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### Hip Evaluation around the World Linda Aronson, DVM

It was pointed out to me that the evaluation chart on the BCCA health page that attempts to compare hip scores from a number of organizations and different countries doesn't stack up in real life. How exactly do the different scores compare? Thus this article was born, and a somewhat strange trip it has been. To save those of you who are easily bored, I will cut to the chase and present my conclusions first. Hip evaluation is subjective. It depends on humans and as such is liable to human error. First there is the person taking the original X-rays, their skill and their patience with positioning and technical knowledge in making those X-rays. Then there is the consistency of the evaluation. Go to a dog show for a four day weekend, and see totally different line ups of winners at all levels. It is subjective judgment. For sure some dogs will consistently win more than others, but they will be beaten at times too. Hip evaluation too is subjective. That being said consistency is better than we might expect. Still, if you have a dog that appears perfectly sound, has a family of dogs with good hips and you get a borderline or dysplastic evaluation, don't just accept it, reshoot and resubmit. Always go to a veterinarian experienced at shooting hip X-rays rather than relying on one who does one every year or so. However, if you are looking to buy a dog and at least the parents do not have some kind of adult health clearance, or if you want to breed to a dog and it lacks hip evaluation, I am with Dr. Corley of the Orthopedic Foundation for Animals (OFA), you can pretty much bet that it failed to achieve a normal hip evaluation. Caveat emptor.

**Hip Dysplasia 101** Canine Hip Dysplasia (CHD) is broad term used to describe malformations of the hip joint which can lead to secondary joint diseases (degenerative joint disease (DJD), arthrosis and (osteo)arthritis), pain and lameness. The hip joint is described as a ball and socket joint. The top of the thigh bone (the femur) has a ball shaped protrusion which optimally fits snugly into a corresponding depression in the pelvic bone. This depression is called the *acetabulum*. Strictly speaking CHD is not a single disease, and I have always thought it would be more helpful to breeders if the particular cause of the problem was described. The major cause of CHD is *subluxation* of the femoral head out of the acetabulum. This may be the result of excessive laxity in the tendons holding the bones together, or because the acetabulum and head of the femur are poorly matched – the acetabulum is too shallow. Poor quality cartilage lining the joint may also



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exacerbate the condition causing the bones to grind against each other and cause pain. CHD is hereditary and a major gene is believed to be responsible. Having a genetic marker may make all the hip evaluation methods unnecessary. However, environment does play a role in the development of pathology in dogs with poor hip formation. Heritability relates the genetic basis of the disease or trait (genotype) with what is actually expressed or seen (phenotype). It is expressed as a number between 0 and 1 or a percentage and the higher the heritability the more the phenotype reflects the genotype, and the greater effect selection can have in eradicating a problem.

The severity of the radiographic changes does not correlate to the degree of impairment the dog experiences. Some dogs with dysplasia may never show clinical signs. The amount of stress to which the joint is exposed, the dog's weight, exercise – amount and type, even the weather may influence clinical signs. Dogs which are heavily muscled are less likely to show signs of dysplasia because the muscles support the joint and keep the bones tightly aligned; similarly small, light-weight dogs are far less likely to show signs even if the joints look dreadful on X-rays. Lameness is most often seen between 5-8 months or around 5 years of age.

Once degeneration of the hyaline cartilage lining the hip joint begins it is self-perpetuating. The initial damage is caused by poor matching of ball to socket causing rubbing. This damages cartilage, sometimes even breaking pieces off. The damaged cartilage releases enzymes that increase the breakdown of the cartilage and also decrease formation of proteoglycans molecules that are used to repair and make new cartilage. The cartilage becomes less elastic and also thinner, so that it provides less cushioning of the joint. Pieces of cartilage and enzymes leak into the fluid filled capsule between the two bones and destroy the glycosaminoglycans (GAGs) and hyaluronic acid that are used to make more cartilage in a healthy joint. Joint fluid acts like oil to lubricate the joint and keep it moving freely, but in the dysplastic joint fluid is depleted and loses the ability to block inflammatory cells, which further damage and inflame the joint. The synovial membrane lining the joint is eroded exposing the nerve endings in the bone beneath the cartilage. To increase joint stability and reduce pain new bone is laid down along the edges of the joint surface, within the joint capsule and along ligament and muscle attachments – bone spurs. This reduces the range of motion of the joint.



