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PennHip^{TM}: A Collaborative Effort to Reduce the Incidence of Canine Hip Dysplasia

PennHIP™ - a collaborative effort to reduce the incidence of canine hip dysplasia

PennHIP™, a nation-wide collaborative effort, whose main objective is to reduce the incidence of hip dysplasia (CHD) in all breeds of dogs, has been initiated by Penn's Veterinary School. The program, conceived by Dr. Gail K. Smith, associate professor of surgery, and his staff, involves a group of specially trained and certified collaborators from all over the United States and Canada.

The program brings a new diagnostic technology, developed over the past ten years here at Penn, closer to breeders of dogs and enables Smith and his collaborators to gather definitive data on hip dysplasia in many breeds in a shorter time.

For many years breeders of dogs have tried to reduce the incidence of canine hip dysplasia, a very common, heritable orthopedic disorder, by screening breeding stock through radiographic examination of the hip joint. Until the Penn researchers developed their compression/distraction stress radiograph technique, the disease was diagnosed by the standard hip extended radiograph. Studies have shown that the latter may not fully identify dogs with lax hips, thus explaining the lack of progress in reducing the incidence of hip dysplasia in the canine population.

The new stress-radiographic technique is 2.5 times more sensitive in quantifying hip laxity than the standard hip-extended method. A measurable amount of hip joint laxity is inherent in all dogs. The range of this laxity is quantitated by a new index scale, ranging from zero to 1. Hips approaching zero are extremely tight and hips approaching 1 are extremely lax.

Breeds of dogs frequently afflicted with canine hip dysplasia have mean hip joint laxities significantly greater (2-3 fold) than breeds known to be free of CHD, e.g., racing greyhounds and performance-bred borzois have uniformly tight hips (median laxity less than 0.25) while golden retrievers have significantly looser hips (median laxity approximately 0.57).

A significant correlation exists between hip joint laxity measured in an individual at four months of age and that measured at six, 12 or 24 months of age. These data indicate that hip laxity can be determined with acceptable accuracy as early as four months. A direct comparison of the new diagnostic method with the standard hip-extended method revealed the superiority of the distraction method for degenerative joint disease prediction.

This predictability of joint laxity from a young age becomes especially meaningful when combined with data showing that only those dogs with measured passive hip laxity greater than 0.3 were susceptible to CHD within the time frame of the study (three years). No hip disease was observed below a distraction index of 0.29. Thus the index of approximately 0.3 may represent a biological threshold separating CHD negative from CHD susceptible hips.

The golden retrievers in the study had a median distraction index of 0.57, indicating a joint laxity well into the "disease-susceptible" range if compared to data from German shepherd dogs. In fact, less than 5% of the golden retrievers exhibited joint laxities below a distraction index of 0.3, suggesting that very few breed members presently can be considered true negatives for CHD.

The data indicate that the susceptibility for degenerative joint disease based on passive hip laxity is breed specific. For example, German shepherd dogs are more predisposed to DJD, given the same laxity, than Rottweilers. On a population basis the disease susceptibility is extremely sensitive to the distraction index, **irrespective of breed.** In the future, accurate clinical disease prediction will require the application of statistical/epidemiological analyses to all breeds, hence the need for PennHIP.

The discovery of a laxity threshold below which hips are nonsusceptible to CHD may serve as a breeding goal for all breeds of dogs, making passive hip laxity as measured by the distraction index (DI) an objective criterion for selecting breeding animals.

Clearly for breeds having loose hips, this goal will not be attainable within one generation of selection. The effective clinical application of this new paradigm to all breeds of dogs awaits knowledge of the heritability of hip laxity by breed and its genetic relationship with other important traits. PennHIP was designed to investigate this.

Variations in hip joint laxity may arise from genetic or non-genetic factors. Genetic factors which produce variation in a population originate from either additive gene effects or from dominance and epistasis which are non-additive. Additive gene effects are passed from parents to their offspring each generation. In contrast, the effects of dominance and epistasis stem from the formation of unique combinations of alleles, and these unique combinations must be re-created anew in every individual of each succeeding generation.

When additive genetic differences among individuals are responsible for a significant proportion of the total phenotypic variation, the population mean (for hip joint laxity) can be genetically moved by applying selection to the choice of breeding animals. Knowledge of how to best apply genetic selection comes from knowing what is the heritability of joint laxity. The investigation of the genetics of passive hip laxity in the German shepherd dog are near completion. The scale of heritability ranges from 0 to 1, 0 being not heritable and 1 being highly heritable. The calculated heritability for hip joint laxity in German shepherds will likely fall between 0.45 and 0.74. These estimates are considerably higher than those published in reports utilizing the standard hip-extended method of hip evaluation. The estimates provide considerable encouragement that the new stress-radiographic method will serve as a powerful tool for selection of breeding stock free from susceptibility for CHD. Similar analyses must be applied to other breeds of dogs.

The introduction of the compression/distraction method into the ever-

expanding arsenal of diagnostic techniques will be a cautious one. By periodic and rigorous monitoring and reporting of the success of this method, Dr. Smith hopes that it will retain its scientific integrity and that those performing it will benefit from the associated scientific credibility.

In order to treat this clinical application as an on-going scientific endeavor, PennHIP has recruited a select group of veterinarians throughout the country as collaborators on the project. PennHIP's ultimate goal is to employ the compression/distraction stress-radiographic method as the primary diagnostic tool for the elimination of CHD through selective breeding.

