

Incidence of canine elbow dysplasia in South Africa

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ABSTRACT

In South Africa, 1919 canine elbow dysplasia grading evaluations were performed from 1999–2006. Of these 1827 were evaluated by the senior author and form the basis of this article. Each report recorded the breed, age, sex, side affected and elbow dysplasia grading. The relationship between breed, age, sex, side affected, origin of radiographs and elbow dysplasia incidence was then analysed. Statistical evaluations were performed including means and standard deviations. The Rottweiler had the highest incidence of elbow dysplasia at 55 % followed by the Bullmastiff, Chow chow, Boerboel and Golden retriever, all of which had elbow dysplasia incidences of >38 %. Males were significantly more affected than females. The incidence of elbow dysplasia in the various breeds was compared with those of the Orthopaedic Foundation for Animals in the United States and was found to be much higher in South Africa.

Key words: elbow dysplasia, incidence, South Africa.

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INTRODUCTION

Elbow dysplasia (ED) is the abnormal development of the elbow joint. It is an all-encompassing term comprehensible to the public for fragmented medial coronoid process (FMCP), osteochondrosis (OC) and osteochondritis dissecans (OCD), ununited anconeal process (UAP) and elbow incongruity⁹. These conditions may occur on their own or in combination with each other^{9,13}. Elbow dysplasia is a developmental disorder with clinical signs seen from 4 months of age onwards followed by the development of arthrosis which may be crippling or subclinical. The pathophysiology, diagnosis and control have been reviewed⁹ specifically to make South African veterinarians more aware of the condition.

The ununited anconeal process was the first component of elbow dysplasia to be described in 1965². The other components were reported from 1975 onwards¹⁴. The dog-breeding fraternity in South Africa was made more aware of this condition in 1998 at a Dog Breeders Symposium organised by the Radiology Section of the Department of Surgery of the Faculty of Veterinary Science of the University of Pretoria¹⁰. At this symposium a meeting was held between representatives of the

various dog breeds affected by elbow dysplasia, the Kennel Union of South Africa (KUSA), South African radiologists and international experts speaking at the symposium. The purpose of the meeting was to establish an elbow dysplasia grading scheme according to the guidelines of the International Elbow Working Group (IEWG) to help combat the effects of this often crippling condition on South African dogs.

Elbow dysplasia is inherited as multifactorial polygenic traits¹. Within the Rottweiler breed the existence of a major gene has recently been suggested¹². Heritability varies from 0.10–0.77 and males may have a higher heritability than females^{9,11}. The various components of ED may be inherited independently from each other^{8,9}. Knowing the ED status of breeding dogs is important for breeders to reduce the incidence of this condition. It has been proven that breeding affected dogs with each other will result in a higher incidence of offspring ED compared with normal dogs being bred to each other^{1,6}. It is also important to be aware of the fact that certain breeds are predisposed to ED and its various components, e.g. German shepherd dogs to ununited anconeal process, Rottweilers to fragmented medial coronoid process and retrievers to osteochondrosis and fragmented medial coronoid process⁶. In a Finnish study spanning 12 years and involving 34 140 German shepherd dogs,

Golden retrievers, Labrador retrievers and Rottweilers, dogs were graded for hip and elbow dysplasia (not all for the latter)¹². Rottweilers showed a 55 % incidence, Golden retrievers 30 %, German shepherd dogs 25 % and Labrador retrievers 20 % with the vast majority of affected dogs having a mean score for both elbows of 1 or less. Environmental factors also play a role in the development of ED and the subsequent arthrosis. These factors include overfeeding (*i.e.* high body mass), high fat intake, excessive calcium and short bursts of exercise up to the age of 24 months¹⁵.

The IEWG elbow certification process evaluates the elbow for signs of arthrosis, the consequence of the various components of elbow dysplasia. Osteophyte formation at very specific locations within the elbow joints are evaluated for size and graded as follows:

- Grade 1 (mild arthrosis): osteophytes <2 mm in size.
- Grade 2 (moderate arthrosis): osteophytes 2–5 mm in size.
- Grade 3 (severe arthrosis): osteophytes >5 mm in size.