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**Assume the position** Diagnosis of CHD is based on X-ray findings in a large scale screening of dogs. Radiographic technique has been standardized worldwide. Optimally (it is required by some agencies) the dog is heavily sedated or anesthetized to ensure full muscle relaxation. It is then laid on the table on its back (dorsal recumbency) with the hind limbs extended behind it. The femurs are parallel with each other, with the spine and the table top. The patellae (knee caps) are centered over the shafts of their respective femurs. This requires rotating the patellae inward. The pelvis should appear fully symmetric. Most organizations require that the X-rays be permanently identified with the dog's registration and/or name, the name of the veterinarian or hospital taking the X-ray, and the dog's microchip or tattoo number.

Pregnant, lactating or estrus bitches may have greater hip laxity and X-rays should be taken one month after the pups are weaned, or before estrus, and two to three months after estrus. Inactive dogs may also have increased laxity, and it is recommended that dogs be in good physical condition – also important if you plan to breed.

Diagnostic quality should be assessed by the evaluating agency upon receipt and those X-rays unsuitable for evaluation should be returned to the veterinarian to be repeated. Problems can include poor position, an X-ray that is too light or too dark, or which is blurred due to movement of the animal.

**The Orthopedic Foundation for Animals (OFA)** OFA is the primary screening organization in North America, but they receive X-rays for evaluation from all over the world. The X-rays are randomly assigned to three board certified veterinary radiologists for evaluation (there are 20 to 25 consulting radiologists located throughout the USA both in private practice and academia). Hips are evaluated considering breed, sex and age. At least 9 areas of the hip are evaluated. The front and back rims of the acetabulum, the top and bottom acetabular margins, the head of the femur (ball joint), the fovea capitis – a flattened area on the top of the ball, the acetabular notch, the junction between the head and neck of the femur (the stem that attaches it to the rest of the bone) and the trochanteric fossa (a depression between the neck and the other nubbin of bone sticking up at the top of the femur). Each area is examined for deviation from the breed normal and the fit of femoral head in the acetabulum. Unlike other evaluations, the Norberg angle (NA, see under BVA/KC) is not



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measured. The hips collectively will be assigned to one of seven different phenotypical (physical) conformations. Three of these are normal (excellent, good and fair), one borderline and three dysplastic (mild, moderate or severe). Dogs rated normal are assigned OFA numbers, and the information is placed on the OFA website [www.offa.org](http://www.offa.org). If they have a verified (by the veterinarian taking the X-rays) identification – tattoo or microchip – the data will be included on AKC registration certificates for any offspring the dog produces. While a report is generated on dogs assigned other grades, unless the owner has chosen the option of open database the score will not be made public, nor will there be public record that the dog has been evaluated.

Assignment is based on consensus, if two examiners assign excellent and one good, the hips will be scored excellent, if one says excellent another good and the third fair, the hips would be assigned a good rating.

Excellent: Superior hip conformation in comparison to other animals of the same age and breed. Deep seated femoral head in well formed acetabulum, the socket almost completely covers the ball and there is minimal joint space.

Good: Slightly less than superior, well formed hip joint, ball congruent with socket and well covered.

Fair: Minor irregularities in the hip joint. The hip joint is wider than the good phenotype so that the ball slips slightly out of the socket resulting in mild incongruency. There may be a slight inward deviation of the weight bearing surface of the socket, so that it looks somewhat shallow (This finding is normal for some breeds, but not Beardies.)