PennHIP collaborators will generate passive hip laxity data by taking C/D radiographs of client-owned dogs and submitting all radiographs, whether good or bad hips, to PennHIP for evaluation. All data from collaborators will be amassed and analyzed in a medical database. Interpretations on individual dogs will remain confidential unless specified by the owner or breeder. Population data, however, will be available to collaborators upon request. Collaborators will have exclusive access to information accumulated over the past seven years as part of the research at Penn's veterinary school and will share information from nationwide and ultimately worldwide sources as the database grows. Additionally, with owner consent, the database will serve as a source of information to identify and select breeding stock.

Dr. Gail Smith, associate professor of surgery, examines radiographs. The radiograph on the left shows the standard hip extended view. The top radiograph on the right shows a compression view of the same dog, and the film on the bottom right shows the distraction view of the same dog. On the distraction view subluxation is evident.

To ensure database integrity, PennHIP will input data exclusively from the PennHIP collaborators. Distraction films from sources not affiliated with PennHIP will not be interpreted and the data from such will not be included in the database.

When a radiograph is sent in, it will be measured for distraction index and the data along with the included minimum database on age, breed, sex, etc., will be compiled in the PennHIP database. Individual hip interpretation relative to breed will be derived from this pool of data. The fee for this analysis is $20 per dog.

At this time 42 collaborators have completed the training program. Their names and the towns where the practices are located are listed below:

ARIZONA: Dr. Roger C. Penwick, Tucson Veterinary Surgical Service, Tucson, AZ;

CALIFORNIA: Dr. Edger M. Church, Animal Emergency and Trauma Center, Norwalk, CA; Dr. Pam Green, Veterinary Centers of America Animal Hospitals, West Los Angeles, CA; Dr. Larry Y. Kerr, Santa Cruz Veterinary Hospital, Santa Cruz, CA;

CONNECTICUT: Dr. Terry L. Dew, Connecticut Veterinary Center, West Hartford, CT; Dr. Steven J. Heyman, Cheshire Veterinary Hospital, Cheshire, CT; Dr. Richard Lau, Cheshire Veterinary Hospital, Cheshire, CT;

FLORIDA: Dr. Jacek J. De Haan, Affiliated Veterinary Specialties, Winter Park, FL;

GEORGIA: Dr. Jon Chambers, University of Georgia, College of Veterinary Medicine, Athens, GA; Dr. Mary B. Mahaffey, University of Georgia, College of Veterinary Medicine, Athens, GA;

ILLINOIS: Dr. William Gengler, Animal Hospital of Verona, Verona, IL; Dr. Gregg T. Greiner, Burr Ridge Animal Surgical Practice, Burr Ridge, IL; Dr. Douglas L. Hammer, Veterinary Surgical Service, Norwood Park Animal Hospital, Norridge, IL; Dr. Jack K. Schaeffer, Aurora Animal Hospital, Aurora, IL;

INDIANA: Dr. A. D. Elkins, Indiana Veterinary Surgical Referral Service, Indianapolis, IN;

MASSACHUSETTS: Dr. Kathy Beck, Angell Memorial Hospital, Boston, MA; Dr. William B. Henry, South Shore Veterinary Association, Weymouth Veterinary Hospital, South Weymouth, MA; Dr. Joseph M. Stoyak, Rowley Memorial Animal Hospital, Springfield, MA;

MARYLAND: Dr. Russ Patterson, Vet Referral Associates, Inc., Gaithersburg, MD;

MINNESOTA: Dr. Gary Noser, Quarry Hill Park Animal Hospital, Rochester, MN;

NEW HAMPSHIRE: Dr. Peter L. Wadsworth, Dover Veterinary Hospital, Dover, NH;

NEW JERSEY: Dr. David T. Horn, Shore Veterinarians West, Williamstown, NJ;

NEW MEXICO: Dr. Frank H. Coons, Manzano Animal Clinic, Albuquerque, NM;

NEW YORK: Dr. Amy Kapatkin, Animal Medical Center, New York, NY; Dr. John Laurie, Orchard Park Veterinary Medical Cemer, Orchard Park, NY; Christopher Thatcher, Animal Medical Center, New York, NY; Dr. Rene T. Vanee, Veterinary Referral Service, Kenmore, NY;

OHIO: Dr. Robert A. Montgomery, Town and Country Veterinary Clinic, New Philadelphia, OH; Dr. Wendy Myer, Ohio State University, Veterinary Teaching Hospital, Columbus, OH; Dr. Tom Vangundy, Metropolitan Veterinary Hospital, Akron, OH;

PENNSYLVANIA: Dr. Sherilyn Allen, Ironstone Veterinary Hospital, Boyertown, PA; Amy Crawford, VHUP, Philadelphia; Dr. Anna Fong, VHUP, Philadelphia; Thomas P. Gregor, VHUP, Philadelphia; Dr. Peter Herman, Chester, PA; Dr. Joan Regan, VHUP, Philadelphia; Dr. Gail K. Smith, VHUP, Philadelphia;

PUERTO RICO: Dr. Carlos Mongil, Rio Piedras, PR;

TENNESSEE: Dr. Samuel L. Beckman, Tennessee Valley Veterinary Surgical Referral Center, Nashville, TN;

TEXAS: Dr. Linda D. Homco, Texas A&M University, College of Veterinary Medicine, College Station, TX; Dr. Catherine Lustgarten, Animal Radiology Clinic, Dallas, TX;

WISCONSIN: Dr. Michael Hayman, Foster-Smith Northwoods Animal Hospital, Minocqua, WI;