statement, it persisted for a long time in the popular press even though the editors should have picked up Olsson's repudiation shortly thereafter.



Two of today's prominent researchers are Dr. Paul W. Poulos Jr. and Dr. Alida Wind. Poulos is president of the IEWG (International Elbow Working Group), found at http://www.vetmed.ucdavis.edu/iewg/iewg.html and Dr. Wind is a renowned orthopaedic surgeon at the Univ. of Calif. at Davis and one of the founders of GDC, the Institute for Genetic Disease Control, which you can see at http://www.vetmed.ucdavis.edu/gdc/gdc.htm When Poulos was in Sweden working on his Ph.D., and with Professor Olsson, the medial coronoid process was one of their areas of interest. He reports that when Olsson "went to unaffected dogs, we could not find any evidence of a separate center of ossification for the medial coronoid. At that time he changed the terminology to 'fragmented medial coronoid process', although the terminology 'fractured medial coronoid' has also been used. I know of no evidence to support a separate centre of ossification for the medial coronoid process."

The same writer (DeBoer) also relates UAP to the disparity in growth rates of ulna and radius, and says that taking a slice out of the ulna (effectively raising the relative height of the radius for better support of the humerus) "allows the anconeal process to unite". He speaks of a "decrease in tension". I know about that experimental procedure, but fail to see the connection, or the effect of better weight-bearing by the radius on the anconeal process. It is unlikely that there would be any biomechanical stress changes on that portion, which is "above and beyond" the gravitational support vectors from humerus to radius to foot. Perhaps a re-wording would help us understand this seemingly puzzling concept. Unfortunately, the article was not annotated.

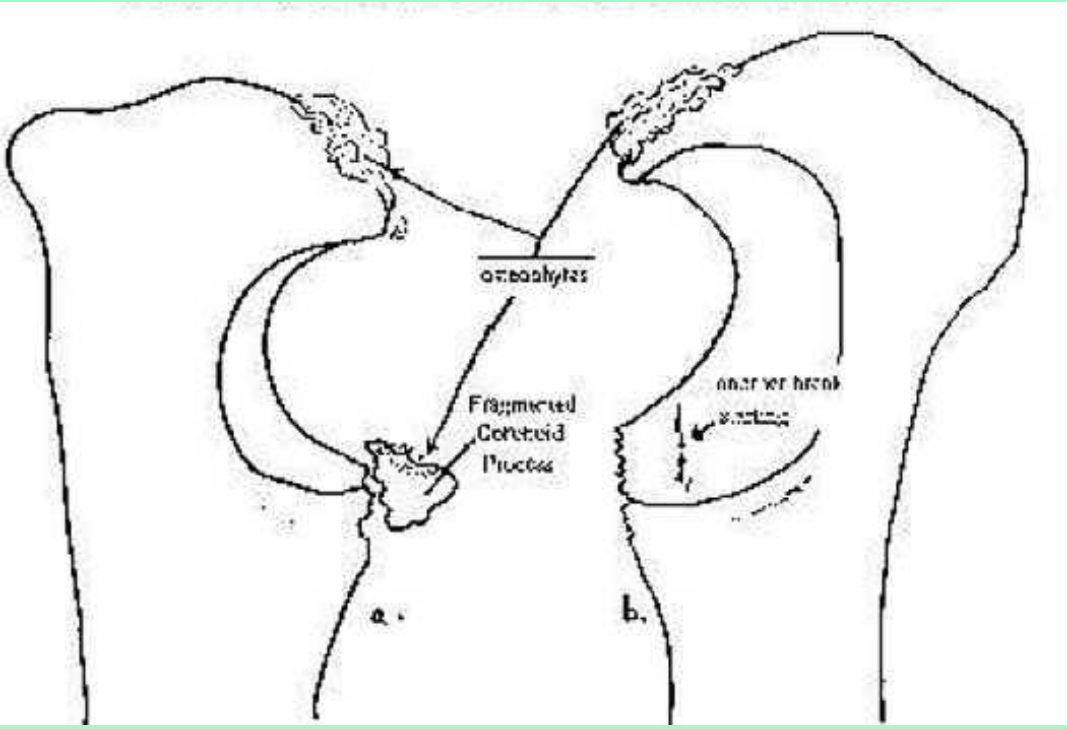
The elbow is called a synovial (lubricated) hinge joint, although it has some minor similarity to a ball-and-socket joint. There is not that sort of rotation that we find in the hip; the twisting of the lower arm is possible because of the design of the radius. Mainly, flexion and extension are the movements in the elbow itself. The ulna acts to add stability and restrict motion, and the radius bears most, perhaps up to 80%, of the weight of the forequarters. At the top (proximal) end of the ulna, there are three main processes that concern us (See **Fig. 5)**. The olecranon process on the back (posterior) side is easily felt and seen and is frequently called the "point of the elbow" by dog fanciers. On the front (anterior) are the anconeal and coronoid processes. The first is seen on radiographs while the other is very hard to find because its shadow is covered by those of other structures such as the condyles (knobs) on the bottom of the humerus. The separate anconeal process shown in Fig. 4 ossifies at the expense of the growth plate between it and the olecranon. If it doesn't do this by age five months, you have the dysplasia known as UAP, ununited anconeal process.