Borderline: Usually more incongruency than the minimal amount seen in the fair hip, but no arthritic changes that would define the hip as dysplastic. Bony changes can not definitively be described as arthritic changes as opposed to normal anatomic variation in that particular dog. Resubmission is recommended, usually in 6 months, at which time the original X-ray will be compared to the new one. In over 50% of dogs no changes will be apparent and the hip will be assigned a normal, usually fair, rating.

Mild: Significant subluxation so the ball is partially out of the socket. The acetabulum is usually shallow, only partially covering the femoral



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head. There are usually no arthritic changes, and if the dog is young 24-30 months it is advisable to resubmit X-rays when the dog is older to track the change. CHD is a chronic, progressive disease. Most owners probably follow the dog with their own vet or orthopedist, however.

Moderate: Significant subluxation with the femoral head barely seated in the acetabulum. Secondary arthritic bony changes are usually seen along the femoral neck and head, bone spurs, and changes in bone structure – sclerosis - are also common.

Severe: Marked dysplasia with the femoral head partly or completely out of the shallow acetabulum. There are large amounts of secondary arthritic change as described above.

It should be noted that until the 90s the criteria for the 7 categories were not precisely defined and scoring was left entirely to the examiner's discretion.

Reports will also include other findings that might be inherited including transitional vertebrae and spondylosis. Transitional vertebrae are malformations of the spine occurring between the major divisions most commonly lumbosacral, but sometimes thoracolumbar. The last lumbar vertebra has anatomical characteristics of the sacrum. Transitional vertebrae rarely produce clinical signs and dogs can be used for breeding, although it is recommended they are not bred to other dogs with transitional vertebrae. Spondylosis is the production of smooth new bone between the vertebrae, and ranges from small bone spurs to complete bridging. Sometimes it is caused by spinal instability, but generally no cause is found and it usually does not produce clinical signs. It should not preclude use of the dog for breeding, but is thought to be inherited.

OFA looked at 1.8 million X-rays evaluations by 45 radiologists, and found that 94.9% of the time all three radiologists agreed the hip should be scored normal, borderline or dysplastic. The exact designation – excellent, good, fair, borderline, mild, moderate or severe – was agreed upon 73.5% of the time. Two radiologists agreed on the score and the third differed by one grade 21% of the time. Two radiologists agreed and the third was within 2 grades of that designation 5.4% of the time. This is good for a subjective assessment. OFA will only assign a number to dogs older than 24 months, and accuracy improves as the dog ages and arthritic changes become more



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apparent. Preliminary hip evaluation will be performed on X-rays submitted on puppies 4 months and older but less than 24 months. Evaluation is performed in-house by OFA's own radiologists and not sent out. Accuracy compared to adult evaluation improves the closer the puppy is to 24 months. Pups receiving a preliminary excellent evaluation were all (100%) deemed normal (excellent, good or fair) as adults. Percentages for preliminary good was 97.9% and for fair 76.9%. Reliability for 3-6 month puppies was 89.6%, 7-12 months 93.8% and 13-18 months 95.2%.

Bearded Collies currently rank 117<sup>th</sup> on the OFA breed list (although this includes non AKC breeds and even some cats). Of 4040 dogs evaluated 15.3% were assessed excellent and only 6.1% dysplastic. This suggests a clear improvement from when I first entered the breed over 20 years ago. My skeptical side wonders though how many X-rays are not submitted because the referring vet reads the X-ray as dysplastic? We cannot really know what the true incidence of CHD is in the breed. The AKC has no requirement of OFA or other hip evaluation for breeding stock.

Because three board certified radiologists evaluate the X-rays it is unlikely that a problem with the hips will be missed. OFA offers extensive advice to breeders on selecting dogs for breeding, and the website includes easy access to information on parents, siblings and half-siblings tested. However, participation is strictly voluntary.

**BVA/KC** The British Veterinary Association/Kennel Club scoring method is used in Britain, Ireland, Australia and New Zealand to score each hip joint separately based on the severity of changes in 9 specific morphologic radiographic criteria – see below. Each criterion is scored from 0 (ideal) to 6 (worst). The final score is given between 0 and 53 for each hip or a total of 0-106 for the two combined. The scoring is done by three board certified radiologists or small animal surgeons from an available panel.

