*Tools for the Breeder: Part One of a Two-Part Series on PennHIP*

# PennHIP: Is It Useful for Berner Breeders?

*By Simon Verge, DMV*

More than 40 years after the creation of the Orthopedic Foundation for Animals (OFA), careful breeding together with the use of traditional radiographic methods with accompanying "graded" judgments by radiologists regarding evidence of hip dysplasia have enabled some breeders to improve their bloodlines. Notwithstanding, most breeders would admit that we still have a ways to go before we have eliminated the threat of faulty hip conformation from our breed. With the introduction of PennHIP, another tool has been added to the breeder's toolbox. With its objective measurement of hip laxity, PennHIP has the potential to contribute substantially to our efforts to reduce the incidence of hip dysplasia in Bernese Mountain Dogs.

This article, the first of a two-part series on PennHIP's technique and application, describes: the historical development of hip laxity as an indicator of hip dysplasia; the PennHIP method as an objective measure of hip laxity; and the extent to which other breeds, domestically and internationally, use PennHIP as an indicator of dysplasia. The interpretation of PennHIP results is discussed in the second article in this series. In addition, I share my experience using the PennHIP technique in my own breeding program for the last 13 years.

**Causes of Hip Displasia.**

Some giant and large-breed dogs, such as the Great Dane or Great Pyrenees, traditionally have lower rates of hip dysplasia than Berners and Newfoundlands. A comparison of these four larger breeds is insightful, because it suggests that the disease has a hereditary component and also that it is not a fate inherent in all larger breeds. Although studies have shown that obesity and excessive exercise contribute to or accelerate the development of hip dysplasia, the scientific evidence indicates that hip dysplasia is primarily a hereditary disease. Because its mode of inheritance is polygenic, eliminating hip dysplasia from bloodlines is complex. Unlike defects such as von Willebrand's disease, with a simpler autosomal recessive mode of inheritance and for which we have a DNA test for carriers, hip dysplasia is far more difficult to eradicate.

**Hip Laxity as an Indicator of Disease.**

As early as the mid 1960s, Henricson, Norberg and Olsson (1966) confirmed passive laxity to be the cause of hip dysplasia. In anesthetized dogs positioned for the hip-extended view as required by several registries (e.g., OFA, the GDC and the OVC), radiologists observed passive laxity in the absence of muscular tone. This laxity varied from one dog to another. By the beginning of the 1980s, OFA refined its classification, basing it on the degree of laxity observed in the traditional radiograph. OFA radiologists rated hip films (Excellent, Good or Fair) depending on the percentage of the femoral head covered by the acetabulum.

The femoral head is anatomically retained in the acetabulum by its articular capsule and the round ligament. We have known for a long time that the hip-extended position required by traditional registries results in a torque effect on the capsule and the ligament, which causes the head of the femur to stay within the acetabulum, in spite of the traction applied to the rear limbs, thus dissimulating most of the passive laxity.

Toward the end of the 1980's, some researchers, including Dr. Gail Smith of the University of Pennsylvania, were motivated to develop an objective technique for measuring this laxity and to highlight its maximum value. These researchers chose to use a standardized position, physiologically more consistent with the normal anatomical position of the femur with respect to the pelvis. This effort initiated a series of comparative studies using mainly German Shepherds and Borzois.

**The PennHIP Method**

Radiographic projections for the PennHIP technique were described in 1990 and require major sedation or general anesthesia to produce absence of muscle tone and repeatability of the procedure.

***Fig. 1: Dorsal View (Courtesy of S. Monteville)***

The first x-ray (Fig. 1: Dorsal View) is taken in the traditional position as required by the OFA to detect any degenerative joint disease (DJD). The next two x-rays are taken in the more anatomically consistent position, with the femurs placed perpendicularly to the x-ray table.

*Fig. 2: Compression View (Courtesy of S. Monteville)*

The next x-ray is taken in compression (Fig. 2: Compression View), using two small cushions filled with sand on both sides of the pelvis in order to see the femoral heads and how well they fit in the acetabulum. This image allows the radiologist to measure the pelvis in preparation for the last x-ray.