The coronoid process develops differently, having always been part of the ulnar bone center. However, if the other lower-arm bone (radius) does not grow at a precisely compatible rate with the ulna, it might be too short to effectively bear the weight of the dog's front end. This puts much extra stress on the coronoid process, which simply is not strong enough to bear the load. Sooner or later it develops fissures (stress cracks) and starts to fragment like a rock ledge crumbling away (**See Fig. 6)**. Of course, the presence of loose bony pieces such as these (they are often called joint mice) leads to inflammation and pain. Some dogs feel it greatly; others are more stoic or tough in regard to pain threshold. Although both anconeal (primarily) and coronoid (secondarily) dysphasia's are related to defects in cartilage growth and ossification, the different routes and origins make me want to keep the manifestations of elbow osteochondrosis separated in thought and discussion. On the other hand, Dr. Wind theorizes, "This disease (ED) is an abnormal development of the elbow joint due to underdevelopment of the ulnar trochlear notch. This causes incongruity within the joint, which leads to osteoarthrosis but may also cause fragmentation of the medial coronoid process, osteochondrosis of the humeral condyle, ununited anconeal process, or combinations thereof."

So you can think of ED as one disease or syndrome, or more than one very closely related disorders.

Fragmented Coronoid Process with tell-tale osteophytes at some distance from the lesion
a. 3 year old Old English Sheepdog with joint mouse moving in and irritating soft tissues.
b. 9 year old Bulldog; joint mouse has been resorted or lost and another break is starting.



Even from before birth, the development of these parts is by endochondral ossification with bone replacing cartilage at hopefully a normal rate and manner. Go back to Figure 4 now. Using the typical medium-size dog as an example, the following "secondary" (other than the main shaft) bone or ossification centres are seen by about 10 weeks:
1. The lateral and medial humeral condyles (the two rounded "bumps" on the distal end of the humerus (upper arm) that fit into the half-moon-shaped groove in the lower arm's ulna),
2. The epicondyle of the humerus,
3. The epiphysis of the radius (that's the shorter of the two bones in the lower arm),
4. The olecranon (the "point" of the elbow) at the proximal (top) end of this longer bone in the lower arm.

During the first 10 weeks, the anconeal process is not visible on radiographs, but in the next couple of weeks, ossification begins, with gradual growth and increased opacity until, somewhere in the 16-24 week time frame, the centre not only turns "completely" to bone, but also fuses with the ulna. The result is a stronger joint with more weight-bearing ability than cartilage could offer. With the normal anconeal process in place (riding or inserting into the notch between the condyles of the humerus, there is stability in motion. Without it, there is a side-to-side action, with the olecranon (topmost point of elbow) rolling around in what is referred to as an "out at the elbows" gait. There are also some breeds in which individuals have been described as "double-jointed" because they have less restriction on extreme extension and flexion than is made by the anconeus and coronoid in most dogs.

