STANDARD HIP VENTRODORSAL LEG EXTENDED VIEW IN THE DIAGNOSIS OF CANINE HIP DYSPLASIA: A Review

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SUMMARY

Canine hip dysplasia (CHD) is hereditary developmental condition that involves a lack of conformity between the femoral head and acetabulum. It invariably leads to osteoarthritis. We hereby review the standard hip ventrodorsal leg extended view to be adopted by our Tanzanian veterinarians. Diagnostic radiography is the only definitive method used to detect CHD. In 1961, a report from a panel of the American Veterinary Medical Association on CHD indicated that, the standard hip ventrodorsal leg extended view is the most preferred. This standard view has become the most common radiographic view for the evaluation of CHD. The standard hip ventrodorsal led extended view is more practical and is technically less demanding. It can be easily reproduced in a practice situation. The use of this view by the Orthopaedic Foundation for Animals (OFA) established in 1966 has contributed significantly to the radiographic evaluation of canine hip joint and control of CHD. Adoption of this technique by our veterinarians is important in the diagnosis and control of CHD in Tanzania. This will serve to prevent losses to pet owners, dog breeders and dog buyers. Radiological screening and selective breeding programmes have been successfully used to control CHD in several countries. We recommend this view to be used in Tanzania for CHD diagnosis in animals suspected to show hind limb lameness and as routine for breeding dogs.

INTRODUCTION

Canine hip dysplasia (CHD) is an inherited, developmental condition that involves a lack of conformity between the femoral head and acetabulum and may invariably lead to osteoarthritis (Lust, 1997). The disease first appears in susceptible dogs when they are between 4 and 12 months old, although in some dogs, the disease is not evident radiographically until they are greater or equal to 24 months old (Lust, 1997). Hip dysplasia affects many domestic mammals as well as humans (Riser *et al.,* 1985). It is one of the common orthopaedic disorders in dogs (Lust, 1997). Presently it is considered the most frequent hereditary orthopaedic disorder of dogs with influence on the

occurrence and development of hip joint osteoarthritis (Ledecky *et al.,* 2004).

The disease was first described by Schnelle in 1937 (Swenson *et al.,* 1997). It was thought to be rare at that time, and it was termed 'bilateral congenital subluxation of the coxofemoral joints' (Smith, 1997). A more descriptive definition of CHD was introduced by Henricson *et al.,* (1966) as being 'a varying degree of laxity of the hip joint permitting subluxation during early life, giving rise to varying degrees of shallow acetabulum and flattening of the femoral head, and finally leading to osteoarthritis'. Based on the connection that exists between hip joint laxity and osteoarthritis, stress radiographic method that detects susceptibility of young dogs to CHD has been developed (Smith, 1997).

Canine hip dysplasia has been reported in several countries (Whittick, 1974) including Tanzania (Makungu, 2006). The disease can affect all breeds of dogs; however, it is most common in large and giant breeds (Whittick, 1974; Martinez, 1997; Smith, 1997). The high prevalence of this condition was recognized around the world in 1950s (Swenson *et al.,* 1997). The prevalence may run over 50% in large dogs if control measures have not been practiced (Riser *et al.,* 1985).

The persistently high prevalence of CHD emphasizes the need for a sensitive and specific diagnostic method to assess a dog's hip status and breeding potential. Diagnostic radiography is the only definitive method used to detect CHD (Fox *et al.,* 1987). Several radiographic views have been used in the diagnosis of CHD (Barclay and Theresa, 1990; Smith *et al.,* 1990; Henry, 1992; Smith, 1997; Lust *et al.,* 2001). Frequently used radiographic views are the standard hip ventrodorsal leg extended view, frog-leg view and stress radiographic views (distraction and compression views).

