A radiological study of the incidence of unilateral canine hip dysplasia

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Summary

The authors reviewed pelvic radiographs of 891 dogs in a retrospective study, to determine the incidence of Unilateral Canine Hip Dysplasia (UCHD). Results show that 149 (16.7%) dogs had UCHD. Comparing dogs affected uni- and bilaterally, results show a maximum of 37.6% with UCHD in dogs less than 12 month old, 22.8% in dogs between 12-24 months of age, 25.5% in dogs between 25-72 months and 14.1% in dogs older than 73 months.

Keywords: unilateral hip dysplasia, canine, radiology.

Eine radiologische Untersuchung über die Inzidenz der unilateralen Hüftgelenksdysplasie beim Hund

Anhand von 891 Röntgenbildern wurde in einer retrospektiven Studie die Inzidenz der Unilateralen Hüftgelenksdysplasie (UHD) beim Hund berechnet. Unsere Ergebnisse zeigen, dass von allen untersuchten Hunden 149 (16.7%) Tiere eine UHD zeigten. Ein Vergleich zwischen uni- und bilateralen Hüftgelenksveränderungen ergab für UHD eine Inzidenz von 37.6% bei jungen Hunden unter 12 Monaten, 22.8% bei Hunden zwischen 12–24 Monaten, 25.5% bei Hunden zwischen 25–72 Monaten und 14.1% bei Hunden älter als 73 Monaten.

Schlüsselwörter: Unilateral Hüftgelenksdysplasie, Hund, Radiologie

Introduction

Canine Hip Dysplasia (CHD) is a frequently encountered orthopaedic disease in veterinary medicine. In the period between 1974–1991 the Orthopedic Foundation for Animals (OFA) evaluated more than 320000 dogs older than 24 months of age. In their population, which included 87 breeds represented by more than 100 individuals, the percentage of affected dogs in each breed was variable from 3.7% for Collies to 48% for Saint Bernard dogs (Larsen and Corley, 1971; Corley and Hogan, 1985; Corley, 1987). These percentages are lower in the USA, most likely due to a better screening prior to the submission to OFA (Kaneene et al., 1997). Despite CHD being found in both sexes with the same frequency (Strande, 1962; Larsen and Corley, 1971; Priester and Mulvihill, 1972), some studies showed a higher incidence in female (Olsson and Henricson, 1959; Hedhammer et al., 1979; Swenson et al., 1997) or male dogs (Preu et al., 1975). Also the improvement in phenotypic appearance of the hips has been shown to be higher in male dogs (Kaneene et al., 1997).

CHD usually presents as a bilateral disease (93%) with equal or similar levels of joint laxity/arthrosis. However, it has also been shown that dysplasia may be associated with unilateral radiographic changes, affecting only one joint while the contralateral hip may appear normal or near-normal on clinical and radiographic examination (Morgan, 1986; Corley, 1987; Morgan and Rosenblatt, 1987). The incidence of Unilateral Canine Hip Dysplasia (UCHD) varies according to the source. In one study (Swenson et al., 1997) radiographic signs of UCHD were found in 18 out of 53 (34%) dysplastic dogs aged 5–12 months. In another study (Lust et al., 1972) 38 out of 176 (21.6%) dysplastic German Shepherd Dogs were unilaterally affected. In a colony of beagles, Morgan (1974) found 10% unilaterally affected dogs while in another study (Morgan, 1986) based on a large veterinary hospital population, 15% of examined dogs had UCHD.

Terminology of 'joint laxity" and/or secondary arthrosis as required for a diagnosis of hip dysplasia is not clear. It is understood that the references listed above describing the frequency of UCHD all make use of radiographic evaluations that did not utilize distraction techniques and that minimal joint laxity

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was not usually considered a criteria for the diagnosis of hip dysplasia. Therefore, the diagnosis of hip dysplasia in this paper was based on the presence of changes indicative of a secondary arthrosis as reported earlier (Lawson, 1968; Townsend et al., 1971; Morgan, 1974; Brass and Paatsama, 1983; Corley, 1987; Morgan and Stephens, 1989). It is also understood that the definition of normal hips as seen radiographically in some diagnostic schemes permits a degree of joint laxity (Brass and Paatsama, 1983). The lack of a specific definition of hip dysplasia has been continued in more recent papers describing the results using distraction techniques in which the term hip dysplasia has been based on the presence of secondary arthrosis.

The aim of this retrospective radiographic study was to ascertain the presence and the incidence of changes of joint laxity/arthrosis in the hip joints that were asymmetrical and its correlation with the breed, sex and age of the dog at the time of examination. Collected data include: side of the affected hip, degree of joint laxity/arthrosis. The presence of transitional lumbosacral vertebral segments was noted as well.