**Norberg Angle (NA)**: gives a measured assessment of several features: the degree of congruence between the femoral head (FH) and acetabulum; the length of the cranial acetabular edge (CrAE) which gives a relative indication of acetabular depth and a measure of coxofemoral subluxation (laxity). A line is drawn between the centers of the two femoral heads (FHC) and a second line from each FHC to the junction between the dorsal and cranial acetabular edges. In normal hips this will be 105° or more.



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Subluxation (SL): is based principally on the level of congruence between the FH and acetabulum. The general fit is assessed by the relationship between the FHC and the underlying image of the dorsal acetabular edge (DAE). The cranial joint space is seen as a shadow between the CrAE and adjacent cranial articular margin of the FH.

Cranial acetabular edge (CrAE): minor alterations in the shape, contour and possibly length of CrAE are indicators of poor articular congruence; more severe changes are consequences of chronic instability, marginal wear and joint remodeling.

Dorsal acetabular edge (DAE): the DAE traverses the FH almost vertically and extends beyond it slightly cranially and caudally forming a well defined interface. Its clarity varies markedly depending on radiographic technique.

Score/ parameter	NA (°)	Subluxation	CrAE	DAE
0	105 & over	Femoral head well centered in acetabulum	Even curve, parallel to FH throughout	DAE has slight curve
1	100-104	FHC lies medial to DAE. Lateral or medial joint space increases slightly	Lateral or medial ¼ CrAE flat and lateral or medial joint spaces diverge slightly	Loss of S curve only in the presence of other dysplastic change
2	95-99	FHC superimposed on DAE. Medial joint space increase obvious	CrAE flat throughout most of its length	Very small exostosis on cranial DAE
3	90-94	FHC just lateral to DAE. ½ FH within	CrAE slight bilabiation	Obvious exostosis on DAE especially



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		acetabulum		cranially and/or minor "loss of edge"
4	85-89	Femoral head centre clearly lateral to DAE. ¼ femoral head within acetabulum	CrAE moderate bilabiation	Exostosis well lateral to DAE and/or moderate "loss of edge"
5	84-80	Femoral head centre well lateral to DAE. Femoral head just touches DAE	CrAE gross bilabiation	Marked exostosis all along DAE and/or gross "loss of edge"
6	79 and less	Complete pathological dislocation	Entire CrAE slopes cranially	Massive exostosis from cranial to caudal DAE

Cranial effective acetabular margin (CrEAM): Earliest detectable abnormalities are minor exostosis, which may be seen as slight rounding of the junction between CrAE and DAE.

Acetabular Fossa (AF): In unstable hips the AF and notch are sites of new bone formation. Increased opacity and loss of distinct margins around the caudomedial acetabulum gives an impression of the amount of new bone, and loss or partial obscuring of the normally clear shadow represents increased fat. Detectable new bone is closely associated with and parallels marked SL. Exact assessment is hard, but in dogs where changes are seen total scores will already be way above average.

Caudal acetabular edge (CdAE): this segment of the acetabulum is subject to the widest range of variation, and depends largely on the pelvis/film angle as well as individual differences in conformation, scored only 0 to 5; changes are mostly due to exostosis together with signs of wear in advanced cases.



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FH and neck exostosis: exostosis is the formation of new and abnormal bone on a bone's surface.

FH recontouring: extent to which FH shape is altered as a result of instability. Usually only seen in extreme cases, but hard to evaluate numerically.

