Breeding to Eliminate Hip Dysplasia: OFA, PennHip, Both ?

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What is hip dysplasia?
When we hear the term "hip dysplasia", we think of lameness associated with arthritis of the hip joint(s). Although arthritis can be caused by multiple factors (among them poor hip conformation, trauma and infection), the term "dysplasia" carries with it the concept that the arthritis is secondary to abnormal growth or development of the hip joints. Clinical signs in dogs with hip dysplasia (HD) vary from none, to mild, to severe, with some dogs requiring reconstructive surgery or artificial hip replacement. Gait abnormalities can include stiffness, reduced step height, shortened stride length, bunny hopping, and/or difficulty in rising, climbing stairs or in jumping over obstacles.

What causes hip dysplasia?
Hip dysplasia is believed to have a genetic predisposition. The exact mode of transmission is not known, although it is believed that multiple genes are likely involved. Identification of the actual genes (and development of genetic tests to identify carriers) has been further complicated by the observation that expression of the HD genes may be influenced by certain environmental factors, such as diet (eg over feeding) and exercise. Although not the only factor, it is currently believed that hip joint laxity contributes to the development of HD. Hip joint laxity results in increased motion in the joint, which eventually leads to cartilage damage and osteoarthritis.

How is hip dysplasia diagnosed?
There are several clinical exam techniques that have been developed to detect signs of osteoarthritis (palpation and range of motion tests) or to assess laxity in a dog's hip joints (eg . Ortolani, Bardens and Barlow tests). Radiographic studies can also be separated into two main groups, one to evaluate joint congruence and to detect signs of osteoarthritis using the standard ventrodorsal hip extended view (eg. OFA), and the other to assess hip joint laxity (eg. PennHip, dorsolateral subluxation [DLS], Flückiger and Half-Axial Position [HAP] methods.

What is OFA?
OFA stands for the Orthopedic Foundation for Animals. Originally established in 1966 to evaluate hips for evidence of dysplasia, the organization now performs and/or collates results from tests for a variety of diseases, including HD, elbow dysplasia, thyroid function, cardiac diseases, eye diseases (CERF and now OFA's own database), congenital deafness, a variety of DNA tests, Legg-Calve-Perthes disease, patellar luxation, shoulder OCD, sebaceous adenitis, tracheal hypoplasia, and a dental database.

To screen for hip dysplasia, radiographs are taken of a dog's hips in a standard ventrodorsal hip extended view. The radiographs are then independently evaluated by three randomly selected, board-certified veterinary radiologists from a

pool of 20 to 25 consulting radiologists throughout the USA. Each radiologist evaluates the dog's hip status considering the breed, sex, and age. There are approximately 9 different anatomic areas of the hip that are evaluated. Ideally, the radiologists are looking to see a deep seated ball (femoral head) which fits tightly into a well-formed socket (acetabulum) with minimal joint space between the two. They also evaluate the degree to which the radius of curvature of the ball is congruent with the socket. Less ideal hips are shallow and may even show subluxation. As dogs become dysplastic, secondary arthritic bone changes become apparent, usually along the femoral neck and head (termed remodeling). Acetabular rim changes (termed osteophytes or bone spurs) and various degrees of trabecular bone pattern changes (called sclerosis) can be seen. The radiologists assign a phenotypic grade of excellent, good, fair, borderline, or mildly, moderately, or severely dysplastic. Once each of the 3 radiologists classifies a dog's hips into one of the 7 phenotypes listed above, the final hip grade is decided by consensus.

Dogs must be at least 24 months old in order to receive an OFA registration number. This age was chosen based on a study in German Shepherd dogs that showed that 95% of dogs that ultimately developed radiographic signs of hip dysplasia by 5 years of age already had these signs at 2 years of age. OFA does offer preliminary hip evaluations for dogs less than 24 months of age. In general, preliminary evaluations are fairly predictive of evaluations at > 24 months, with reliability increasing as age at the time of preliminary evaluation increases. From the OFA website: "For normal hip conformations, the reliability was 89.6% at 3-6 months, 93.8% at 7-12 months, and 95.2% at 13-18 months."