In 1961, a report by a panel of the American Veterinary Medical Association on CHD indicated that the standard hip ventrodorsal leg extended view is preferred. The view is highly used by the Orthopaedic Foundation for Animals (OFA) and is sometimes referred to as the OFA view. This view has become the most common radiographic view for the evaluation of CHD. The view has contributed significantly to radiographic evaluation of the canine hip joint in the diagnosis and control of CHD (Henry, 1992). The standard hip ventrodorsal leg extended view is more practical and it is technically less demanding. It can be easily reproduced in any practice situation.

The frog-leg view permits good evaluation of early osteophytes formation on the femoral head and neck. The main disadvantage of frog-leg view is this position tends to force femoral heads into the acetabulum, which may allow mild or early subluxation to be missed (Henry, 1992).

Stress radiographic views which are advocated by the Penn HIP method of hip evaluation can predict as early

as four month of age what degree of dysplasia the dog may develop and susceptibility to osteoarthritis (Smith, 1997). The major disadvantage which has been reported to be associated with stress radiographic views is they are more demanding technically and are difficulty to reproduce in a practice situation (Fox *et al.,* 1987).

Surgical and medical symptomatic treatments that are available cannot return the limb to normal function and may result in shortening of the life span of affected dogs. Despite the occurrences of the cases there is no breeding policy being followed to prevent losses to pet owners, dog breeders and dog buyers. Radiological screening and selective breeding programmes have managed to control the prevalence of CHD in several countries (Corley, 1992; Swenson *et al.,* 1997).

Recognition of the standard hip ventrodorsal leg extended view is important in the diagnosis and control of CHD so as to prevent losses to pet owners, dog breeders and dog buyers. The main objective of this paper is to review the standard hip ventrodorsal leg extended view in order to advocate its use in Tanzania.

THE STANDARD HIP VENTRODORSAL LEG EXTENDED VIEW

Age for diagnosis

Typically CHD first appears in susceptible dogs at the age of between 4 and 12 months, although in some dogs, the disease is not evident radiographically until they are 24 months old (Lust, 1997). According to OFA, the susceptibility to CHD can be assessed in animals less than 24 months of age but the minimum age for radiographic certification that dogs had a normal hip joint phenotype should be 24 months (Corley, 1992).

Positioning

In order to attain proper positioning the animal should be under general anaesthesia preferably xylazine and ketamine combination (Makungu, 2006). An anaesthetized patient is placed in a dorsal recumbence. The hind limbs are extended and the stifles are rotated inward until the patellas can be palpated on the midline over the trochlear grooves. The film should include the area between the wings of the ilia and the stifles (Fox *et al.,* 1987) (Figure 1). A cradle or blocks (e.g. sand bags) may be placed on the lateral sides of the thorax to avoid rotation. Radiographic features indicative of a properly positioned patient are as follows; the wings of the ilia appear symmetric, the obturator foramina appear equal in size and symmetric in outline, dorsal acetabular edges should be visible through the femoral edges and the patellae should overly the femoral trochleas (Kealy, 1987) (Figure 2).

Figure 1. A general anaesthetized patient placed in a dorsal recumbence ready for standard hip ventrodorsal leg extended view.

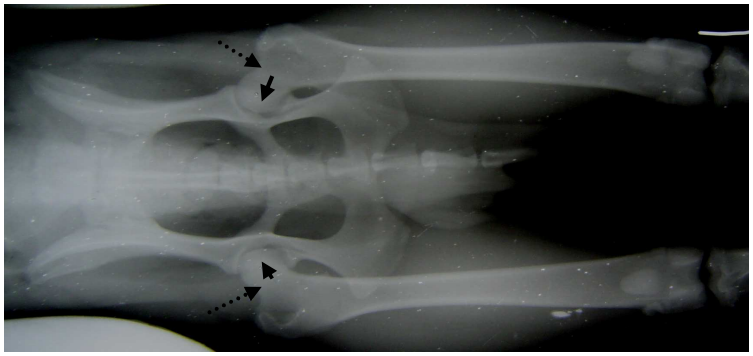

Figure 2. A standard hip ventrodorsal leg extended view showing features of a normal (free from CHD) proper positioned patient. Note: The wings of the ilia are symmetric, the obturator foramina are equal in size and symmetric in outline, dorsal acetabular edges are visible through the femoral edges and the patella overlies the femoral trochlears which are indicative of a proper positioned patient. There is also a distinct femoral neck (dotted arrows), smooth and rounded femoral head well seated in a C-shaped acetabulum (solid arrows), more than 60% of the femoral head is covered with acetabulum and without secondary changes which are indicative of a normal patient.