The primary cause of the arthrosis is not specifically evaluated^{9,12} but has to be mentioned in the report if obvious. The minimum requirement for IEWG grading is a maximally flexed, well collimated ML view of both elbows. Ununited anconeal process is readily diagnosed on this view and FMCP may occasionally be diagnosed. OCD has to be very severe to be diagnosed on a single ML flexed view. Various countries thus insist on additional views to improve interpretation accuracy for osteophyte and primary cause detection and this accuracy increases with the number of views made. It is thus important to realise that some conditions, for example FMCP, may need multiple views to make a specific diagnosis. At the above-mentioned Dog Breeders Symposium a South African elbow dysplasia scheme was initiated with the following guidelines according to the IEWG:

- Dogs to be a minimum of 12 months old and should preferably be done at this age.
- Radiographs to be made simultaneously with the hip dysplasia certification radiographs to save on costs.

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Table 1: Incidence of elbow dysplasia in total, males versus females and faculty versus private radiographs for left and right elbows.

	n	Left elbow			Right elbow		
		% Affected	Av. score (SD) population	Av. score affected elbows	% Affected	Av. score (SD) population	Av. score elbows
Total	1827	27	0.49 (0.89)	1.76 (0.78)	25	0.45 (0.89)	1.78 (0.77)
Males	739	29	0.55 (0.95)	1.86 (0.78)	27	0.49 (0.90)	1.83 (0.99)
Females	1086	26	0.44 (0.84)	1.69 (0.77)	24	0.43 (0.84)	1.74 (1.01)
Sex?	2	100	2.50	2.50	100	2.50	2.50
Faculty	621	32	0.57 (0.93)	1.75 (0.78)	30	0.53 (0.92)	1.78 (0.79)
Private	1206	25	0.44 (0.86)	1.77(0.78)	23	0.42 (0.84)	1.78 (0.77)

- Radiographs only to be interpreted by qualified veterinary radiologists.
- Only a single maximally flexed good quality ML radiograph of each elbow to be made. It was decided to evaluate only a single view in order to limit costs and thus encourage greater participation in the scheme by dog breeders. The single-view examination is also followed by Sweden and Norway¹¹.

In South Africa, these ED evaluations have been done by 4 radiologists with the bulk of them done by the senior author in his capacity as chief KUSA scrutineer and professor of radiology at the Faculty of Veterinary Science, Onderstepoort, or in his private capacity for referral radiographs from throughout Southern Africa. The elbow dysplasia scheme has now been in operation for nearly 8 years and it was decided to evaluate the results of dogs processed to date and compare the incidence of the disease with that of the United States. At this stage it is impossible to judge if the scheme has resulted in a reduction in the incidence of ED in South Africa. This can only be done after another 8 years in order to compare the 2 studies with each other.

MATERIALS AND METHODS

Records of all elbow radiographs examined by official KUSA scrutineers from the scheme inception date, 1 January 1999 to 31 October 2006, were reviewed. One scrutineer only evaluated dogs of the German Shepherd Dog Federation of South Africa but these were not specifically graded and were thus excluded. There were 1919 cases evaluated of which the senior author examined 1827, which form the basis of this report to standardise interpretation of results. For each report the breed, age, sex, side affected and ED grading were recorded. Additionally the population was divided into 2 groups, 1 for all radiographs made at the Veterinary Faculty and the other group for all referral radiographs received for interpretation. Elbow dysplasia grading to 2 decimal points was then recorded for the population as a whole, per breed and for sex with means and standard deviations for each

of these determined. Statistical analysis was undertaken using the R Foundation for Statistical Computing program version 2.4.0. Sexes, side affected and origin of radiographs were compared using a 2-sample *t*-test for the population at large and for affected elbows only. Significance was taken at $P < 0.05$. The incidence of ED in the more common breeds examined was then compared with the incidence recorded by the Orthopaedic Foundation of America (OFA)⁷. Where a primary cause was noted on the report it was recorded.