Gross differences in growth rates between ulna and radius can put great pressure on the coronoid process, leading to FCP, and in many dogs the lower forelimb is bowed. If lameness does not develop, there may still be very variable amounts of ulnar growth retardation; many fiddle-fronted dogs are seen in the show rings, especially Toys and Shar Pei, but also many other breeds. If the coronoid process of the ulna bears a disproportionate amount of the weight from the humerus, and that upper arm is not as much supported by the (shorter) radius, eventual fracture is almost assured, especially in the larger, heavier dogs and those that do a good amount of jumping and running. The wide-top radius is designed to support most of the dog's front-end-heavy weight.

In the development of the normal elbow, there is good congruity (which is to say tight fit) between humeral condyles and the trochlear notch that runs from the ulna's anconeal and coronoid processes, and between humerus and radius. Likewise, there is a tight fit between the radius and the ulna, with the curve of the coronoid process continuing in an unbroken arc forming the articular top surface of the radius. In some elbows, the coronoid process is situated a bit higher than normal (or you could say the top of the radius isn't high enough because it has lagged in growth). This "step" is often accompanied by a crack in the coronoid process, or a fragmentation. In some elbows with or without FCP, UAP, or OCD, there can be increased joint space between humerus and radius, humerus and ulna, or both. Studies at Davis showed that joint incongruity preceded clinically observable FCP and since it is seen in conjunction with UAP and OCD also, the implication is strong that incongruity precedes these lesions as well.

Breeding for Better Elbows — What is "Normal"?

In Scandinavia, there is a closer working relationship between scientists, government, and breeders than is found in the Americas. Dr. Lennart Swenson, geneticist at the Swedish University of Agricultural Sciences, calls our attention to the fact that it is relatively easy to define "normal" and segregate them from "affected" (dysplastic elbows), and select our breeding stock from the former class. But within the category we identify as normal, how should we further separate them by genetic liability? We can give grades of dysplasia to the affected dogs, but should we not further identify the best of the unaffected? That is a harder task because of more minor differences and lower accuracy in designating our dividing lines.

Professor Swenson gives this table, based on a study of the incidence of elbow dysplasias in Rottweiler progeny (The word "normal" here probably should be in quotation marks, since the dogs obviously are not normal in genotype.):

Parents Offspring Affected, %
normal X normal 31
normal X mild ED 43
normal X mod/severe ED 48
ED X ED 56

Elbow dysplasias, whatever type, are polygenic, and as you know that means environmental forces such as nutrition might affect individual differences in severity of the dog, but do not change what it passes on to the next generation.

We lump together in a category called "normal" all those that we subjectively decide do not have characteristics worthy of putting them over the line or threshold into the affected categories. It is harder to create grades of normality than to segregate other dogs into grades of abnormality. The somewhat threshold nature plus the polygenic basis makes us treat all such dogs as equal, even though some may be, in the words of George Orwell, "more equal than others".

Covert Elbow Dysplasia

Not only can we not tell how one normal-elbow dog differs from the next, but also we can be fooled by actual affected dogs that show no arthrosis or dysplasia. Therefore, we should consider that, on average, breeding a phenotypically normal dog only means that we are using the medium or mean "normal" from a range of genetic (and perhaps phenotypic) quality in the population from which it was selected. The only thing we can safely and accurately say about the ones classified as "normal" is that we don't see any signs, not that we can be positive

there is not the same number of bad genes as in some of the less-obvious cases. In the affected category we can give a grade, but in the normals, we can only estimate the genetic value as being the average of that segment of the colony. We as practical breeders must find some middle ground where we are neither too demanding (discarding most of the dogs in a breed) nor too lax (calling too many normal or acceptable).