Animals, materials and methods

Animals

All pelvic radiographs taken at the University of Pisa, Department of Veterinary Clinical Sciences and the Veterinary Clinic dell'Orologio in Sasso Marconi-Bologna in the period 1994–1998 were reviewed. The study only included those radiographs where dog positioning was considered adequate according to the recommendations for ventrodorsal pelvic radiographs with extended limbs described by Brass and Paatsama (1983). Radiographs of 891 dogs (600 males and 291 females) including 48 different breeds met this criteria and were included in the study.

Commonly presented breeds were German Shepherd Dogs, English and Irish Setters, Boxers, Labrador and Golden Retrievers. Mongrel dogs were subdivided into three groups according to size: small dogs (under 10 kg), medium dogs (10 to 25 kg) and large dogs (over 25 kg). Most of the radiographs were taken under general anaesthesia; however, some were taken under light sedation and a few (in dogs in which anaesthesia or sedation carried an unacceptable risk) were taken without pharmacological restraint. The study included young dogs under one year of age without clinical signs referred for CHD screening as well as adult dogs with hindlimb lameness. A small number of dogs being evaluated for an abdominal or vertebral study were included if an acceptable ventrodorsal radiograph of the pelvis was available. Thus, the age was variable from a minimum of 4 months to a maximum of 15 years.

Radiographic examination

All radiographs were reviewed by three of the authors (CS, VM, MM) who are qualified to evaluate pelvic radiographs by the Italian hip dysplasia commission. Grading of CHD was based on articular congruence, osseous remodeling, presence of osteophytes and secondary bone formation (Müller and Saar, 1966; Willis, 1986; Flückiger, 1993). A final grading of mild, moderate or severe CHD was obtained for each affected hip. Specifically, CHD was considered mild in the presence of minimal articular incongruence, a slightly flattened craniolateral rim, none or little signs of degenerative joint disease (DJD) and none or only minor signs of osseous remodeling. CHD was considered moderate in the presence of prominent articular incongruence, flattening of the craniolateral rim, positive signs of DJD, and strong evidence of osseous remodeling. CHD was considered severe in the presence of either marked subluxation or luxation, obvious flattening of the craniolateral rim, positive signs of DJD deformation of the femoral head and thickening of the femoral neck (Brass and Paatsama, 1983).

Dogs that showed no evidence of joint laxity or arthrosis were evaluated to have bilateral normal hips, those judged as bilaterally affected had joint laxity and/or arthrosis that permitted a diagnosis of mild, moderate or severe CHD in each hip joint as described above. A third group was evaluated as having one hip joint judged with either mild, moderate, or severe CHD while the other joint was judged to be normal or near-normal (Fig. 1).

The evaluation and grading of each radiograph was made independently by each examiner: a final evalua-

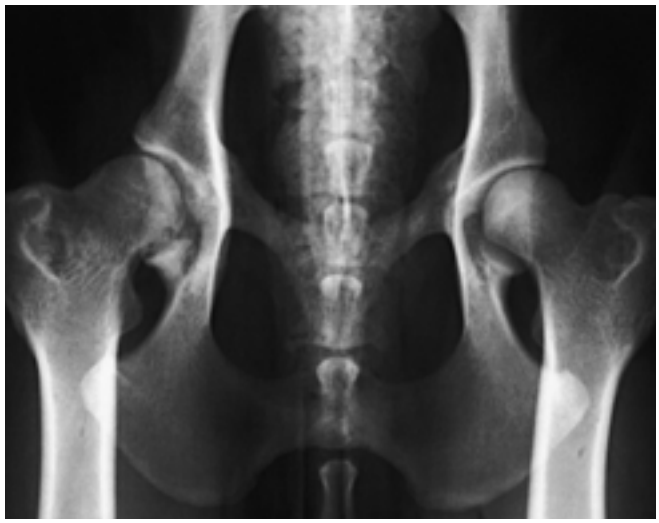

Figure 1: Radiography in extended ventrodorsal projection that shows right moderate UCHD. The left side shows mild flattening of the cranial acetabular edge, suggesting hip laxity, without signs of secondary degenerative joint disease (DJD).

tion of normal-normal, normal-dysplastic or dysplastic-dysplastic was made and the severity of arthrosis was assessed. If a full agreement was not reached, the radiograph was subsequently evaluated in the presence of all examiners and a consensus evaluation obtained. Transitional vertebrae were identified by detection of separation of the sacral spinous processes, of a disc space between S1 and S2 or the presence of anomalous lateral processes. Symmetry of the anomalous processes and sacroiliac attachments was noted and the anomaly was recorded as either symmetrical or asymmetrical.

Statistical analysis

All data were statistically reviewed with the χ^2 test to assess the significance of any differences of results obtained. The level of significance was set at $P < 0.01$.