RESULTS

The total population results are given in Table 1, which also compares males to females and radiographs taken at the Faculty of Veterinary Science, Onderstepoort, with radiographs taken by private practitioners. For each the number of dogs examined, the percentage of each elbow affected and the average elbow score for the population as well as for affected elbows is given with their standard deviation. The mean age of all dogs was 24.6 months.

For the population at large there was a significant difference in elbow dysplasia incidence between radiographs submitted to the faculty versus private practice ($P < 0.001$) and also between males and females with males having a higher grading than females ($P = 0.046$). There was no significant difference between left and right elbows in the whole population or within males or females.

When comparing only the affected elbows there was no significant difference between males and females and the origin of the radiographs but there was a significant difference between left and right elbows of males ($P = 0.0048$) and females ($P = 0.002$).

Forty-seven breeds were examined, of which 21 breeds had 11 or more evaluations carried out representing 1762 cases (Table 2). These were ranked in order of percentage incidence of ED with grading incidence also presented and all data compared to those of the OFA. The remaining 65 cases represented another

26 breeds with the same data given as for Table 2 but data were not compared with that of the OFA owing to the low numbers (Table 3).

The Boerboel was the most common breed (446 examinations) of which 8.3 % had an UAP and 2.8 % had an identifiable FMCP. The next highest incidence of UAP was in the Bullmastiff at 5 %. The Labrador and Golden retrievers had an incidence of 2.9 % and 2.1 % of detectable FMCP, respectively.

DISCUSSION

Twenty-seven per cent of dogs evaluated had elbow dysplasia with an average score of affected elbows being 1.77. Four breeds: Rottweiler, Bullmastiff, Chow chow and Boerboel had an incidence higher than 40 %, with the Rottweiler being the highest at 55 %. Males had a significantly higher incidence of ED, which is likely to be due to their faster growth rate or a possible sex-linked factor^{3-5,8}. Although grading of affected elbows was on average 0.19 higher in males than females this was not statistically significant. The mean values of left and right elbows differed quite markedly in all dogs as well as within males and females in the population at large, with left elbows more severely affected than right elbows but not significantly so. When comparing only affected elbows of all dogs this trend was reversed but not significantly so. However, in the affected elbows within males and females there was a significant difference but in this instance the right elbow was more severely affected in females versus the left in males. It is interesting to note these differences, which are influenced by the dilution factor of the normal dogs in the one scenario compared to only looking at affected elbows in the other. From a clinical perspective these changes are unlikely to have any significance. A higher percentage of dogs radiographed at the faculty had elbow dysplasia but the grade of dysplasia or elbows affected was similar. This is most likely due to non-submission of severely affected elbows by practitioners.

Table 2: Breed incidence of elbow dysplasia with 11 or more examinations per breed with data compared to that of the Orthopaedic Foundation of America.

