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A Vets View

So far the attempt to describe polygenic inheritance (DW Feb 20th 2009) has used general examples. Hip Dysplasia (HD) is a specific, well known condition common to many breeds and it may more effectively demonstrate the practical challenges polygenic inheritance represents. However at the outset, the reader might be interested to know that the path to recognising the inheritance of HD was not without controversy. Initially some thought it a recessive and others a dominant gene that lacked penetrance and it is only since the 1960s the consensus view settled on polygenic inheritance. In deed it was Helen Hein who first put forward this as a concept (read Genetics of the Dog by Malcolm Willis for this history). So this is a good condition to use as an example as it is a disease with a pattern of occurrence across the breeds that has led to differing opinions thus demonstrating the value of skilled geneticists. As the complexity of HD is unravelled readers might come to appreciate that this controversy was not entirely surprising.

So HD is certainly a challenge and it is in many ways quite remarkable that any progress has been achieved in its control. Firstly, it is a diagnostic challenge as there is no simple, reliable detection method using just visual or manual examination. Thus the x-ray is used to take a close look at the conformation of the hips and to allow the image of the joint to be evaluated (scored). This takes specialist expertise to both acquire the x-ray image and to evaluate. Scoring demands standardisation of the x-ray view to allow scores to be compared across a breed and between breeds. Thus accurate diagnosis is relatively expensive and there is a risk for the patient (even accepting it is small) who is otherwise apparently healthy. A further complication is the fact that a dog's ability to move is not reliably affected by the presence of HD. This is often used by any who wish to discount the importance of the defect and to raise doubt about the value of the health scheme devised evaluate it. Yet, a poor gait associated with poor hip conformation is strongly influenced by environmental factors such as body size, age, fitness and type of exercise. So here is a second dimension where the disease is inherited but its clinical appearance strongly influenced by outside factors. The result is a disease that is not simply 'present' or 'absent', but one which demonstrates a whole range of clinical appearances between 'normal' and 'severely lame'. As a result, lack of lameness at the time hips are scored (usually around 12 months of age) may simply reflect an assumption that the conformational defect and the symptoms should occur at the same time, but this is incorrect. It is certainly true that dogs with high scoring hips have a high tendency to have mobility problems later in life. In fact the best time to assess a dog would be at a considerably older age when hip changes are more fully developed and symptoms might more reliably align with the scores. However selection of breeding stock occurs at an early age so 12 months of age is a practical compromise.

The scoring system was devised to aid accurate assessment of the status of a breed with the ambition to first determine the hip scores of individual dogs but more importantly to determine an average breed score derived from these assessments. For the breeder the challenge is then to select breeding stock. Here the advice of the geneticist should be accepted for although considering a single dog's score compared to the breed average is the minimum standard to be applied, using low scoring dogs (under the breed average) is barely adequate and too simplistic. It is preferable to select breeding stock from low scoring dogs from low scoring parents and grandparents and ideally taking account of the number of low scoring siblings in all three generations. This draws on the fact that where a polygenic inheritance applies, the more a breeder uses stock with a depth of good quality attributes in the forebears, the more reliably they will produce good quality stock. This then is the logic behind the theoretical advice to score all breeding stock, along with all their offspring, with the aim to provide more security in ongoing stock selection.

Yet none of this explains why HD still exists after nearly four decades of scoring and selection. A geneticist will identify the heritability of the condition and this holds part of the key to this dilemma. Many estimates have been made for the heritability of HD in dogs with results ranging between 25-40%. It is an estimate (we lack sufficient data for accuracy) and it cannot be assumed that every breed is the same. Nevertheless, this would mean that environmental factors affect the incidence of HD by anything between 60-75%. What does this all mean for the breeder of dogs? Overall, progress will be slow because the environmental factors will influence the true effect of the inherited factors. So basically, the more a breed uses dogs below the breed average derived from earlier generations scoring below the breed average, the more it will tend to produce pups that are low scoring. Thus overtime the number of low scoring dogs being produced will increase and the breed average will decrease. Yet, if breeders are expecting to eliminate HD from their breed by routine scoring this is unlikely to happen, or at least it will take many more generations yet and can easily be reversed. The example of the racing greyhound and the show greyhound illustrates this point. Given speed is the selection pressure for the racing dog, hip scores are unsurprisingly excellent and act as a pinnacle for all breeds to strive for. The show greyhound however has a mean score higher than its racing cousin and so HD starts to appear once the highly critical selection pressure is removed.

This focus on HD takes no account of all the other 'breed type' selection pressures. In fact the selection decisions we all routinely face to maintain breed type are likely to be subject to polygenic inheritance, each with differing levels of heritability and differing importance of the environmental factors influencing their appearance. This is why breeding is such a challenge. Hip Dysplasia, unlike many other conformational variables, may affect health directly and although it can be argued it is not the most important health and welfare condition we face as dog breeders, given its inheritance, it is something we cannot ignore and must take into account as a quality factor in sire and dam selection.

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