Score/ parameter	CrEAM	AF	CdAE	FH & neck exostosis	FH recontouring
0	Sharp clean cut junction of DAE & CrAE	A fine bone line curves medial & caudal from caudal end of CrAE	Clean line	Smooth rounded profile	NIL
1	Indistinct junction of DAE & CrAE	Slight increase in bone density medial to AF. "Fine line" hazy or lost	Small exostosis at lateral CdAE	Slight exostosis in "ring form" &/or dense vertical line adjacent to the trochanteric fossa ("Morgan Line")	FH does not fix in circle due to exostosis or bone loss
2	Very small exostosis or very small facet	"Fine line" lost in AF & ventral AE hazy due to new bone.	Small exostosis at lateral & medial CdAE	Slight exostosis visible on skyline &/or density on	Some bone loss &/or femoral head/neck ring of exostosis



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		Notch at CdAE clear		medial femoral head	
3	Facet &/or small exostosis &/or slight bilabiation	Incomplete remodeling of acetabulum with medial face lateral to AF. Ventral AE lost. AF hazy. Notch irregular	Large exostosis and narrow notch at CdAE	Distinct exostosis in "ring" formation	Obvious bone loss & distinct exostosis giving slight conical appearance
4	Obvious facet &/or obvious exostosis &/or moderate bilabiation	Marked remodeling. Medial face of acetabulum clearly lateral to AF. Ventral AE lost. Notch partly closed	Marked exostosis and "hooking" of lateral end of CdAE	Obvious complete collar of exostosis	Gross remodeling. Obvious bone loss & exostosis gives mushroom appearance
5	Gross exostosis &/or gross bilabiation	Gross remodeling. Dense new bone throughout acetabulum. CaAE notch lost and AF obscured	Gross distortion due to mass of new bone in acetabulum. Notch lost completely	Massive exostosis giving mushroom appearance	Very gross remodeling with marked bone loss and much new bone
6	Complete remodeling of	Complete remodeling and new	Void (no grade 6 for this	Massive exostosis & infill of	FH is improperly shaped due to



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	CrEAR. Massive exostosis &/or gross facet	articular surface, well lateral to AF. Notch lost	parameter )	trochanteri c fossa and below FH	maldevelopme nt of FHC
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Owners receive a report on their dog which gives the NA for each hip, as well as the score for each criterion - so it is easier to identify where there are problems, and these scores are tallied to give the final score for each hip. Heritability from the BVA/KC scheme is 70% (estimated 30-50% depending upon country for FCI). There is no translation of the numerical score into a dysplasia grade, but the BVA recommends breeding dogs with a score of 5 or less for each hip (10 combined) or clearly below the mean score for the breed. Breed mean score is listed and updated regularly on the BVA's website

[www.bva.co.uk/public/documents/CHS\\_Hip\\_Scheme\\_Breed\\_Mean\\_Scores.pdf](http://www.bva.co.uk/public/documents/CHS_Hip_Scheme_Breed_Mean_Scores.pdf)

Currently based on 2910 Beardies evaluated the BMS is 11 with a range from 0-79. Prior to 2000 the Australian KC gave a grade as well as a numerical score, but this was discontinued as it was found to be unreliable. Sadly, many breeders in Australia and New Zealand still aren't testing hips on their dogs. In part this may be because there is a scarcity of radiologists approved to evaluate their X-rays. Like OFA the scheme is completely voluntary. There are no Kennel Club restrictions as to which dogs are used, even those that are severely dysplastic. Many breeding dogs are still untested in all these countries.

**FCI** The Fédération Cynologique Internationale is the umbrella organization for more than 80 national kennel clubs in most European countries, Russia, South America and Asia. Their scientific committee described a 5 grade scoring system from A (normal hip joint) to E (severe hip dysplasia). The grades are defined descriptively based on the size of the NA, degree of subluxation, shape and depth of the acetabulum and signs of secondary joint disease. Over the last 40 years many Western countries have implemented mandatory radiographic hip evaluation as a prerequisite for breeding. Dogs must be at least 1 year of age for official scoring. Hips are usually scored by a single examiner per breed club or within a country, although there are some exceptions. Dogs with moderate or severe CHD are barred from



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breeding in most countries. There are usually specific breeding restrictions for those with mild dysplasia. The FCI classifications are based on evaluations of dogs between 12-24 months of age (certain breeds are assessed only after 18 months). When older dogs are examined, secondary arthritic changes are assessed with regard to the dog's age. Publication of results varies between the individual breed clubs.