The OFA evaluation is subjective. It relies on the opinions of radiologists who are considered to be experts in the field. A reasonable question to ask would be how consistently do the OFA radiologists grade radiographs? From the OFA website: "When results of 1.8 million radiographic evaluations by 45 radiologists were analyzed, it was found that all three radiologists agreed as to whether the dog should be classified as having a normal phenotype, borderline phenotype, or HD 94.9% of the time. In addition, 73.5% of the time, all three radiologists agreed on the same hip phenotype (excellent, fair, good, borderline, mild, moderate or severe). Twenty-one percent of the time, two radiologists agreed on the same hip grade and the third radiologist was within one hip grade of the other two. Two radiologists agreed on the same hip grade and the third radiologist was within two hip grades of the other two 5.4% of the time." In other words, historically there has been good agreement among the evaluating radiologists regarding their assessments of an individual dog's phenotype.

A more difficult question to ask is how well does an OFA phenotype evaluation predict the likelihood that a dog will or will not develop clinical signs of HD? The standard ventrodorsal hip extended view has been considered to lack sensitivity when it comes to detecting hip joint laxity because the standard position tightens the joint capsule, the ligaments of the femoral head and the associated muscles, making the hip appear to be tighter. In a life-long study in 48 Labrador Retrievers,

19 of the 48 dogs were judged to be dysplastic (mild, moderate, or severe) by OFA criteria at 2 years of age and 29 dogs were scored as normal (ie, excellent, good, and fair). The 19 dysplastic dogs remained dysplastic for life. However, 16 of the 29 dogs with "normal hips" at 2 years of age developed hip dysplasia by the end of life. Thus, there appeared to be a significant number of "false negative" dogs when evaluated by the OFA criteria. It should be noted that 3 of the 7 mothers of these dogs were considered to be dysplastic. It is impossible to know what the percent of "false negatives" might have been if the parents had had "normal" hips.

What is PennHip?

PennHip stands for the University of Pennsylvania Hip Improvement Program. The PennHip technique was developed by Dr. Gail Smith in 1983, but the PennHip program and database didn't actually start until 1993. There are 3 radiographic views taken with the PennHip method: 1) the standard ventrodorsal hip extended view, also used by the OFA method. This view is used to evaluate the hips for evidence of existing osteoarthritis. 2) a compressed view, which is used to evaluate hip joint congruity, or "goodness of fit" of the femoral heads. 3) a distracted view, which is used to obtain quantitative (ie objective, not subjective) measurements of passive hip joint laxity. Veterinarians must receive special training and be certified in order to be allowed to offer the PennHip technique to clients. Dogs must be sedated or anesthetized for this technique so that the muscles surrounding the hip joints are relaxed and allow passive laxity. The distracted view is obtained by placing a special adjustable metal tool between the dog's hindlegs. This tool acts as a fulcrum – the veterinarian pushes the hind legs against the tool, which pushes against the femoral heads, displacing them from their sockets. The looser the hips, the more the femoral heads can be displaced. The amount of displacement is measured as a "distraction index" or DI. It is a measure of the distance that the femoral head can be pushed out of the socket, divided by the radius of the femoral head. By computing an index, rather than the raw measurement of displacement, the DI adjusts for differences in the size of the dog (and therefore also the size of the bones).

In studies published by the PennHip group, hips with a DI < 0.3 showed no evidence of osteoarthritis and were extremely unlikely to develop arthritis later in life. As the DI increases above 0.3, the percent of hips with osteoarthritis increases. That being said, there are a fair number of dogs with DIs 0f 0.4-0.5, and even as high as 0.7, with no osteoarthritis, albeit very few of them at 0.7. In the longitudinal study cited for the OFA results above, the onset of radiographic evidence of osteoarthritis occurred later in life and there was less subluxation for those dogs with lower DIs.

