Radiographic findings in the coxofemoral joint of Australian Cattle Dogs

Achados radiográficos em articulação coxofemoral de cães da raça Australian Cattle Dog

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ABSTRACT

Australian Cattle Dogs (ACD) are medium-sized animals widely used in fieldwork for managing cattle and sheep. There needs to be more information about the conditions these dogs can develop despite being well-characterized animals since the beginning of the 20th century. Hip dysplasia (HD) is a developmental abnormality between the femoral head and the acetabular fossa, which can be debilitating. However, the available literature has no studies on the prevalence of this condition in dogs of this breed. This study aimed to evaluate radiographs of ACD qualitatively and quantitatively. For this purpose, 49 dogs considered healthy without clinical signs of HD were radiographically assessed, and the animals were classified as dysplastic (D) and non-dysplastic (ND). A frequency of 46.9% of dysplastic dogs was observed, with males being more affected. The cortical index (CI) and angle of inclination (AI) could not differentiate D from ND animals; only the Norberg angle (NA) was effective in this differentiation. No correlation was observed between AI, CI, and AN.

Keywords: Norberg angle. Inclination angle of the femoral neck. Cortical index. Blue heeler. Hip dysplasia.

RESUMO

Os cães da raça Autralian Cattle Dog (ACD) são animais de porte médio, muito utilizados no trabalho de campo para manejo de gado e ovelha. Apesar de serem animais bem caracterizados desde o início do século XX, há poucas informações sobre afecções que esses cães podem desenvolver. A displasia coxofemoral (DCF) é uma anormalidade do desenvolvimento entre a cabeça do fêmur e a fossa acetabular podendo ser debilitante. Contudo, não há estudos, na literatura disponível, sobre a prevalência desta afecção em cães dessa raça. O objetivo deste trabalho foi avaliar qualitativamente e quantitativamente radiografias de cães da raça ACD. Para tanto, foram avaliados radiograficamente 49 cães considerados hígidos e sem sinais clínicos de DCF. Os animais foram classificados em displásicos (D) e não displásicos (ND). Observou-se a frequência de 46,9% de cães displásicos, sendo os machos mais acometidos. O índice cortical (IC) e o ângulo de inclinação (AI) não foram capazes de diferenciar os animais D dos ND, apenas o ângulo de Norberg (AN) foi eficaz nessa diferenciação. Não houve correlação entre AI, IC e AN.

Palavras-chave: Ângulo de Norberg. Ângulo de inclinação de colo femoral. Índice cortical. Blue heeler. Displasia coxofemoral.

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Introduction

Australian Cattle Dogs (ACD) are medium-sized dogs widely used for fieldwork. They are energetic and biting and are used in managing cattle and herds of sheep. This breed has well-developed muscle conditioning, which gives it the agility, strength, and endurance essential to perform its work (Confederação Brasileira de Cinofilia, 2012; Schwartz, 2004). There are few studies on the conditions that affect these animals, especially debilitating orthopedic alterations, despite being a consolidated breed since the beginning of the 20th century (Cruz, 2007; Schwartz, 2004).

Poor coaptation of the coxofemoral joint or hip dysplasia (HD), as it is known, is a developmental abnormality between the femoral head and the acetabular fossa (Cavalcanti, 2018; Rocha et al., 2014). Large dogs are the most affected, but smaller dogs, such as ACD, can also develop this condition (King, 2017; Loder & Todhunter, 2018; Mölsä et al., 2020). The disease is considered highly complex due to its multifactorial nature, and both genetic factors involving polygenes and environmental factors influence the development of this condition (Fossum, 2008; Mikkola et al., 2021).

The clinical signs of HD include pain, discomfort, and claudication, as it is an anatomical and functional alteration and can cause a biomechanical disability in the affected animals (Vieira et al., 2010). The diagnosis of HD is based on clinical signs, age, breed, history, and physical and radiographic findings, but clinical symptoms do not always correlate with radiographic findings (Cavalcanti, 2018; Fossum, 2008).