Breed	Rank		n		% Dysplastic		% Grade 1		% Grade 2		% Grade 3	
	SA 21	USA 82	SA	USA	SA	USA	SA	USA	SA	USA	SA	USA
Rottweiler	1	2	148	9407	54.7	40.9	20.3	30.3	31.1	9	3.4	1.6
Bullmastiff	2	18	102	1378	53.9	13.7	21.6	8.9	19.6	3	12.8	1.7
Chow chow	3	1	19	392	47.4	46.4	5.3	21.2	15.8	17	26.3	8.2
Boerboel	4	nil	446	nil	43.3	nil	14.1	nil	12.1	nil	17.0	nil
Retriever (golden)	5	25	243	14295	38.3	11.5	16.1	8.9	15.6	2	6.6	0.7
Bernese mountain dog	6	3	16	6725	37.5	29.5	6.3	18.6	12.5	7.5	18.8	3.5
Staffordshire bull terrier	7	nil	16	nil	31.3	nil	6.3	nil	25.0	nil	0.0	nil
Giant schnauzer	8	28	12	185	25.0	10.3	25.0	8.6	0.0	1.6	0.0	0.0
Great Dane	9	46	69	923	21.7	4.2	11.6	3.5	8.7	0.5	1.5	0.2
Rhodesian ridgeback	10	nil	151	nil	21.2	nil	12.6	nil	6.6	nil	2.0	nil
German shepherd dog	11	8	24	23088	20.8	19.5	16.7	14	4.2	4.1	0.0	1.5
Retriever (Labrador)	12	24	340	33094	20.6	11.5	10.3	8.5	5.6	2.1	4.7	1
Newfoundland	13	5	35	3744	20.0	25.3	5.7	14.8	11.4	5.8	2.9	4.7
Bouvier des Flandres	14	32	11	1908	18.2	8.7	18.2	6.8	0.0	1.6	0.0	0.3
Irish wolfhound	15	22	12	272	16.7	11.8	0.0	8.1	16.7	2.9	0.0	0.7
Australian cattle dog	16	21	11	355	9.1	12.1	0.0	9.6	9.1	2.0	0.0	0.6
Border collie	17	68	11	904	9.1	1.4	0.0	0.8	9.1	0.4	0.0	0.1
Australian shepherd	18	42	18	1975	5.6	4.3	5.6	3.2	0.0	1.0	0.0	0.1
Dobermann	19	70	45	1080	2.2	1.3	2.2	1.1	0.0	0.1	0.0	0.1
Alaskan malamute	20	51	17	323	0.0	3.4	0.0	1.5	0.0	1.2	0.0	0.6
Weimaraner	21	71	16	632	0.0	1.3	0.0	1.1	0.0	0.2	0.0	0.0

From this study it is difficult to judge the incidence of the specific causes of elbow dysplasia in South Africa. Having only a flexed ML view severely limits identifying OCD, FMCP and elbow incongruity and the primary cause, where visible, was only recorded more regularly during the last 4 years. However, even with these limitations, it was interesting to note

that the Boerboel, a South African breed resembling the Bullmastiff, had the highest incidence of UAP and second highest incidence of detectable FMCP.

The findings of this South African study differ quite markedly from those of the OFA (Table 2). In looking at the results of the first 12 breeds of dogs in South Africa, ranked according to severity of ED, and

excluding breeds not in the OFA study, the percentage of dysplastic dogs of the various breeds was consistently higher in South Africa with a tendency for more grade 2 and 3 ED cases. The mean age of dogs examined in South Africa was 25 months which is probably much higher than that of the OFA and could have been a contributing cause for the

Table 3: Breed incidence of elbow dysplasia with fewer than 11 examinations per breed.

Breed	n	% Dysplastic	% Grade 1	% Grade 2	% Grade 3
Neapolitan mastiff	2	100	50.00	50.00	0.00
American Staffordshire terrier	1	100	100.00	0.00	0.00
Retriever (flat coated)	1	100	0.00	100.00	0.00
Sharpei	6	50	0.00	33.33	16.67
Black terrier	2	50	0.00	0.00	50.00
White shepherd dog	2	50	50.00	0.00	0.00
Airedale	2	50	0.00	50.00	0.00
Retriever (Chesapeake bay)	2	50	50.00	0.00	0.00
Saint Bernard	4	25	0.00	0.00	25.00
German shorthair pointer	6	17	16.67	0.00	0.00
Boxer	6	0	0.00	0.00	0.00
Shiba	5	0	0.00	0.00	0.00
Jack russell terrier	4	0	0.00	0.00	0.00
Berner sennenhund	3	0	0.00	0.00	0.00
Afghan hound	3	0	0.00	0.00	0.00
Siberian husky	3	0	0.00	0.00	0.00
Spaniel (English springer)	2	0	0.00	0.00	0.00
Basenji	2	0	0.00	0.00	0.00
White Swiss shepherd dog	2	0	0.00	0.00	0.00
Pyrenean mountain dog	1	0	0.00	0.00	0.00
Whippet x	1	0	0.00	0.00	0.00
Belgian shepherd dog	1	0	0.00	0.00	0.00
Irish setter	1	0	0.00	0.00	0.00
Old English sheepdog	1	0	0.00	0.00	0.00
Rough collie	1	0	0.00	0.00	0.00
Bloodhound	1	0	0.00	0.00	0.00