Radiographic technique

Radiograph can be made at a Focal Film Distance (FFD) of 90cm, however this distance may vary depending on the type of the x-ray machine used. The x-ray beam should be centred at the level of the hip joints, which can be located by palpation of the greater trochanters. Exposure should be sufficient to allow visualization of the dorsal acetabular margin through the

femoral head and neck. The exposure time should be sufficiently fast to prevent motion artifact. Shielding of the testes or ovaries with leaded material is recommended (Henry, 1992). As with all radiographs, the films should be adequately identified by a permanent method. It is commonly recommended that female dogs should not be radiographically evaluated while in estrus partly due to mild subluxation that may be observed during estrus (Henry, 1992).

Interpretation

Radiographic features which are suggestive of normal dog (free from CHD) are; a distinct femoral neck, smooth and rounded femoral head well seated in a C-shaped acetabulum, more than 60% of the femoral head is covered with acetabulum and without secondary changes (Fox *et al.,* 1987) (Figure 2).

Evaluation of CHD varies among different countries but is based on findings of subluxation and secondary changes involving the hips or both (Henry, 1992; Smith, 1997). Diagnosis of moderate to severe CHD is fairly straight forward because of the obvious subluxation or degenerative changes observed. The main difficulty arises from mild or borderline changes, which require excellent radiographs and a more extensive knowledge and experience in hip evaluation. Subluxation is considered by many as definitive evidence of the presence of CHD. It is certainly one of the primary radiographic findings in early CHD (Henry, 1992).

Subluxation of the hip joint of the dog is indicated radiographically by; (i) Incongruence of the cranial acetabular rim and the subchondral bone margin of the femoral head in the cranial one-third of the joint (between the fovea capitis and the craniodorsal acetabular margin), (ii) Widening or wedging of the joint space in the cranial one-third of the joint, (iii) Less than three-fifth (60%) of the femoral head is covered by the acetabulum and (v) Various measurements methods i.e. quantitative methods (Henry, 1992) (Figure 3).

Radiographic signs suggestive of secondary changes of the acetabulum include; (i) Shallow 'C' or cup-shaped acetabulum, (ii) 'Wearing away' or remodelling of the craniodorsal margin, (iii) New bone formation on the craniodorsal margin, (iv) Irregularity of the cranial acetabular margin to a flattened or double curved line and (v) Filling of the acetabular fossa with bone, usually seen as increased opacity of the acetabular notch and the appearance of a shallow acetabulum (Henry, 1992) (Figure 4).

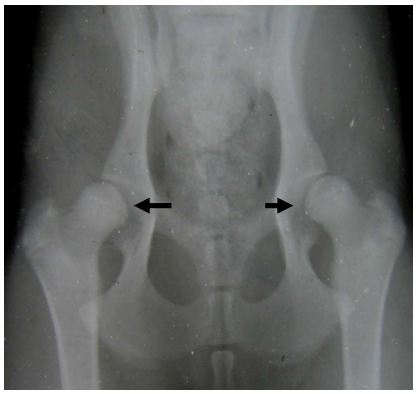

Figure 3. A standard hip ventrodorsal leg extended view of a dog with CHD showing bilateral subluxation of the hip joints. Note: Bilateral widening of the joint space in the cranial one-third of the joint (arrows) and less than 60% of the femoral head is covered by the acetabulum.