Results

From a total of 891 dogs, 419 (47%) showed no evidence of CHD, while 323 (36.3%) were bilaterally affected with joint laxity and/or arthrosis that permitted a diagnosis of milde, moderate or severe CHD. 149 (16.7%) dogs were evaluated as having one hip joint judged with either mild, moderate, or severe CHD while the other joint was judged to be normal or near-normal. Therefore, out of 472 (52.9% of the total) dysplastic animals, 149 (31.5%) showed unilateral disease, 78 (52.4%) of which with signs of CHD on the right side and 71 (47.6%) on the left side ($P > 0.05$). Of 149 individuals affected by UCHD, 99 (66.4%) were males and 50 (33.6%) were females; 54 from 78 dogs with right sided CHD were males and 24 females; 45 from 71 dogs with left sided CHD were males and 26 females ($P > 0.05$). The affected dogs within age groups are shown in table 2. The incidence of UCHD varied widely within various breeds (Tab 1). No significant differences ($P > 0.05$) in the degree of CHD were detected as far as sex or side are concerned (Tab. 2).

Table 1: Unilateral (UCHD) and Bilateral Canine Hip Dysplasia (BCHD) incidence in different breeds.

BREED (represented groups with 20 dogs or more	UCHD	BCHD	CHD Free
		(in different breeds) %	
Great Dane	**25.8**	35.5	38,7
Labrador R.	**25.0**	22.2	52.8
Dobermann P.	**21.7**	17.4	60.9
Newfoundland	**21.4**	57.2	21.4
Boxer	**20.0**	33.8	46.2
Rottweiler	**20.0**	32.0	48.0
Kurzhaar	**18.2**	40.9	40.9
German Shepherd	**17.5**	44.7	37.8
Cane Corso	**17.4**	60.9	21.7
Mixed breed	**12.6**	29.4	58.0
English Setter	**10.3**	44.9	44.8
Breton Spaniel	**9.6**	38.0	52.4
Pastore Maremmano	**7.7**	38.5	53.8

Table 2: Numerical incidence and percentage of UCHD subdivided by sex, severity and side affected.

	MALE		FEMALE		Total	
	Left	Right	Left	Right	Left	Right
Mild	**21** 14.1%		**12** 8.1%		**33** 22.2%	
	9 42.8%	12 57.2%	2 16.7%	10 83.3%	11 33.3%	22 66.7%
Moderate	**50** 33.6%		**22** 14.7%		**72** 48.3%	
	24 48.0%	26 52.0%	11 50.0%	11 50.0%	35 48.6%	37 51.4%
Severe	**28** 18.8%		**16** 10.7%		**44** 29.5%	
	12 42.9%	16 57.1%	13 81.2%	3 18.8%	25 56.8%	19 43.2%
Total	**99** 66.5%		**50** 33.5%		**149** 100%	
	45 45.4%	54 54.6%	26 52.0%	34 48.0%	71 47.6%	78 52.4%

In UCHD dogs, the incidence of moderate CHD (48.3%) was greater than that of mild (22.2%) and severe (29.5%) CHD ($P < 0.01$). Mild and severe arthrosis affected mainly the right and the left hip joints respectively (Tab. 2), while moderate CHD was equally distributed between left and right hip joints (Tab. 2). A transitional vertebra was present in 11 from 417 (2.6%) CHD-free dogs, in 11 from 323 (3.4%) dogs with bilateral CHD and in only 8 from 149 (5.4%) dogs with UCHD. Among 8 dogs with UCHD and a transitional vertebra, 7 were German Shepherds, while the other was a Labrador Retriever. The transitional vertebra was asymmetrical in 4 out of 8 cases (50%).

Discussion

The true aetiology of canine hip dysplasia has yet to be established. It is recognized as a hereditary polygenic disease and it has been suggested that there are many contributing factors. Nonetheless, the pathogenesis and evolution of changes affecting each coxo-femoral joint are probably similar, irrespective of the etiology. Unilateral hip dysplasia is poorly understood and poses