poorer grading of South African dogs. In the dogs ranked 13 to 21 only the Newfoundland and Australian cattle dogs had a slightly lower incidence of dysplasia than the OFA dogs. This could imply that these South African dogs have better breeding lines for elbow dysplasia. However, the numbers are also fairly low and the validity of this conclusion may thus be questionable. The OFA has been evaluating elbows since 1990 and has had a steady decrease in ED incidence as breeders have become more knowledgeable and applying stricter selection against ED when breeding. The benefit of breeding ED-free dogs is illustrated by the following mating probability results for 13 151 breeding pairs of dogs (primarily Labrador retrievers, Golden retrievers, Rottweilers, and German shepherd dogs) with known elbow status of the OFA⁷:

Normal elbows × Normal elbows =
12.2 % offspring affected with ED.

Normal elbows × Dysplastic elbows =
26.1–31.3 % offspring affected with ED.

Dysplastic elbows × Dysplastic elbows
= 41.5 % offspring affected with ED.

It is hoped that this article will help to inform South African breeders about the dangers of breeding with dysplastic dogs and that the incidence will also decrease over time if ED-free breeding pairs are used. Currently no breed society insists on ED screening before breeding. Many owners of breeds that have a high incidence of ED, such as the Boerboels, retrievers, Rottweilers and Bullmastiffs have their dogs examined and hopefully practise responsible breeding. KUSA needs to take the lead and promulgate regulations that breeds at risk have their elbows evaluated prior to breeding. No breeding recommendations have necessarily to be made at this stage but at least potential purchasers of dogs will be able to make an informed choice. With time ED status breeding regulations for these breeds can be put in place. This study also emphasises the high incidence of ED in breeds not regularly examined, which in-

clude the Chow chow, Bernese mountain dog, Staffordshire bull terrier, Giant schnauzer, Great Dane, German shepherd dog, Bouvier des Flandres and Irish wolfhound. These breed societies and breeders also need to take note of ED and start having their dogs' elbows screened. The German Shepherd Dog Federation, which has the bulk of South African German shepherds as its members, has to date not officially graded dogs for elbow dysplasia, which reflects their low numbers in this study. However, with an incidence of 19.5 % in the United States (Table 2) and 14 % in Germany⁸, the German Shepherd Dog Federation needs to implement an ED scheme for its members as well. The same applies to organisations controlling the Boerboel, which has an extremely high incidence of ED.

Dogs should normally be evaluated at 12 months of age. The earlier ED is diagnosed the sooner animals can be prevented from breeding. The mean age of the South African dogs examined was nearly 25 months. Increasing age resulted in increasing arthrosis and poorer grading in this study as well as elsewhere⁸ and it may be that there will be some improvement in scores as more dogs are screened at 12 months. Other limitations of this study include limited numbers in some breeds which could skew the data, non-submission of dogs or their radiographs for evaluation e.g. owners who did not intend breeding their dogs, dogs that had already undergone surgery for ED or the presence of an obvious lesion and thus the radiograph is not sent for screening. Another limiting factor is that the technique of a single view will underestimate the incidence of ED. Some dogs may have the primary disease condition without any sign of arthrosis and as such some of these will be missed if additional views or more advanced grading systems are not utilised⁵.

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