HIP DYSPLASIA: A FELINE POPULATION STUDY

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The study population consisted of cats presented to the University of Missouri-Columbia Veterinary Medical Teaching Hospital from January 1, 1991 through December 31, 1995. Ventrodorsal radiographs including the pelvic region were evaluated for radiographic evidence of hip dysplasia. Each radiograph was evaluated independently by three board-certified veterinary radiologists and a consensus normal of dysplastic evaluation was determined. There were 684 cats from 12 breeds. The data derived from this study indicate the frequency of feline hip dysplasia in this population to be about 6.6% (45/684) and that the incidence appears to be breed dependent. Also, the radiographic appearance of hip dysplasia in cats is different than in dogs. A shallow acetabulum with remodeling and proliferation involving the cranio-dorsal acetabular margin were the most common radiographic signs. Minimal remodeling of the femoral neck was seen. *Veterinary Radiology & Ultrasound, Vol 40, No. 4, 1999, pp 460–464.*

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Introduction

LITERALLY DEFINED, hip dysplasia is abnormal development of the coxofemoral joint(s). Hip dysplasia has been documented in numerous species, including humans, and is the most commonly diagnosed orthopedic disease in dogs. The canine neonate is born with normal joint conformation but in individuals genetically predisposed to hip dysplasia, changes occur between thirty and sixty days of life which lead to abnormal joint development.[1] This situation is different in humans where pathologic changes are usually present at birth. The sequence of events relative to the time at which pathologic changes occur is not well described for other species in which hip dysplasia occurs. The pathophysiology responsible for the alteration in joint development has yet to be completely defined.[2–11] In dogs, laxity of the hip joint has been recognized as a constant feature of hip dysplasia and is generally accepted to play an important role in its pathogenesis.[11,12]

Hip dysplasia is an inherited disease and the mode of inheritance is generally accepted to be polygenic. With polygenic traits the environment, while not causing the disease, may exacerbate or modify the phenotypic manifestation of the disease. In this respect heritability is often misinterpreted. The heritability index (h^2) is a statistical estimate of phenotypic variation among related individuals due to genetic differences within that population. The index may change with time for reasons such as selective breeding, survivability of affected individuals and evolution. The index measures the additive effect on the phenotype of an inherited trait against the phenotype of the general population and to date the heritability of hip dysplasia in cats has not been reported.[13]

Hip dysplasia occurs in cats, but its frequency in the general cat population is not well documented.[14–16] Since cats seldom have clinical signs referable to hip lameness, hip dysplasia has received little attention in this species. For this reason, breeding of some cat breeds for specific traits may have resulted in inclusion of a predisposition to hip dysplasia without knowledge of the breeder.

While the Orthopedic Foundation for Animals, Inc. (OFA) hip registry mainly contains data on hip dysplasia in dogs, numerous requests for evaluation of hip conformation in cats have also been processed. The Maine Coon Cat is over represented in the group due to previous reports of hip dysplasia as a specific problem in that breed.* In the period January 1, 1974 through December 31, 1995 the O.F.A. received 288 requests for evaluation of coxofemoral joint conformation in cats. Two hundred eighty four of these requests were for Maine Coon Cats and there were 123 males and 161 females. Of these animals 21.1% were judged to have radiographic evidence of hip dysplasia according to standard O.F.A. grading protocols.†

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†Keller GG, Corley EA: Hip Dysplasia: Orthopedic Foundation for Animals Data on the Maine Coon Cat. Maine Coon Breeders and Fanciers Assoc. Scratch Sheet, p. 18, 1996.

This indicates that hip dysplasia is a problem in Maine Coon Cats specifically and potentially in the rest of the cat population as well.[16]

The objective of this study was to determine the prevalence of hip dysplasia in a general population of cats.

Methods

The radiographic archives of the University of Missouri-Columbia College of Veterinary Medicine were screened by the primary author for the period, January 01, 1991 through December 31, 1995. Radiographic examinations (pelvic, abdominal, etc.) of cats depicting a ventrodorsal projection of the coxofemoral joints where obtained. The primary author reviewed all of the material for diagnostic radiographic technique and positioning before inclusion in this study. Diagnostic studies included cats with a well-positioned pelvis with symmetrical obturator foramena and femura positioned to allow separation of the greater trochanters to accurately visualize the femoral head and neck area. Since most material consisted of abdominal radiographs, the distal femur and stifles could usually not be evaluated for positioning. Each radiograph was then evaluated independently by three American College of Veterinary Radiology diplomates and an opinion of either normal or dysplasia was rendered. A consensus evaluation of normal or dysplastic was then reported.

The breed, age and sex of the animal was recorded and each of the radiologists made free script notations as to the over-all hip status and if dysplastic, the radiographic findings present to warrant such a diagnosis, i.e., subluxation, shallow acetabulum, remodeling of the femoral head/neck, acetabular rim changes and degenerative joint disease/osteoarthritis. All radiologists used the same radiographic criteria for the diagnosis.

