

# Heritability of Canine Hip Dysplasia

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Canine Hip Dysplasia (CHD) can affect dogs of all breeds. It is the most frequent orthopaedic disease in large and giant breed dogs. The occurrence of CHD is not dependent on sex and usually, both hip joints are affected in case of presence.

## Canine Hip Dysplasia Characteristic

A healthy dog has the globular head of the femur (thighbone) deeply articulated into the acetabulum (hip socket) and the hip joint capsule is tight. The articular surfaces of the bones fit to each other. The healthy joint performs only a circular movement and does not perform any side movement under normal load.

The CHD occurs if there is an abnormal development of the hip socket, the head of the femur, the joint capsule or a ligament. Besides the normal circular movement in the hip, a side movement of the head of the femur affects the joint during the load. Due to this side motion of the joint, the degenerative changes of the joint appears (arthrosis).

Clinical signs of CHD in young dogs (3-12 months) are reluctance to exercise, very slow standing up, limping, difficulty climbing the stairs, jumping from heights and problems to jump in the car. Sometimes, it is possible to hear unusual clacking sound while walking. In older dogs, CHD is manifested mainly by significant limping.

Advanced stadiums of CHD are treatable surgically only and some of them only by total hip replacement (endoprosthesis).

## Diagnosis and Classification of Canine Hip Dysplasia

Diagnosis of CHD is determined according to the Federation Cynologique Internationale (FCI) standards by X-ray examination. This method is used for CHD diagnosis in all countries that are

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Figure 1: Photograph of a Cane Corso Italiano dog (Koleta Alison, Evžen Korec's archive).

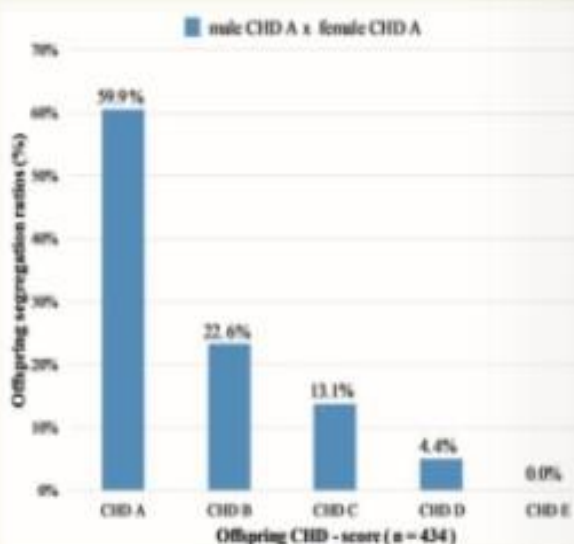


Figure 2: Parental crosses male CHD-A x female CHD-A.

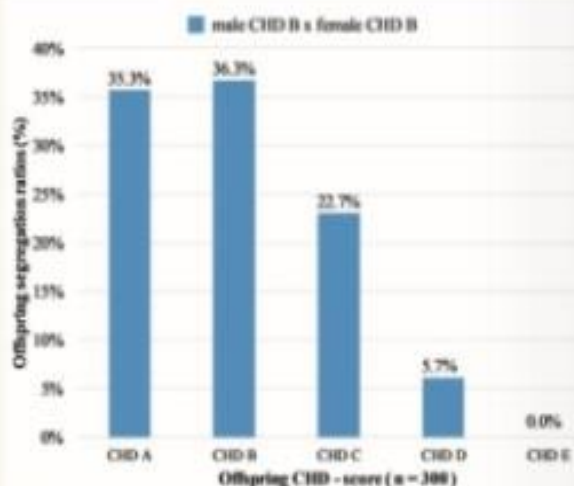


Figure 3: Parental crosses male CHD-B x female CHD-B.

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members of FCI (the majority of European countries, Russia, South America and Asia). In the US and Canada, a different standard is used – OFA (Orthopaedic Foundation for Animals). In the United Kingdom, Ireland, New Zealand and Australia, BVA/KC standard (British Veterinary Association/ Kennel Club) is used.

According to the standards of FCI, the X-ray examination is performed at the age of 12-18 months. The exact age, when the examination is performed, is determined for each breed by binding conditions of a relevant breeding club. The result of the examination at the specified age is necessary for the decision, whether the individual will be included in the breed or not. For successful surgical treatment, the examination should be performed much earlier, optimally at the age of 3-4 months.