What can breeders do to decrease hip dysplasia in Weimaraners?

When comparing OFA to PennHip, overall there is fairly good correlation between the two scoring methods. In one study (representing multiple breeds), OFA excellent dogs had a mean DI of 0.32, compared with mean DIs of 0.41 for dogs judged as OFA good and 0.47 for dogs judged as OFA fair. However, these two methods of hip evaluation cannot be considered to be interchangeable, because of the wide range of DIs within each

subjective OFA scoring category. Although hips with a DI <0.3 always corresponded to passing OFA scores, passing OFA hip joint scores were associated with a wide range of DIs, with many dogs having DIs in the osteoarthritis-susceptible range.

PennHip recommends that, in order to decrease the prevalence of hip dysplasia, breeders should only breed dogs with DIs that are better than the median DI for the breed (ie in the upper 50%). That being said, their own evidence suggests that any dog with a DI of 0.3 or less would have a very small chance of becoming dysplastic. So if the median DI for a breed is equal to or less than 0.3, there would be no reason not to breed a dog with a DI of 0.3, regardless of whether or not it was in the upper 50% for that breed, in my opinion. The current median DI for the Weimaraner breed is 0.38 (with 537 Weimaraner evaluations performed). This means that 50% of Weims that had the PennHip procedure done had DIs less than 0.38, and 50% were greater than 0.38. This suggests to me that overall Weims are in good shape as far as their hips go (or at least, I can say that for the Weims that have undergone the PennHip procedure).

Hip dysplasia appears to be a quantitative genetic trait, with multiple genes and non-genetic factors playing a role in disease expression. In order to make genetic improvements in hip joint health, it is necessary to breed dogs with better-than-average hip joints for the breed . Data from the OFA website suggests that there may have been some slight progress made in the Weimaraner breed over the past 30-40 years. The OFA website reports that 11989 Weimaraner hips have been radiographed from 1974-2012, with 21.3% being graded as excellent and 8.4% being graded as dysplastic. More recently, from 2006-2012, there were 1053 studies with 28.6% being excellent and 5.4% being dysplastic. Although these data may appear to show a trend for better hips, the differences are not large, and there is no statistical evaluation of the data. Additionally, since there is no requirement for owners to submit radiographs to OFA once taken, the percentage of dysplastic hips is likely under reported. Another problem with interpretation of this data is that there is no follow-up to determine whether or not the dogs ever developed HD. From data published in peer reviewed journals, it has been shown that a large percentage of dogs that receive an acceptable OFA classification (ie excellent, good or fair) go on to develop osteoarthritis later in life (ie there are a large number of “false negative” dogs when scored by the OFA or similar evaluation process (ie systems that rely on the standard ventrodorsal hip extended view). In fact, if one accepts a PennHip DI of 0.3 for a “cutoff” value for predicting healthy hips, then, according to one study, 82% of dogs scored as having “normal” hips by OFA would one day develop osteoarthritis. So there is a problem with using OFA phenotypes to decide which dogs are “better-than-average”. As a partial “work-around” for this problem, if one is looking at OFA data to make breeding decisions, it has been suggested that it is more important to choose dogs with parents and multiple siblings with OFA evaluations of good or excellent, rather than to focus simply on an individual being OFA excellent.

Personally, I do both OFA and PennHip on my dogs. I believe that PennHip has been shown, in peer-reviewed

research articles, to be more objective than OFA and to better correlate to eventual development of osteoarthritis (or not). However, I think the general public better understands OFA. Among my own dogs, and dogs of friends who also do both OFA and PennHip, I can say that our best PennHip score dogs (some with DIs in the 0.1x range) only got OFA designations of "good", while my OFA excellent dogs did not have my best PennHip DIs (one OFA excellent dog with DI 0.37). After all is said and done, HD is only one of many traits that come under consideration in making breeding decisions. All other things being equal, I think choosing dogs with lower DIs will help reduce the prevalence of HD within our breed.

References:

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