Examination of the relationship between variables in the population with regard to the incidence of hip dysplasia was established ($P < 0.05$) using Chi-square.

Results

There were 696 cats evaluated (382 males/314 females) representing 12 breeds. The age ranged from 1 to 256 months with a mean of 67.4 and a median of 42.8 months. In 12 of the 696 cats the presence or absence of hip dysplasia could not be determined. The majority of these animals had prior pelvic and acetabular trauma, or were too immature that a determination could not be made.

The frequency of hip dysplasia for the total population of cats was 6.6% (45/684) (Table 1). Dysplastic cats ranged in age from 8 to 204 months with a mean and median of 72.6 and 70 months, respectively. The prevalence in the Domestic was 5.8% (35/603) versus 12.3% (10/81) in purebred cats. The difference in frequency of dysplasia between the Domestic and purebred cats was not significant ($P = 0.07$).

There was general agreement regarding the radiographic abnormalities present in animals diagnosed as dysplastic. The most consistent radiographic finding was a shallow acetabulum (45/45). A shallow acetabulum was present in cats with degenerative joint disease (43/45) and two cats were diagnosed as dysplastic solely on the presence of shallow acetabulum. Subluxation (defined as incongruent or non-parallel joint surfaces) was not consistently associated with degenerative joint disease (2/45).

TABLE 1. Summary of Coxofemoral Joint Status by Breed

Breed	Total	Total		%/no.	Dysplastic	
		Male	Female	dysplastic	Male	Female
Domestic	603	338	265	5.8/35	16	19
Abyssinian	2	1	1			
Balinese	1	1	0			
Birman	3	1	2			
Burmese	5	1	4			
Havana	1	1	0			
Himalayan	16	8	8	25.0/4	0	4
Japanese Bobtail	1	0	1			
Manx	3	3	0			
Persian	19	8	11	15.8/3	1	2
Russian Blue	2	1	1	50.0/1	0	1
Siamese	28	15	13	7.1/2	1	1
Sub Total	81	40	41	12.3/10	2	8
Total	684	378	306	6.6/45	18	27

The consensus opinion of dysplastic or normal was unanimous among the three radiologists in 93.4% (650/696) of the cats.

Sixty percent (27/45) of the dysplastic animals were females and females represented 45 percent (314/696) of the total population. The difference in frequency of dysplasia between sexes was not significant ($P = 0.066$).

Discussion

This study indicates that hip dysplasia is present in domesticated cats and in our study the incidence in this population was 6.6% (45/684). Furthermore, the frequency may be breed dependent, i.e., 5.8% in the Domestic, 7.1% in Siamese, 15.8% in Persians, and 25.0% in Himalayans. However, the purebreeds are represented in smaller numbers when compared to domestics (Table 1).

This finding raises a question to the possibility of certain feline breeds having higher frequencies of hip dysplasia. The Persian and Himalayan, like the Maine Coon, are breeds with a larger body type which may be a contributing factor in the development of degenerative joint disease in predisposed animals. It may also be that the breeds with a high level of affliction are the results of a narrower base gene pool. Thus the effect of a single affected animal on the gene pool of the breed as a whole is greater. Larger numbers are needed to more accurately determine the true incidence in purebred cats.

The lack of a sex predilection for hip dysplasia in cats is comparable to reports on dogs but contrary to findings in humans where there is a 4:1 female to male ratio.[17,18] No

demonstrable difference in the demographics, age, or reasons for examination were detected between male and female cats.

Though no measurable objective criteria were developed for acetabular depth, the subjective impression was that the normal acetabulum of the cat seemed to be generally shallower than in the dog (Fig. 1). In dogs, one of the generally accepted criteria for normal acetabular depth is coverage of 50% or more of the femoral head. However, even this generally accepted criteria is not well documented. If this criterion were universally applied to cats then substantially more cats in this study would have been judged to be dysplastic. However, numerous cats of advanced age had <50% acetabular coverage of the femoral head but no evidence of degenerative joint disease.

This study indicates that hip dysplasia in cats is consistently associated with an abnormally shallow acetabulum. This finding would appear to be an important cause for the onset of degenerative joint disease and a major basic conformational defect of feline hip dysplasia. The shallow acetabulum is similar to the situation in humans but unlike dogs where subluxation of the hip joint, with or without a shallow acetabulum, is an early radiographic finding.

Subluxation was not consistently associated with degenerative joint disease in this population of dysplastic cats (2/45). The role joint laxity plays as an important cause for degenerative joint disease in the cat is not fully understood but may be an important pathologic finding (especially early in the course of the disease) in cats. The issue of joint laxity would be more accurately investigated in a prospective study.