The level of affection is distinguished by FCI to the following grades:

- A. No signs of Hip Dysplasia (previously marked as 0)
- B. Near normal hips (previously marked as 1)
- C. Mild Hip Dysplasia (previously marked as 2)
- D. Moderate Hip Dysplasia (previously marked as 3)
- E. Severe Hip Dysplasia (previously marked as 4)

In the Czech Republic, the conditions for including an individual into the breeding program are currently (unfortunately) only in the competence of each breeding club. Some clubs allow dogs with CHD-D diagnose to join the breeding program that leads to the permanent genetic load of such breeds. Some clubs tend to maintain and multiply dogs at any cost and the genetic purity of the breed is not taken into account at all.

## Heritability of Canine Hip Dysplasia

Currently, an intensive research of genes that might be responsible for the origin of CHD is underway. It is obvious that a large number of genes are involved in the development of dysplasia, which makes it a complex polygenic inheritance.

CHD can also arise in dogs with a healthy genetic origin but with the enormous load on the joints during puppy development. Such inappropriate loading can be too long and too intensive movement not equal to the age of the puppy or jumping from the heights in young puppies. The cause of arising CHD can also be an inappropriate surface for puppy movement. Typically, inappropriate floors are slippery surfaces (parquet, tiles or marble floor) on which the puppies' legs slide off. These kinds of surfaces must be covered by a

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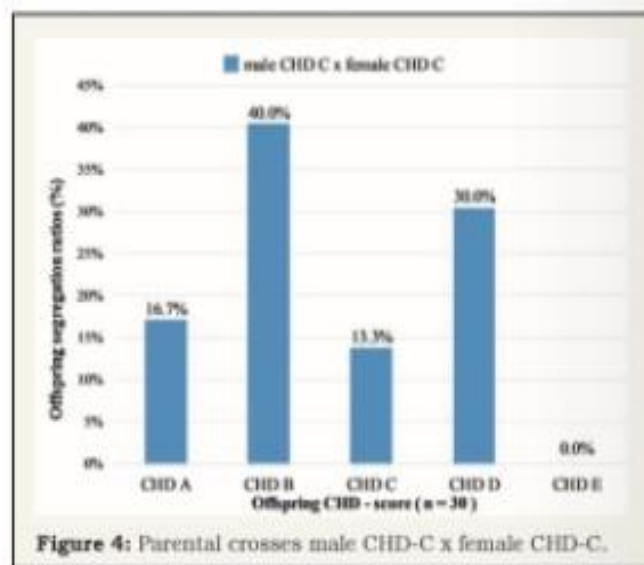


Figure 4: Parental crosses male CHD-C x female CHD-C.

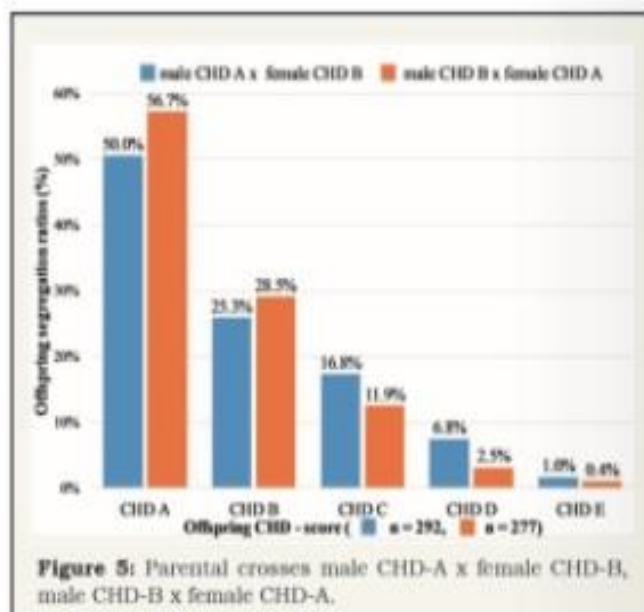


Figure 5: Parental crosses male CHD-A x female CHD-B, male CHD-B x female CHD-A.

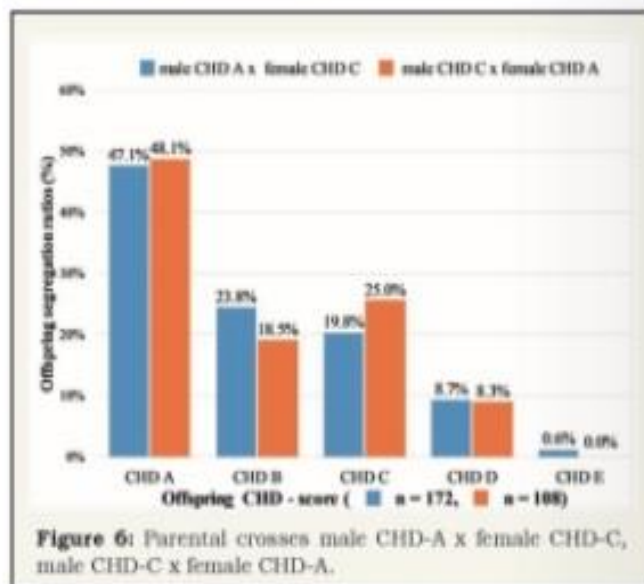


Figure 6: Parental crosses male CHD-A x female CHD-C, male CHD-C x female CHD-A.