A: No signs of HD. The femoral head and acetabulum are congruent. The craniolateral acetabular rim appears sharp and slightly rounded. The joint space is narrow and even. The Norberg angle is about  $105^{\circ}$ . In excellent hip joints the craniolateral rim encircles the femoral head somewhat more in caudolateral direction.

B: Near normal hip joints. The femoral head and acetabulum are slightly incongruent and the NA is about  $105^{\circ}$  OR the femoral head and the acetabulum are congruent and the NA is  $< 105^{\circ}$ .

C: Mild HD. The femoral head and the acetabulum are incongruent, the NA is about  $100^{\circ}$  and/or there is slight flattening of the craniolateral acetabular rim. No more than slight signs of osteoarthritis on the cranial, caudal or dorsal acetabular edge or on the femoral head and neck may be present.

D: Moderate HD. There is obvious incongruity between the femoral head and the acetabulum with subluxation. The NA is  $> 90^{\circ}$  (only as a reference). Flattening of the craniolateral rim and/or osteoarthrotic signs are present.

E: Severe HD. Marked dysplastic changes of the hip joints, such as luxation or distinct subluxation are present. The NA is  $< 90^{\circ}$ . Obvious flattening of the cranial acetabular edge, deformation of the femoral head (mushroom shaped, flattening) or other signs of osteoarthritis are noted.

The individual breed club selects the person who evaluates the X-rays. Training and competence varies enormously from self trained veterinarians or in some cases lay persons to highly skilled board certified radiologists or small animal surgeons. Quality of scoring varies accordingly and it can be extremely difficult or impossible to compare grades between countries. Within a single country each regional breed club may have its own evaluator leading to inconsistency within the same country. The best information on evaluation is probably found on the website of the Italian fondazione salute animale (FSA) –



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<http://www.fondazionealuteanimale.it/CENTRALE/index.html> – it is not surprisingly in Italian. In general, Western and Northern European countries employ evaluators of a similar caliber to those used by other systems.

For some of the many attempts to compare hip schemes in Europe with OFA here is a small sample:

[www.leonberger.com/Leo World/hd.html](http://www.leonberger.com/Leo_World/hd.html) ;

[www.ofbridgefour.com/UK/17\\_hip\\_system.htm](http://www.ofbridgefour.com/UK/17_hip_system.htm) ;

<http://malinut.com/ref/library/hips>

**South Africa's** Hip Scoring Scheme under KUSA (Kennel Union of South Africa) according to FCI rules and regulations scores each hip and gives an FCI grade. Prior to 2007 5 grades were given 0 normal hips; 1 marginal to mild/moderate dysplasia; 2 moderate to severe dysplasia; 3 severe dysplasia; 4 very severe dysplasia. These remain listed. There are 6 approved evaluators.

**Ontario Veterinary College (OVC):** There is no official Canadian Kennel Club hip evaluation scheme. Some breeders use OFA and some OVC. Hips considered normal are classified normal/pass with no further sub-grading. Those that do not pass, receive grade 1 (least severe, roughly equivalent to OFA borderline), grade 2 (mild dysplasia), grade 3 (moderate dysplasia) or grade 4 (severe dysplasia).

**Japan Animal Hereditary Disease Network (JAHD):** Until JAHD was established Japanese breeders had their dogs' hips evaluated by either OFA or BVA. Dogs must be at least a year old and evaluation is by a point system similar to, but different from, BVA. To find the details go to their website [www.jahd.org/](http://www.jahd.org/) but it is in Japanese.