If we were to improve diagnostic techniques in the study of ED as we have with the use of the PennHIP Distraction Index for hip joints, we could differentiate between dogs in the "normal" category, and improve our selection immensely. We could avoid more of the carriers than we have in the past. If we could assign a numerical, objective value, or even an improved subjective one, to each normal dog, they could have individual phenotypic values and thus a closer estimate of each dog's genetic value. Better techniques of ascertaining these differences would be extremely helpful. However, in the meantime, we might get more mileage out of data on close relatives, especially if the population of the "normals" were a small percentage such as in the previous paragraph. That means we would need all exam results to be added to the database; in other words, an open, mandatory, and complete registry. Information on siblings, parents, offspring, and other close relatives would make for better differentiation of normals as much as improved diagnostic techniques would. As knowledge of breed value increases, so does efficiency of breeding programs. The only open registry in North America (at the time of this writing) was GDC, and they operated such registries for both hips and elbows. They have since merged with OFA and consequently the openness of their data is a thing of the past.

Breed Differences

Depending on breed, elbow dysplasias can range from inconsequential to a very serious problem. In one review it was reported that one dog in 300 seen at 14 university veterinary teaching hospitals had some elbow disease. That all-breed estimate fails to convey the serious economic and emotional costs of ED incidence in the more popular breeds.

Most body types are represented in the early lists of breeds affected by one or another of the elbow dysplasias, including Akita, Bouvier, Dobe, Fila Brasileiro, Springer, Irish Wolfhound, Shar Pei, and others. In the early 1999 OFA elbow data, approximately 30% of the Bernese Mountain Dogs were dysplastic, 12% of the Golden Retrievers, over 20% of the German Shepherd Dogs, 13% of the Labs, and 42% of the

Rottweilers. Border Collies appear to be almost free of ED, while the incidence in the Chow Chow is about 50%!

The 1998 OFA data shows the average of all breeds in the database to be about 11%, [incidentally, that means Swissies are worse off than the average], males are more affected than females, and that it is bilateral in as many as 35% of affected dogs. Now that statistic seems suspect to me, so it leads me back to the concept of covert ED. No explanation was proffered as to why the OFA's ED percentages in Rotties and Berners were lower than those seen in Scandinavia. I might offer one possible idea: during the time the Norwegians and Swedes were emphasizing breeding dogs with normal elbows (and seeing progress in that joint) as well as normal hips, we in America were concentrating on promoting the preferential use of dogs with OFA numbers for hips only. If, as Dr. Olsson has said, osteochondrosis is the description of a general disorder in which HD is one manifestation, and elbow problems are others, then perhaps by selecting for normal hips, our better American breeders were unwittingly and unintentionally selecting dogs with fewer genes for osteochondrosis of any sort, including in elbows. Or maybe not.

In the mid 1990s, the large and sometimes ponderous SV (Germany-HQ club for GSDs) at last admitted that elbow dysplasia was a serious enough problem in the GSD that it was worth their attention. While finding that HD was more prevalent and of greater concern, they now acknowledged that ED existed and should be addressed. They started with a voluntary program with 450 dogs participating and in that initial study found GSDs had more than 10 % incidence of UAP, FCP, and OCD. But some 30% of GSDs had some sort of arthrosis. Similar numbers also had been reported in Scandinavian and Australian studies, they noted. The SV suggested screening all dogs of 6 and 12 months of age.

Working the Affected Dog

Often, the dog that is diagnosed with mild ED of one sort or another belongs to someone active in the sport end of the dog game, having no plans to breed but wanting to do obedience work. Caution must be advised here, but it is possible for many dogs to live a happy life and compete in such events. AKC-CKC-type obedience is easier, as the jump heights have been lowered, the rings are small, and no really fast running for considerable distances is required. Let your dog and your common sense guide you in how much you ask or encourage your dog to do. These affected or suspected dogs especially should be prevented from becoming heavy. Many of the Grade 1 dogs will not develop any

lameness. As is recommended for any other sort of osteochondrosis, keep the nutritional volume and energy level (and hence the weight) down, and do not supplement with calcium.