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carpet in order to achieve correct development of the puppy. CHD can also occur if the puppies do not have the proper nutrition. The development of puppies of large and giant breeds require a sufficient amount of calcium and added supplements containing substances that form joint cartilage. For a good development of the joint, it is necessary to add glucosamine sulphate, chondroitin sulphate, MSM and hydrolysed collagen that can be found, for example, in Apto-flex supplement.

## Estimated Breeding Value (EBV)

Recently, a number of genes have been described that are responsible for the origin of CHD. These findings can be used to determine the breeding value (EBV). The introduction of Breeding Value for CHD and breeding only those dogs with optimal breeding value can significantly contribute to reducing the incidence of CHD in each breed. The breeding value can be estimated only by a geneticist and these data are not available for most of the breeders. An extensive research done in the US in 1970-2015 on 60 dog breeds showed that phenotypic selection only, i.e. including the individual into breeding process according to x-ray examination, leads to a significant reduction of CHD presence in all dog breeds.

## Heritability of Canine Hip Dysplasia in Cane Corso Italiano

Our research group in ZOO Tábors studied the heritability of CHD in Cane Corso Italiano breed (Picture 1). We analysed data of 1813 dogs of this breed. We monitored offspring of these dogs in relation to the CHD grade which resulted from crossing parents classified both as Grade A, B or C and then all other combinations of the crossing (one parent A x the second B, one parent A x the second C, one parent B x the second C). The results are summarized in Figures 1-6.

The majority of the offspring (59.9%) with CHD - A classification were born in the crossing where both parents were classified as A. This crossing did not give any offspring with E classification; only 4.4% of the offspring were classified as CHD - D.

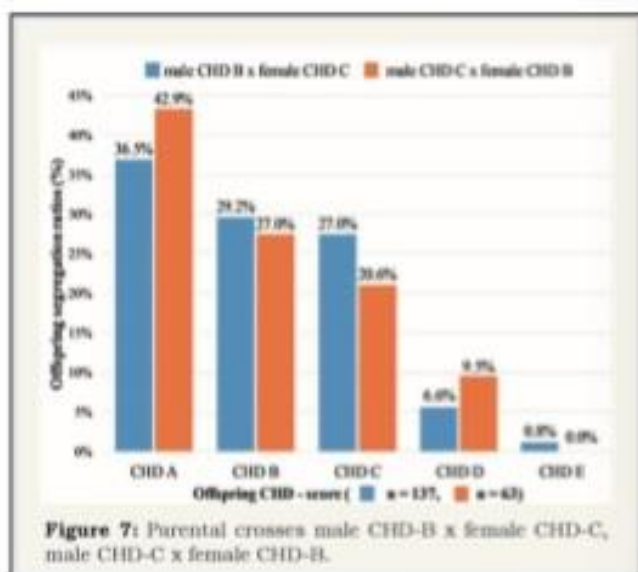


Figure 7: Parental crosses male CHD-B x female CHD-C, male CHD-C x female CHD-B.

The crossing of males CHD - A and females CHD-B gave offspring of 50% CHD - A, 6.8% of CHD - D and only 1% of CHD - E.

The crossing of parents with CHD - C classification gave only 16.7% of CHD - A offspring and 30% CHD - D offspring.

Interestingly, the crossing where males were classified as CHD - A and females as CHD - C resulted in the offspring with significantly more CHD - A dogs (47.1%) compared to the crossing where both parents were CHD - B. There only 35.3% of dogs were born CHD - A.

## Conclusions

The results of our study clearly show that for the elimination of hip dysplasia in Cane Corso Italiano, primarily dogs with CHD - A classification should be reproduced. If the individuals of CHD-B or CHD-C classification should be bred, then exclusively with an individual with CHD-A classification.

Individuals with CHD-D classification should not be included into breeding process.

The decision of a dog breeding according to the grade of hip dysplasia should not be left in the competence of individual breeding clubs, where there is a higher tendency to breed also unsuitable dogs, but should be determined by uniform rules of FCI, for all breeds. This is the only way to reduce the presence of Canine Hip Dysplasia.

This article is a popular version of a scientific publication:

Korec, E., Hančl, M., Bydžovská, M., Chalupa, O., Korcová, J., Segregation Analysis of Hip Dysplasia in Cane Corso Italiano Dogs, published on January 12, 2018, in the American scientific mag