**PennHIP (University of Pennsylvania Hip Improvement Program):** As has been pointed out the majority of hip scoring schemes rely upon primarily subjective evaluation of X-rays, albeit mostly by skilled professionals with board training. In most cases dogs should be at least 12 months old for reliable evaluation and in the meantime breeders and owners spend money developing and showing dogs that could be saved if they were known to be dysplastic. Even worse, the numbers of dysplastic dogs produced has only dropped relatively modestly and we are a long way from eradicating this debilitating problem. Enter PennHIP. Their goal was to produce an evidence based technique with hard data. They train each veterinarian and veterinary



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technician approved to take the three X-ray views required, and they also wanted a technique which could accurately identify dysplastic dogs as young as 3 to 4 months.

PennHIP relies upon three different views of the hip (to see typical X-rays go to [http://www.pennhip.org/ph\\_method.html](http://www.pennhip.org/ph_method.html)). The traditional X-ray hips extended view is used to look for signs of DJD only. In this position the femur is pushed into the acetabulum with the result that it can make hips look much better than they are, particularly before DJD sets in. The distraction view still has the dog lying on its back, but the stifles are flexed and the legs held out to either side by a forced distraction device. This pulls the femur away from the acetabulum as far as the hip construction allows. Laxity is 2.5 to 11 times that of the traditional view. Specially machined circular gauges are placed over the X-ray to match the cortical margin of the acetabulum and the femoral head. The distance between the centers of these two circles  $d$  is the joint laxity. Because  $d$  varies with the size and age of the dog as well as the distance of the dog from the film, this is corrected for by dividing  $d$  by the radius of the circle covering the femoral head  $r$  to give the Distraction Index (DI). Ideally the centers of the circles would be identical and the DI would be 0. DI has no units and can range from 0 to 1 or more. The higher the DI is the looser the hips are and the greater the risk of CHD. In the compression view the femurs are positioned in a neutral, stance-phase orientation and the femoral heads are pushed fully into the sockets. The Compression Index (CI) is measured in the same way as DI and measures hip joint congruity – how good a match the FH and acetabulum are. For proper evaluation of DI and CI the muscles around the hip must be completely relaxed and can only be evaluated in dogs that are deeply sedated or under general anesthesia.

Papers evaluating PennHIP have been published in refereed journals but originate from the lab that developed the technique. They compared the accuracy of evaluating hips at 4, 6, 12, 24 and 36 months between standard OFA scoring scheme with a board certified radiologist, measuring the Norberg angle and DI. Compared to results obtained at 24 months the DI was remarkably predictive at 4 and 12 months. OFA at 4 months was little better than random, and even at 12 months not felt to be clinically helpful. NA fared better, but was not nearly as good as DI. To assess the correlation between DI and the risk of developing DJD, DI and DJD was compared in adult dogs. In a study of 142 German shepherd dogs, only one hip  $< 0.3$  showed signs of DJD (however the mean age of the dogs was only



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20 months). All hips with a DI of 0.7 or greater showed evidence of DJD. In a second study, dogs assessed at 4, 12 and 24 months of age were followed longitudinally to see if they developed DJD. The study looked at the predictive value of DI, NA, OFA score, weight and sex. DI was the most significant prognostic factor for all age groups and the strength of its predictive power increased with age. For some breeds, such as rottweilers, DI can be higher than 0.3 and the dog due to other factors will be less prone to DJD than GSDs, but the higher the DI these dogs have the more likely they are to get DJD. For this reason, a core population of members of the breed has to be established to determine the maximum "safe" DI for the breed.

A study of 4 breeds evaluated by the OFA method (English Setters, Portuguese Water Dogs, Chinese Shar-peis and Bernese Mountain Dogs) showed mean direct heritabilities of 0.17, 0.30, 0.31 and 0.30 respectively. Such figures help explain why using OFA it has been hard to eradicate CHD. By Contrast heritability for DI in GSDs and Labrador retrievers is 0.50 and 0.60.