Registries

In 1981, Dr. Wind began studying elbow laxity in Berners, basically the "same breed" as the Swissy. By 1986, Dr. George Padgett, pathologist at Michigan State, with a special interest in genetics, sent a questionnaire to national breed clubs re the status of and needs for genetic disorder control schemes. He proposed a disease registry which would contain information on genetic risks of individuals, based on their own phenotype plus those of their progeny, siblings, and half-siblings. Physicist Dr. Martin Packard developed a computer program about that time. Bernese (and other breed) fanciers, radiologists, geneticists, and vets soon were working hand-in-glove with like-minded individuals and groups in Sweden, Canada, Switzerland, the US, Canada, and the U.K. Almost all were also coming to realize that elbow dysplasias and other problems were very much genetic in nature, and that registry and control measures were needed. Some first approached the OFA because of that foundation's wide recognition in the field of HD control and registry. After she found OFA initially to be less than enthusiastic, Dr. Wind found other funding to organize the inaugural International Elbow Working Group meeting in Davis, CA in 1989. In that year these three brought together a group of about eight people who collectively gave birth on the same day to twins: the IEWG (Int'l Elbow Working Group) and the GDC (America's first open registry).

The OFA published a table for several years, showing the current progress, called "Trends in Elbow Dysplasia". One such year's report, given to several clubs and available on the Internet, is shown here, though the amount of change seems minor.

Breed % Dys. through 1990 % Dys. 1993-94
Bernese Mtn. Dog 30.6 29.7
Golden Retriever 11.8 10.7
German Shepherd Dog 21.6 18.2
Labrador Retriever 14.2 11.3
Rottweiler 46.1 36.0
Newfoundland 24.3 19.6

GDC used to update news periodically on their two websites. The following comes from their December 2000 memorandum. Access to the searchable GDC registry was available through the GDC website,

and people could then use that search to:
• Find out if a dog is registered with GDC;
• Find how many of its close relatives, parents, siblings, and offspring are also registered;
• See how many close relatives will be listed in a Kin Report;
• Find the number of evaluations and the sites evaluated for each dog;
• Track your dog's new registration. Pending registrations are marked with an asterisk (*).
• Updated weekly with all newly registered dogs;

These reports provided information on the following:
• The dog in question;
• Siblings, half-siblings and progeny (offspring) of dog;
• Siblings, half-siblings and progeny of sire;
• Siblings, half-siblings and progeny of dam;
• List of additional related dogs (useful for creating a genetic pedigree)
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GDC was a public-benefit non-profit organization that worked for the health of companion animals, and tax-deductible gifts were solicited until they decided to merge with OFA in 2002. GDC accepted and registered dogs with:
• OFA and other registries' elbow evaluations if two views are included;
• OFA evaluations of affected and unaffected hips;
• PennHIP evaluations of hips.

Control Through Peer Pressure

Better progress can be expected when leaders of various major breed clubs take their blinders off and encourage selection for control of these disorders of the elbow. The GSD Club of America at the time of this writing is still not requiring its Select dogs (officially highly-recommended for breeding) to have "normal" elbows, in spite of the notorious problem with UAP in many American show lines. The SV's top radiograph expert, Dr. Brass, until very recently if at all, still considered elbow dysplasias not to be a serious problem despite many of the winners today being line bred on dogs who "threw" much UAP. However, an article in the SV Zeitung (magazine) covered the topic for the first time in the late 1990s, so acknowledgment of the problem is in the works. Very little has been done so far in the United Kingdom. Australia's GSD community, which follows the SV lead in some respects, has had the same head-in-sand attitude, although bloodlines are a little different. Genetic problems don't go away without help.

modified slightly spring, 2002.

 Fred judged the Greater Swiss Mountain Dog sweepstakes at the "national" weekend and presented a seminar for the club in the fall of 1999 in Virginia Beach, VA. He is the author of "Canine Hip Dysplasia and Other Orthopedic Problems" and lectures worldwide on these and other topics.

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