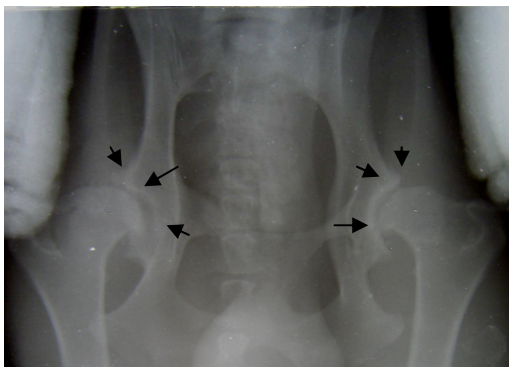

Figure 4. A standard hip ventrodorsal leg extended view of a dog with CHD showing bilateral secondary changes of the acetabulum. Note: Bilateral shallow acetabulum, wearing away of the craniodorsal acetabular margin, irregularity of the cranial acetabular margin and filling of the acetabular fossa with bone (osteophytes) which is seen as increased opacity of the acetabular margin and the appearance of the shallow acetabulum (solid arrows). Subluxation of the femoral heads and changes of the femoral head and neck are also evident.

Abnormal radiographic secondary changes of the femoral head and neck include; (i) Shift in position of the femoral head in young dogs, (ii) Loss of the spherical shape of the head (remember to exclude the fovea capitus), (iii) New bone formation around the articular margin of head, (iv) New bone at ligamentous and capsular attachment sites on the femoral neck, which can produce a radiopaque ring with thickening and roughing of the femoral neck and (v) Coxa vara or coxa valga (Henry, 1992) (Figure 5).

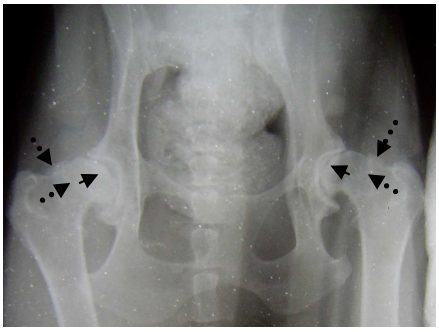

Figure 5. A standard hip ventrodorsal leg extended view of a dog with CHD showing bilateral secondary changes of the femoral head and neck. Note: Bilateral loss of the spherical shape of the head, new bone formation around the articular margin of the head (solid arrows) and at the capsular attachment sites on the femoral neck (dotted arrows) which produce thickening and roughening of the femoral neck. Changes of the acetabulum are also evident.

Grading or classification

Several schemes have been devised to provide a means of grading the severity of CHD. However the lack of universal acceptance of one method has led to misunderstandings and confusion (Henry, 1992). The OFA uses seven grades, which are excellent, good, fair, borderline, mild, moderate and severe dysplastic. Normal phenotypes are graded as excellent, good, or fair. Borderline hip conformation is assigned to those dogs for which the radiographic findings are questionable and consensus of normal or dysplastic cannot be determined. A repeated study is recommended in six to eight months for comparison. Dysplasia is graded as mild, moderate, or severe depending on the magnitude of the radiographic changes (Table 1). Radiographs of dogs 24 months of age or older are independently evaluated by three randomly selected radiologists. A consensus of three independent evaluations is reported to the owner and the referring veterinarian. A breed registry number is issued to normal dogs and is reported as public information to the appropriate breed club. The hip status of dogs under 24

months is rated in the same manner, but one veterinary radiologist makes the evaluation. No breed registry number is assigned, and the results are reported only to the owner and the referring veterinarian (Corley, 1992)