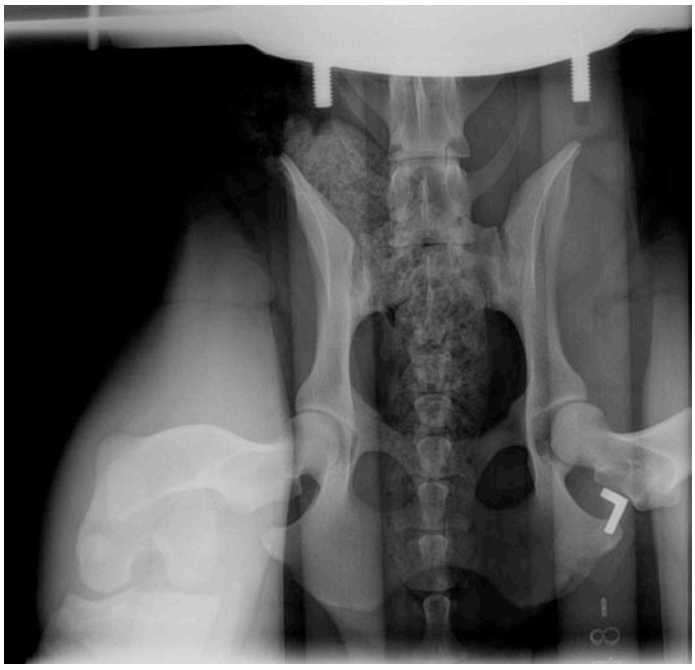

*Fig. 3: Distraction View Courtesy of S. Monteville)*

The final x-ray (Fig. 3: Distraction View) is taken with the assistance of a distractor, made of two parallel bars adjusted according to the pelvis size (interacetabular space). It is placed manually on the abdomen of the animal, against its pelvis. To obtain an image during maximum passive laxity, another technician holds the hocks of the animal and exerts brief pressure towards the interior to push the animal's knees towards each other. The trained personnel at PennHIP in Pennsylvania calculate laxity and interpret the results. The hip, being a "ball-and-socket" joint, functions optimally (without articular stress) when the geometric centers of the femoral head and the acetabulum coincide, which should be the case on the compression view. During the distraction view, these geometrical centers move away, providing a measurement that should correspond to maximum laxity. The distraction index (DI) is obtained by the division of this displacement by the radius of the femoral head. The DI generally varies between 0 and 1. (Interpretation of the distraction index is discussed in the second article in this series.)

**Limitations of the Traditional Methods and Solutions Afforded by PennHIP**

There are several limitations with traditional radiographic methods. Traditional positioning typically does not fully reveal passive laxity and may tend to reduce it. The PennHIP method requires the absence of muscle tone. This is achieved by putting the animal under deep sedation or a complete anesthesia. Sedation ensures that measurement of laxity is not influenced by the tendency of conscious animals to tighten muscles and thereby tighten the joint.

The PennHIP position allows passive laxity to be viewed at its maximum value, which is usually 2 to 11 times greater than the values found in the traditional hip-extended position. With PennHIP, it is possible to measure laxity very precisely. A study by Kapatkin et al. (2004) compared the laxity observed by the PennHIP technique (DI) to that of the traditional hip-extended view (HEI) in 500 dogs of 10 different breeds, including Bernese Mountain Dogs. The laxity measured with DI for Bernese Mountain Dogs was 2.56 times greater than that observed in the hip-extended view.

When evaluated on sensitivity[1] and robustness (stability of the measure over time), the PennHIP technique appears to perform well. The sensitivity of the laxity measurement is quite good. Research indicates that measurements made at 4 months of age are robust (generally stable) over the lifetime of the dog. Therefore, in using PennHIP, it is possible to establish an early prognosis for the lifetime risk of developing hip dysplasia and passing it on to progeny.

Some registries have recognized the difficulty facing radiologists in making these pass/no-pass judgments. As a result, some organizations refined grades for passing. In the early 1980s, OFA refined its classification for official hip certification. Instead of making pass/no-pass judgments, radiologists were asked to grade dogs earning a passing hip certification according to the more refined classes: Excellent, Good or Fair. Other certification registries chose to remain with the pass/fail schemes. The judgments involved in making these evaluations are complex. The grading approach is an attempt to reduce subjectivity across radiologists and across radiographs.

PennHIP does not issue a passing or failing score. Instead it measures hip laxity directly from the radiograph for both hips and then places those measurements within the distribution of all measurements taken for the breed. The result is a laxity measure and a percentile score that places the dog being examined within the context of all dogs evaluated for that breed (submitted to date).


