

PennHIP hip dysplasia breeding scheme

Mike Guilliard MA VetMB CertSAO MRCVS

guilliard@talk21.com

tel: 07784202024

Canine hip dysplasia (CHD) is a common cause of hind limb lameness and exercise intolerance. The dictionary definition of dysplasia is abnormal growth or development and as such CHD is a developmental condition meaning that all pups are born with normal hips but the abnormality develops as they grow. CHD is prevalent in almost all breeds and must be seen as a result of breeding programmes selected to accentuate characteristics that are desirable for the various breed standards. Breeds such as the racing Greyhound, where the selection process is towards racing performance, have normal hips and do not develop the osteoarthritis associated with CHD.

It has long since been known that CHD is an inherited condition and as such, by identifying the carriers of the genes, it should be possible to decrease its prevalence and severity through selective breeding programmes. As the condition is caused by many genes screening for specific genes is not yet a possibility, and so identification of carriers is by the expression of the genes themselves in the adult, and is called the phenotype. This involves identifying abnormalities in the hip joints.

Basically all hip improvement schemes attempt to predict the likelihood of the development of hip osteoarthritis. Osteoarthritis is really the end point of CHD and it indicates that the hip joint has degenerated and is likely to be painful.

The standard method of screening used by the British BVA/Kennel Club selects as its phenotype changes to the hip joints as seen on a hip-extended x-ray, with various changes to the joint being scored as to their severity. These changes fall into three categories that are basically subluxation, or how incompletely the ball of the hip fits into the socket, joint remodelling and osteoarthritis. Similar schemes include the OFA scheme of the USA, the FCI scheme of Europe and the German SV a stamp scheme.

The British BVA/KC hip scheme advises owners to breed from dogs that are well below the breed mean score. However it is apparent to breeders and veterinarians that the hip status of the national canine population has not seemingly improved over the many years of the scheme's existence. The BVA/KC will argue that breed mean standards have improved but as there is no compulsion to submit all x-rays, many with high scores are not submitted saving the owner the submission fee. However this skews the breed mean scores, making them non-representative.

Of the nine parameters scored on each hip by the BVA/KC, it is only the Norberg angle that can be measured objectively where as the rest are subjective assessments with both intra and inter assessor agreement variance. The scores for subluxation are also affected by positioning with the hip-extended view artificially tightening the hip joints. In addition, although osteoarthritis changes are scored, no indication of its significance is given to the breeder, and as osteoarthritis gets worse with age so will the hip score.

The diagnostic test of any scheme has to evaluate hip phenotype as an estimate of the genes actually present (genotype), and its relationship is the concept of heritability. A high heritability approaching 1, means that the phenotype accurately reflects the genotype. Heritability of a given trait is lowered if environmental factors, such as diet or exercise can influence the trait's expression. Diagnostic error also lowers the estimate of heritability making the measure less useful as a hip screening tool.

In two well-executed studies of subjective hip scoring using the OFA method in the German shepherd dog, breed estimates of heritability were 0.22 and 0.43, and in four other breeds it was found to be 0.26. These degrees of heritability are considered low meaning that genetic change will be slow. These levels of heritability would also apply to the BVA/KC scheme.

An improvement in decreasing the incidence of CHD can therefore be achieved by using a screening test with a higher heritability. The only such test available is the Pennsylvania Hip Improvement Program (PennHIP). It is the only hip screening method capable of quantifying the risk for osteoarthritis as a result of hip dysplasia, and is based on the measurement of hip joint laxity or looseness. The screening test necessitates taking three different hip views. A standard hip-extended view allows the reporting of osteoarthritis already present, while the compression (figure 1) and distraction (figure 2) views enable the calculation of the distraction index (DI).

The DI is a linear scale that directly measures the degree of hip subluxation or laxity; a DI of 0.8 would indicate that 80% of the femoral head was subluxated from the acetabulum whereas a DI of 0.25 indicates that there is only 25% subluxation and thus the hips are described as tighter. There is a degree of normal joint laxity in the hips of all breeds and a DI of 0.3 is considered normal with virtually no risk of developing subsequent osteoarthritis. However the laxity profiles of different breeds vary as can be seen in figure 3 that plots the probability of developing osteoarthritis at 24 months of age against the DI.