Table 1. OFA classification of hip joints

Grade	Description
1. Excellent hip joint conformation	Superior hip joint conformation as compared with other dogs of the same breed and age. Acetabular cup is a well-formed C shape and the femoral head is well seated within it (75% or greater). *
2. Good hip joint conformation	Well-formed hip joint conformational as compared with other dogs of the same breed and age. Acetabular cup is a well-formed C shape and the femoral head is well seated within it (60 to 75%.)
3. Fair hip joint conformation	Minor irregularities of hip joint conformation as compared with other dogs of the same breed and age. Examples include arthritis with no evidence of subluxation, ossicles at the cranio dorsal acetabular rim, or reduced cup shape to the acetabulum but no evidence of joint laxity.
4. Borderline hip joint conformation/ Indeterminate	Marginal hip joint conformation of indeterminate status with respect to hip dysplasia at this time. A repeat study is recommended in six to eight months. Either the conformation of the animal prevents determination or there are film quality problems that interfere with the reader making an accurate interpretation (positioning, darkroom technique, exposure).
5. Mild hip dysplasia	Radiographic evidence of minor dysplastic change of the hip joints. Mild subluxation or shallow acetabular formation-40 to 50% of femoral head is covered by the dorsal acetabulum with minimal secondary changes.
6. Moderate hip dysplasia	Well-defined radiographic evidence of dysplastic changes of the hip joints. Moderate subluxation (25 to 40% of femoral head is covered by the dorsal acetabulum) or subluxation with evidence of secondary changes.
7. Severe hip dysplasia	Radiographic evidence of markedly dysplastic changes of the hip joints. Severe subluxation (less than 25% of femoral head is covered by the dorsal acetabulum) or moderate subluxation with marked secondary changes.

Source: Fox, *et al*., (1987)
*Comments in italics are provided by the authors as interpretive guide.

DISCUSSION

History, clinical signs, physical diagnosis and radiography are useful in the diagnosis of CHD. Hind limb lameness is not always attributable to CHD, it is important that the clinician perform a thorough orthopaedic and neurological examination to rule out other causes of pelvic limb lameness. Conditions that are frequently confused with CHD include bilateral stifle pathology (rupture cranial cruciate ligaments, luxating patellas, meniscal tears), immune mediated arthropathies, metabolic bone disease in young dogs (osteochondritis dissecans, panosteitis, hypertrophic osteodystrophy), and spinal diseases (rupture of intervertebral discs, degenerative myelopathy and lumbosacral instability (Fry and Clark, 1992).

Diagnostic radiography is the only definitive determination of CHD (Fox *et al.,* 1987). Although pelvic radiography is mandatory to definitively diagnose CHD, it should not be the first step in the workup because other diagnoses may be missed or there may be concurrent conditions (Fry and Clark, 1992).

Qualitative and quantitative radiographic methods have been applied to CHD assessment. Quantitative methods, which are used for CHD assessment are measurements of Norberg angle (Kealy, 1987; Smith, 1997), distraction and compression indices (Smith *et al.,* 1990; Smith, 1997), percentage of femoral head coverage (Rasmussen *et al.,* 1998) and Rhodes and Jenny Acetabular Index (Whittick, 1974). Smith (1997) has reported that quantitative methods apart from detecting CHD they can also be used to predict as early as four months of age the degree of hip dysplasia the dog may develop and the susceptibility to osteoarthritis. However, these methods are technically demanding and difficult to reproduce in a practice situation (Fox *et al.,* 1987). On the other hand, qualitative radiographic method for CHD evaluation advocated by OFA which uses standard hip ventrodorsal leg extended view is more practical and easy to use (Fox *et al.,* 1987), therefore user-friendly in real-life situations.

In Tanzania there is no breeding policy for CHD, breeders do not screen their dogs against disease and moreover breeding certification is not existent. In order for our country to venture into dog breeding, a breeding policy should be instituted. This will assist Tanzania to conform to the world standards for breeding dogs and thus be able to compete globally in this business. Breeders are also advised to form Kennel club as pre-requisite for breeding registration and certification. If the dog is found to be dysplastic at an early age, the economic losses from costs of training, handling, showing to local pet owners, dog breeders and dog buyers can be minimized.

Based on the above, it is hereby recommended that standard hip ventrodorsal leg extended view should be used by Tanzanian

Veterinarians for routine CHD diagnosis in animals suspected to show hind limb lameness. Further more evaluation for certification should only be done by scrutinizers who have been appointed by the responsible authority.

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