Minimizing subjectivity in the interpretation of radiographs is always a concern but may be more of an issue when not dealing with a direct measurement. Historically, the OFA grade represents a consensus opinion of three specialists in radiology (drawn from a panel of radiologists), certified by the ACVR, to arrive at a hip grade. Other registries (such as OVC) relied on the opinion of one radiologist who was always the same person (but who would be replaced one day).

Important in grading radiographs is the radiologist's understanding of the reference group (e.g., the typical results for the breed in question). Efforts must be taken to compensate for normal cognitive tendencies to be influenced by what one has just seen. Registries wish to avoid the radiologist granting an "excellent" grade to an average Berner that might more appropriately merit a "good" because the radiologist has been influenced by the five dysplastic Newfoundlands he has just seen or unfairly penalizing that same Berner with a "fair" because he has evaluated a series of Borzois radiographs, all with impeccable hips.

PennHIP studied the variability across different examiners and found that there was less than a 5% difference in distraction index measurements. The result is a measurement of passive laxity that is interpreted centrally.

In choosing a hip registry, a dog owner should examine how the registry evaluates itself – including the skills of its radiologists and the quality of the resulting evaluations that they perform – and how frequently it makes these data known to its customers. Hip registries should evaluate the quality of their hip assessments on an ongoing basis (not as a one-time report). These reports should be quantitative and easy to find on their websites.

A problem for any registry is the option for owners or their veterinarians to withhold x-rays that appear to be marginal or poor. Failing to submit these x-rays has the effect of distorting disease frequency statistics, most likely making the breed appear to have a lower incidence of disease than is fact and thus creating a false sense of confidence about our progress in eliminating dysplasia from the breed. PennHIP has attempted to address this problem by certifying veterinarians who can do the radiographs and requiring them to submit all radiographs to their evaluation center in Pennsylvania or risk losing their certification. Indeed, clinics offering PennHIP radiographs are required under contract with PennHIP to send radiographs directly to them for interpretation (for which expenses are included in the cost of the procedure). Although the PennHIP database is currently closed, at this time it offers breeders the ability to better understand the true frequency of disease because all radiographs must be submitted. According to the PennHIP website, the registry is expected to become semi-open within the next few months.

**Standardization Issues**

A number of problems not associated with differences in technique are worth noting.

1. The term "laxity" does not mean the same thing in the OFA and PennHIP measures. While the concept of laxity is a single defined concept, the definition does not include the conditions under which it is to be measured Our interest in laxity critically involves measurement. We want to predict DJD in our dogs, and we want to lessen the odds of DJD in their progeny. Either the PennHIP measure of laxity or the OFA assessment of laxity is intended to help with such predictions. A core question is how well each performs.

2. Traditional radiographic methods lack comparability across registries because rules and policies for evaluation vary across those registries.

3. By most scientific accounts, the degree of laxity observed with traditional methods is influenced by the level of sedation or anesthesia used. Thus, a non-anaesthetized but cooperative dog will have significant muscular tone to resist the hyper-extended position required by traditional registries, masking any passive laxity. Since sedation appears to influence the degree of laxity that can be detected and some registries do not have a consistent policy regarding sedation, comparing results across registries is difficult. It is worth noting that many veterinary colleges or hospitals will perform certification radiographs only when

the dog is under general anesthesia. In contrast, there are other clinics that willingly take radiographs without sedation. Well-intentioned clients typically overestimate the true risk of anesthesia to their pets. Other clients may be hoping to improve results by refusing to anesthetize their pets.

4. The traditional method attempts to evaluate an articular degenerative process that may take several years to develop by looking for the earliest possible signs of the disease that can be detected radiographically. The sensitivity of the traditional techniques is related directly to the age of the animal being x-rayed. Registries differ on the minimum age at which x-rays can be taken for official certification. For example, OFA requires a dog to be 24 months old to obtain certification for hips. In contrast, OVA's minimum age is 18 months. GDC's minimum age was 12 months. At best,comparing results of traditional radiographic screening across the various registries is problematic. At worst, the true disease status may change as the dog ages, suggesting a possible problem with the robustness of evaluations over timeNote that one might rationally be willing to give up some amount of predictive accuracy in return for earlier timing, e.g., if one needs to make a decision about whether to breed.