Heritability of DI varies from different studies and averages out at around 0.65 (0.42 to 0.92) but is always considerably higher than the heritability of subjective hip scoring methods. Improvements in the hip status of the offspring are also governed by the selection pressure and this is defined as the deviation of the parental mean from the population mean. An example would be breeding parents with a mean hip score of say 5 when the breed mean is 18. This would greatly increase the selection pressure whereas if the mean parental hip score was 14 then the selection pressure would be low.

Using high selection pressure from the DI profile of the breed or of the closed colony, enables rapid improvement in hip status of the offspring in just a few generations. Breeders like to select other genetic factors in breeding programmes and dogs having the tightest hips may be undesirable for other traits, but by using the DI method, providing that the breeding stock is from the tighter side of the breed mean, hip improvement can still be achieved, albeit more slowly, than if maximum selection pressure were applied.

Another huge advantage of the PennHIP method is that pups can be accurately assessed from 16 weeks of age and subsequent submissions are allowed and indeed encouraged. In addition all cases have to be submitted for analysis and therefore the breed mean DI scores are free of selection bias and more accurate.

The disadvantage of the PennHIP method is that until now it has relied on manual holding to obtain the compression and distraction x-rays and that contravenes UK radiation safety rules. However a hands-free technique has recently been evaluated that is both cheap and simple, and this will allow UK veterinarians to take PennHIP x-rays and to become PennHIP certified.

The major disadvantage of the BVA/KC scheme is that it can produce false negative results in that many dogs scored as having good hips will have an unacceptable degree of laxity and will go on to develop osteoarthritis and therefore should not be used for breeding. However the strength of the BVA/KC scheme is that any dog with a high hip score will have bad hips meaning no false positives.

The PennHIP system is rapidly gaining worldwide acceptance and with more than 80,000 dogs on its data base, is poised to be the next standard hip screening method. Further information about PennHIP can be found at www.pennhip.org



PennHIP compression view

Figure 2



PennHIP distraction view

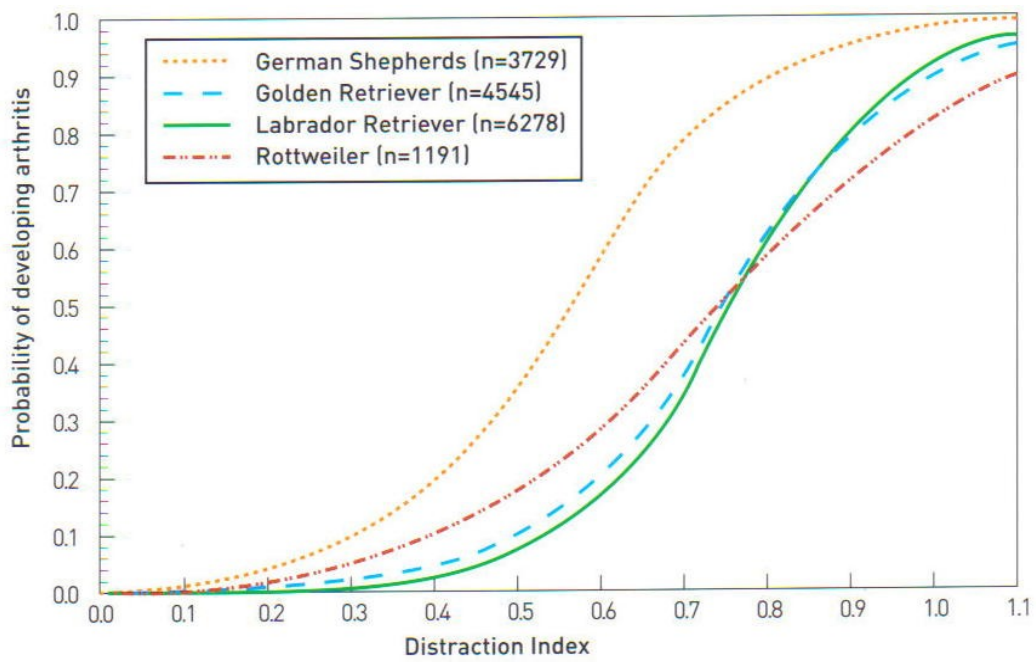


Figure 3

Depiction of the probability of developing osteoarthritis in 4 different breeds of dog at 24 months of age.