more questions, from both an aetiologic and a clinical point of view. The present study showed that the incidence of UCHD is similar to that reported earlier and is age dependent. The highest incidence in this study was detected in the group of dogs aged less than one year. This suggests that a diagnosis of a normal coxo-femoral joint is provisional until the dog reaches adulthood unless special effort is taken to determine joint laxity. A young dog evaluated as normal or unilaterally affected by CHD on the basis of a conventional ventro-dorsal radiograph could receive a different evaluation when adult (Townsend et al., 1971). Detection of a lower incidence of UCHD in older age groups supports the hypothesis that hips evaluated as normal could undergo development of secondary arthrosis easily diagnosed radiographically. This would result in a diagnosis of bilateral dysplasia at an older age, probably because the early joint laxity/arthrosis was not detected. Therefore, perhaps the most important age groups in our study were the 12–24 months group, in which 22.8% of the population was affected by UCHD and the 25–72 months group in which 25.5% was affected by UCHD. Different considerations are generally made for the group of dogs over 73 months of age (14.1% of the total sample). Since degenerative changes due to aging could erroneously be interpreted as unilateral or bilateral hip dysplasia, a limit of six years of age for CHD evaluation is usually agreed upon (Lawson, 1968). In this study we considered only radiographic signs without any correlation with clinical signs, especially hip laxity. Nowadays, the finding of hip laxity, especially in young age, is considered predictive of hip dysplasia in adult age, despite the absence of signs of arthrosis. From this point of view, the finding of a positive Ortolani's sign in a three-month-old large dog breed may lead to a surgical option to prevent further development of osteoarthrosis (Vezzoni, 2002).

Another problem concerns the preclusion to have a further investigation on the status of the hip conditions in later stages of the skeletal development in young animals. This condition could lead to underestimate a bilateral CHD in younger ages, where degenerative changes could be present only in one hip while laxity is already present in the contralateral, resulting in bilateral CHD. Among dogs affected by CHD 66.4% were males and 33.4% were females, a similar sex distribution found in our study (67.3% male, 32.7% female, $P > 0.05$) and confirmed by others (Keller and Corley, 1989).

In dogs with UCHD, the left and right coxo-femoral joints were similarly affected (left 71, right 78, $P > 0.05$). CHD in small breeds was very low and UCHD was detected only in three cases (Yorkshire Terrier, West Highland White Terrier, Shih-tzu). Commonly represented breeds include: German Shepherd Dogs with 36 dogs affected by UCHD (17.5% of the breed population), Great Danes with 8 dogs (25.8%) and Labrador Retrievers with 9 dogs (25.0%). The distribution of subjects affected by CHD did not significantly differs from previous studies (Keller and Corley, 1989). Morgan (1986) suggested that breeds at higher risk of CHD had a higher incidence of UCHD. This is not supported by our findings: German Shepherd dogs, with a 44.7% incidence of CHD, had only a 17.5% incidence of UCHD. In addition, the suggestion that the incidence of UCHD could vary within different breeds (Morgan and Stephens, 1989) is clearly supported by our results and it appears that it is not related to the frequency of bilateral CHD or CHD-free dogs. Because body weights were not known in this study, a correlation between weight and the incidence of UCHD was not possible. All three subgroups of mixed breeds had dogs affected by UCHD with the large and medium size subgroups affected more frequently than the small size subgroup.

Our results show that in dogs affected by UCHD, the affected hip may show variable degrees of CHD, without any significant difference between sexes or the side of involvement. Many theories have been suggested about the role played by a transitional vertebra at the lumbosacral junction in the etiopathogenesis of arthrosis secondary to CHD. A transitional vertebra may be involved in the development of UCHD if it causes an asymmetry of the iliac attachment to the sacrum resulting in one acetabulum being in an "open" position while the other one is in a "closed" position (Morgan et al., 2000). Among the 149 cases of UCHD in the present study, only eight (5.4%) had a transitional vertebra. Thus, this study does not support the contention that this congenital anomaly influences the development of UCHD particularly regarding the grade and side affected. We also cannot support any particular theory on the pathophysiology of this entity. Further studies are required to ascertain if UCHD has to be considered as a unique form of CHD or only an early manifestation of an asymmetric bilateral CHD.

Une étude radiologique sur l'incidence de la dysplasie coxo-fémorale unilatérale chez le chien

Sur la base de 891 clichées radiologiques une étude rétrospective sur l'incidence de la dysplasie coxo-femoral unilatérale chez le chien a été entreprise. Nos résultats montrent que 146 (16,7%) des chiens examinés présentaient une dysplasie unilatérale. Une comparaison entre les altérations de l'articulation de la hanche uni et bilatérale montre une incidence de lésion unilatérale de 37,6% chez les jeunes chiens de moins de 12 mois, de 22,8% chez les chiens de 12 à 24 mois, de 25,5% chez les chiens de 25 à 72 mois, et de 14,1% chez les chiens de plus de 73 mois.

Riassunto

Gli Autori hanno revisionato 891 radiogrammi di pelvi canine, per valutare l'incidenza della displasia dell'anca monolaterale. I risultati mostrano che il 16.7% della popolazione presenta displasia monolaterale, con un valore massimo di 37.6% nel gruppo di età inferiore ai 12 mesi, valore che scende nei gruppi successivi. Non vi è differenza significativa di incidenza della patologia nei due sessi; l'anca destra è leggermente più colpita di quella sinistra ed è numericamente più rappresentata la displasia di grado medio.

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