**Genetic Selection and Heritability**

In dog breeding, heritability[2] might be characterized as the genetic improvement (or decline) observed from one generation to the next on a given criterion using a particular evaluation technique. The hereditary component of a characteristic is the proportion of observed variation in a particular trait (as height) that can be attributed to inherited genetic factors rather than environmental ones. Knowing the degree to which hip dysplasia is heritable is important information in attempts to control the disease. Leighton (1997) published a study that showed a heritability of the distraction index (DI) of 0.46 for German Shepherd Dogs and Labradors. Reed et al. (2000) published a study involving four breeds including Bernese Mountain Dogs and estimated the heritability according to the traditional technique of the OFA at 0.26 ± 0.03. A study of 47 litters of Golden Retrievers published by Smith et al. (2000) showed a much higher heritability of 0.64 for the distraction index provided through the PennHIP procedure that was considered by some to be an improvement over traditional radiographic techniques.

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**International Adoption of the PennHIP Technique**

Originating in the USA, where more than 1,000 veterinarians are certified in the method and offer it in their practices, the PennHIP technique has gained support around the world. Available in more than 29 countries, it is widely used in Denmark, Australia, New Zealand, Belgium, Canada, the Netherlands, Norway and Japan. Importantly, PennHIP is the official technique of the central canine registries of Australia and Japan.

**PennHIP and Berner Garde**

As of February 2009, more than 1,325 PennHIP evaluations had been performed on Bernese Mountain Dogs. This represents every evaluation that has ever been done, because under the rules of PennHIP, veterinarians are required to submit all evaluations they perform or risk losing their PennHIP certification. Interestingly, of the 1,325 PennHIP evaluations performed on BMDs, breeders/dog owners made only 213 (16%) of them public by posting them in the Berner-Garde database. For breeders searching for stud dogs with good orthopedics, the story is even worse. In a BGF database search for champion stud dogs who were PennHIP x-rayed and had hip and elbow certifications free of dysplasia after 24 months, only 27 stud dogs were listed, of which only 16 were still living. The ability to withhold negative results by veterinarians or owners not submitting results to a database or a radiograph to a registry (open or closed) prevents concerned fanciers from knowing the true incidence of the disease. Without knowing the true incidence of disease, how can we make statements about our progress in reducing it?

**Recognition of PennHIP by American Breed Clubs for the CHIC Register**

Among the 123 breeds included in the Canine Health Information Center (CHIC) program (established by the AKC and the OFA), 102 (83%) breed clubs require an evaluation of hips. Of these 102 breeds clubs, 71 accept PennHIP (70%).

Of the 50 breeds listed on the OFA website as having incidence of hip dysplasia at greater frequency than Berners, 29 (58%) are involved in the CHIC program. (Most of the other breeds have only small numbers of dogs, thereby limiting their involvement.) As of early 2009, 23 of the 29 breed clubs already engaged in CHIC (79%) accept PennHIP as a hip evaluation technique. Currently, Bernese Mountain Dogs are not among the breeds that accept PennHIP for CHIC certification. Following the lead of other breed clubs, the BMDCA should consider allowing PennHIP as one of the acceptable tests for CHIC certification.

*For more information on PennHIP, see http://www.pennhip.org/*

**Footnotes**

[1] In statistics, *sensitivity* is the probability of a positive test result among individuals (people, dogs, etc.) with the disease. Here sensitivity should be interpreted as "the ability of a technique to predict a degenerative process."

[2] Information on *heritability* can be found on http://www.utm.edu/departments/cens/biology/rirwin/391/391heritability.htm, which are lecture notes for Biology 391, Organic Evolution, at the University of Tennessee at Martin. In that material, the instructor states that "(t)he main measure of genetic variation in polygenic (quantitative) traits is called heritability. Heritability is defined as the proportion of all the variation in a quantitative trait in a population that is present because of genetic variation (genetic differences among individuals.) Remember that the total variation of a trait in a population can depend on genetic variation or environmental variation, so heritability is the proportion that is genetic, not environmental, out of that total.

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If you are interested in sharing information about your experience with PennHIP, please join the following Yahoo group at http://pets.groups.yahoo.com/group/pennhipberners or send e-mail to: PennHIPBerners@yahoogroups.com

**About the author:** Simon Verge, DVM, is a Canadian veterinarian who has been breeding and raising Berners since 1991 under the registered kennel name of Hautbois. He has participated in 12 BMDCA Nationals since 1997. He has been board Chairman of the Bernese Mountain Dog Club of Quebec since 2006 and is a current member of the Canadian Kennel Club's Genetics and Medical Committee and Breeder Relations Committee.