The location of the degenerative changes in feline hip dysplasia differs from that seen in the dog. The most extensive remodeling and proliferative changes involve the cranio-dorsal acetabular margin with minimal remodeling of the femoral neck (Figs. 2 and 3). This attempt to buttress or reinforce the acetabular margin is further evidence of the importance of a shallow acetabulum as a basic factor in the development of the disease. In the dog the most severe changes generally involve the femoral neck and head with dorsal rim proliferation occurring in the more advanced stage of the disease (Fig. 4).

FIG. 1. Appearance of radiographically normal feline coxofemoral joints.

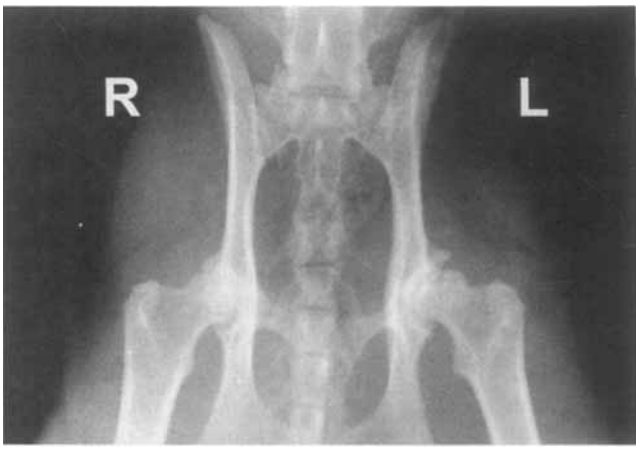

FIG. 2. Appearance of a cat with degenerative joint disease secondary to feline hip dysplasia. Note the bilateral shallow acetabula, acetabular subchondral sclerosis and osteophyte formation along the dorso-cranial acetabular margin.

FIG. 3. Appearance of one of the two cats in this population with subluxation as well as degenerative changes described in Figure 2.

FIG. 4. Typical degenerative changes in dog with hip dysplasia. Note the difference in appearance of the acetabular remodeling compared to the cat (Figures 2 and 3).

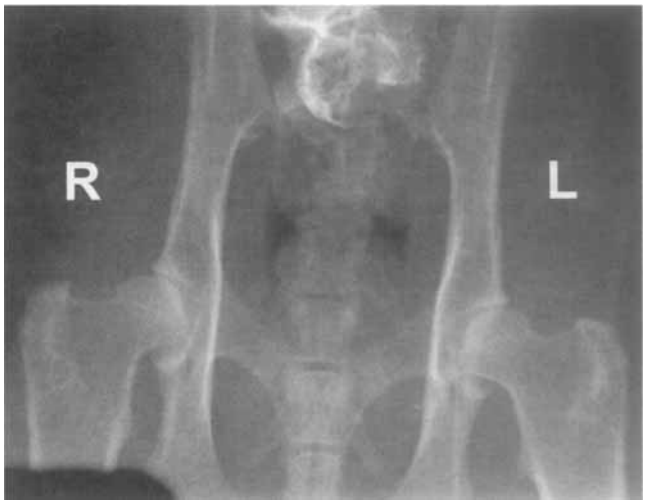

FIG. 5. Radiographic appearance of a "mushroom-shaped" femoral head in a 102-month-old cat. Due to the advanced age of the cat and lack of visible bone proliferation and remodeling along the dorso-cranial acetabular margin, this change was reported as a normal anatomic variant.

In cats, a "mushroom shaped" or oval appearing femoral head was present in cats with radiographic changes associated with hip dysplasia but was also visualized in cats (even of advanced age) without remodeling and proliferative changes involving the cranio-dorsal acetabular margin, shallow acetabula and/or subluxation (Fig. 5). This radiographic change was reported as a normal anatomic variation in cats that did not have radiographic findings associated with degenerative joint disease or subluxation and could be comparable to the "Morgan Line" described in dogs.[19] The frequency and significance of this radiographic change could be more definitively understood in a prospective study including gross pathologic and histopathologic information.

Since hip dysplasia is present in cats, conscientious breeders should consider evaluating the cats in their breeding stock if a problem exists. This particularly applies to the Maine Coon Cat in which a high frequency has been documented. Larger population numbers are needed to establish the frequency of hip dysplasia in other purebred cats. In addition, a study documenting the mode of inheritance would be beneficial.

A consistent breeding program, using a standardized diagnostic protocol, is the only proven method for reducing the frequency of an inherited disease. Due to the paucity of information available on the cause, progression and inheritance of hip dysplasia in cats, mass selection is the only breeding protocol available. Selective breeding based on normal phenotype will reduce the frequency of hip dysplasia over generations and this with additional information (pedigree depth and sibling status) will hasten progress.[20,21] However, this method will only work if a sufficient percentage of the population is evaluated and breeders are conscientious about eliminating affected animals from the breeding pool. This is problematic where some affected animals have other desirable traits. In these circumstances breeders have to decide where the greatest priority lies and attempt to strike a balance of desirable traits.

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