The Norberg angle (NA) measurement, associated with the subjective assessment of osteoarthritis signs, is used to classify HD in the radiographic examination. HD is classified into five degrees based on this assessment, namely: HD− or A, free animals; HD± or B, suspect animals; HD+ or C, animals with mild HD; HD++ or D, animals with moderate HD; and HD+++ or E, animals with severe HD (Cavalcanti, 2018). The radiographic examination is essential in identifying osteoarthritis signs, which characterize the degenerative joint disease resulting from joint laxity and joint incongruity (Fossum, 2008; Thrall, 2018).

Other radiographic measurements allow for assessing the anatomy and functionality of this joint, the first being the angle of inclination of the femur (AI), which measures the angle formed by the inclination of the head relative to the femoral long axis (Genuíno et al., 2015; Hauptman et al., 1985). The second measurement is the cortical thickness, which indicates the degree of bone stiffness (Vieira et al., 2010), being established by the ratio between the diameter of the medullary region and the cortical region and called the cortical index (CI) (Genuíno et al., 2015; Hartung & Hasselt, 1988).

Thus, this study aimed to radiographically evaluate and classify the coxofemoral joint through subjective analysis and objectively through AN, CI, and AI measurements of Australian Cattle Dogs.

Material and Methods

The radiographic records of a veterinary hospital allowed the evaluation of 49 dogs of the ACD breed, consisting of 32 females and 17 males aged between 1 and 8 years. The animals were considered healthy in the history, general clinical examination, and laboratory (blood count). The animals were anesthetized and positioned according to Henrigson et al. (1966) to obtain the images.

The assessment of the coxofemoral joints was performed by three examiners and included a qualitative assessment and measurement of AN, CI, and AI. The data were divided into two groups considering the classification: non-dysplastic animals (ND) with classifications A and B and dysplastic animals (D) with classifications C and D.

CI was calculated according to the methodology of Hartung & Hasselt (1988). The AI measurement of the femoral head was performed by the A method described by Hauptman et al. (1985), using the Autocad® software.

The data were analyzed for normality distribution using the Shapiro-Wilk test and the Tukey mean comparison test using the BioEstat® program (p<0.05). A randomized block design was used to compare age groups (less than 2 years old, 2 to 4 years old, 4 to 6 years old, and over 6 years old), subdivided for the four treatments in a 2×2 arrangement, using the sexes (male and female) and pelvic limbs (right and left).

The Pearson Correlation test was also performed using the BioEstat® program to evaluate the correlation between the AN, CI, and AI variables.

Results and Discussion

Among all the evaluated animals, 26 radiographic examinations were included in the ND group, comprising 21 females and 5 males with a mean age of 3±1.4 years. The D group had 23 radiographic examinations of 10 females and 13 males aged 3±2.3 years. Regarding classification, 11 (22.4%) animals were classified as A or HD−, 15 (30.6%) as B or HD±, 6 (12.2%) as C or HD+, and 17 (34.7%) were classified as D or HD++. No dogs classified as E (HD+++/severe HD) were observed in this study. Thus, a frequency of 46.9% (23/49) for HD in Australian Cattle Dogs was obtained.

The frequency of dysplastic dogs obtained in this study can be considered low compared to studies carried out with dogs of the breeds Rottweiler (Genuíno et al., 2015), German Shepherd, and Labrador Retriever (Vieira et al., 2010) and similar to that described for Golden Retriever dogs (Paster et al., 2005). Male Australian Cattle Dogs had a higher frequency, similar to German Shepherd dogs, unlike the Labrador retriever and Rottweiler breeds, in which females had a higher frequency of HD (Vieira et al., 2010).

HD is classified using signs of joint congruence, the presence of osteophytes in this joint, remodeling of the head and femoral neck, and the measurement of the Norberg angle (Cavalcanti, 2018). Joint incongruence was observed in 14.3% of the animals evaluated in this study. In addition, the main osteoarthritis signs consisted of the crown of osteophytes in the insertion of the joint capsule, flattening of the head, and thickening of the femoral neck. The first usually observed signs are joint subluxation and acetabular tear (Genuíno et al., 2015; Powers et al., 2004; Vieira et al., 2010; Weigel & Wasserman, 1992), but these changes were not seen on the radiographs evaluated in the present study.