The PennHIP evaluation generates a confidential report made directly to the owner. Each hip is evaluated with DI and CI measurements, as well as for DJD, cavitation and other changes. The PennHIP database is closed to the public, although they are contemplating opening the database for dogs with normal hips. (PennHIP is now administered by ICG, International Canine Genetics, which is owned by Synbiotics Corp.) PennHIP compiles statistics by breed semi-annually from the data it has collected. These are currently sent only to participating PennHIP veterinarians, although if you ask the researchers they will pass the data on. Currently there are 50 Bearded Collies in the PennHIP database with an average DI of 0.57, and range from 0.27 to 1.17. (The percentiles are: 25th: DI = 0.71; 50th: DI = 0.57; 60th: DI = 0.54; 75th: DI = 0.44.) For comparison, my two Beardies that I ran PennHIP on back in 1994, one at 82 months had a DI of 0.29 on both hips and the other at 27 months was 0.38 on the right hip and 0.33 on the left. Both were OFA good.

**Comparing methods:** There have been relatively few studies beyond those by PennHIP assessing accuracy of a particular method or comparing methods. I have already reported OFA's findings. A 2008 paper in *Veterinary Radiology & Ultrasound* compared interobserver agreement in the assessment of standard X-rays and its effect on agreement in diagnosis of



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canine hip dysplasia and routine FCI scoring. The research group was Belgian. There were 9 experienced and 21 inexperienced evaluators. With regard to whether the X-rays could be assessed, 68% of the experienced but only 46.5% of the inexperienced evaluators said they could. However, consistency of evaluation was not good, one dog receiving a range of FCI scores from excellent to moderately dysplastic. The study questioned the credibility of the FCI screening method for CHD as it is applied in most European countries. A study, also Belgian, in 2008 in the AVMA's American Journal of Veterinary Research compared OFA and BVA/KC databases on the prevalence of CHD, and the relationship of CHD to body weight and height. They found a very high correlation between the ranking order and the percentage of dysplastic dogs by breed between the two registries. Not surprisingly they also found weight and height, but particularly body mass index correlated with incidence of CHD – big, heavy dogs are most likely to get CHD.

**Conclusions:** While, with the exception of PennHIP and NA, most methods used to assess hips structure are subjective, the requirement to assess particular landmarks, especially when assigning a point value to each, increases the accuracy of evaluation and the likelihood that abnormalities will be detected. These abnormalities will more likely be found as the dog ages, and so it is preferable that dogs be assessed or reassessed once they have passed their second birthdays. In order to significantly reduce the incidence of CHD all or at least most breeders should score their breeding dogs and also nonbreeding relatives and then use that information to determine whether to breed a dog and where. PennHIP probably has the greatest potential for reducing the incidence of CHD, but until we have a significant number of Beardies assessed we can only guess at the safe DI for the breed. Because three X-ray views are needed and the number of trained evaluators relatively few, the cost far exceeds that of other methods.

Getting back to the initial question of how the various hip scores compare the answer is not exactly. Due to the subjectivity of evaluation you can submit the same X-ray to the same agency at different times (or take a new X-ray and submit it) and get different evaluations, or the same X-ray to different agencies and get very different assessments. On the whole though, probably the best bet is the chart from OFA (I have left off SV – which is only for GSDs). However, the average OFA Bearded Collie is Good, while the average BVA Bearded Collie is 11 (total), and I would probably say A-1 and A-2



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are the equivalent of OFA excellent, B1 good, B-2 good to fair and C fair to borderline!

<b><u>OFA</u></b>	<b><u>FCI (Europe)</u></b>	<b><u>BVA (UK, Australia)</u></b>
Excellent	A-1	0-4 (no > 3/hip)
Good	A-2	5-10 (no > 6/hip)
Fair	B-1	11-18
Borderline	B-2	19-25
Mild dysplasia	C	25-35
Moderate dysplasia	D	36-50
Severe dysplasia	E	51-106

### Glossary:

Cranial: towards the head.

Caudal: towards the tail.

Dorsal: towards the spine.

Ventral: towards the belly.

Medial: towards the midline

Lateral: away from the midline (towards the flank)