The AN measurement results for the D group were similar to those obtained in a study with German Shepherd dogs (Vieira et al., 2010). This similarity may be because both breeds are shepherd and lupoid (Confederação Brasileira de Cinofilia, 2012; Schwartz, 2004). In addition to these methods, CI and AI can be complementary to assess this condition (Genuíno et al., 2015).

The mean CI obtained in this study was 0.32±0.04 for ND and 0.33±0.05 for D, values very close to those found in Rottweiler dogs (Genuíno et al., 2015) and shown in Table 1. CI indicates bone stiffness and may vary under conditions that cause changes between spongy and compact bone (Hartung & Hasselt, 1988). CI presented no difference ($p>0.05$) when compared between sexes, limbs, and ND and D groups, as observed in other studies (Genuíno et al., 2015; Tôrres, 1993; Vieira et al., 2010).

The AI measurement on the evaluated radiographs resulted in a mean of 158±2.57° for the ND group and 158±2.62° for the D group (Table 1). Some authors have suggested it as an important parameter in the HD investigation because femur conformation is important for good joint functioning, and AI directly influences the magnitude and direction of the forces acting on the joint and, consequently, the coaptation of this joint (Genuíno et al., 2015; Weigel & Wasserman, 1992). However, no correlation was observed between the radiographic classification of HD and AI in the present study.

No correlation was observed between the parameters AN, AI, and CI (Table 2). It can be attributed to AI or CI not directly influencing joint laxity (Lust et al., 1993; Tôrres, 1993; Weigel & Wasserman, 1992).

Age and sex showed no significant difference for AN, CI, and AI measurements, unlike studies carried out with Rottweilers, German Shepherds, and Labrador Retrievers (Genuíno et al., 2015; Vieira et al., 2010), but similar to what was observed for German Shepherd and Labrador Retriever dogs (Vieira et al., 2010).

Table 1 – Mean values of the Norberg angle (NA), cortical index (CI), and angle of inclination of the femur (AI) obtained through radiographic evaluation of hip dysplasia in Australian Cattle Dogs performed at the Laboratory of Diagnostic Imaging and Cardiology at the Federal University of Pelotas.

Group	Classification	NA	CI	AI
Non Dysplasic	A	107 ± 1.89 [a]	0.30 ± 0.04 [a]	158 ± 2.64 [a]
	B	104 ± 1.89 [b]	0.32 ± 0.05 [b]	158 ± 2.57 [a]
Dysplasic Animals	C	102 ± 1.89 [c]	0.34 ± 0.04 [ab]	157 ± 2.53 [a]
	D	98 ± 1.89 [d]	0.32 ± 0.05 [ab]	158 ± 2.61 [a]

Means followed by the same letter in the columns do not differ statistically from each other by the Tukey test ($p \leq 0.05$).

Table 2 – Pearson's correlation coefficient for the variables Norberg angle (NA), angle of inclination (AI), and cortical index (CI) obtained through radiographic evaluation of hip dysplasia in Australian Cattle Dogs, performed at the Laboratory of Diagnostic Imaging and Cardiology at the Federal University of Pelotas.

Classification	NA × AI		NA × CI		AI × CI	
	r	p	r	p	r	P
A	0.0753	0.7525	-0.0287	0.8992	-0.0193	0.9355
B	0.2054	0.3356	-0.0841	0.6960	0.3929	0.0574
C	-0.2056	0.5216	0.2608	0.4386	-0.5671	0.0688
D	-0.0677	0.7221	-0.1953	0.2682	-0.2396	0.2022

r - Pearson's correlation; p - probability of significance.

Conclusion

The evaluated radiographs showed a frequency of 46.9% of dogs of the ACD breed, with findings compatible with hip dysplasia. The cortical thickness index and the angle of inclination of the femur were not efficient indicators for predicting HD in this breed. Only the Norberg angle was sensitive in this radiographic identification.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethics Statement

This is a retrospective study of data obtained in a veterinary hospital, therefore, approval by an ethics committee was not necessary.

Acknowledgements

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