



**Biotica
Research**

Today

**Vol 2:9 886
2020 888**

Breeding Guidelines to Reduce Genetic Disorders in Dogs

Ahlawat, A. R.^{1*}, Odedra, M. D.¹ and Dongre, V. B.²

¹College of Veterinary Science & Animal Husbandry, Junagadh, Gujarat (362 001), India

²Subject Matter Specialist, College of Veterinary Science & Animal Husbandry, Udgir, MAFSU, Nagpur, Maharashtra (440 006), India



Open Access

Corresponding Author

Ahlawat, A. R.

e-mail: dranshuahlawat@gmail.com

 **Keywords**

Autosomal, Dominant, Recessive, Selective breeding

Article History

Received in 05th September 2020

Received in revised form 09th September 2020

Accepted in final form 10th September 2020

E-mail: bioticapublications@gmail.com

How to cite this article?

Ahlawat *et al.*, 2020. Breeding Guidelines to Reduce Genetic Disorders in Dogs. *Biotica Research Today* 2(9): 886-888.

Abstract

Like humans, dogs can suffer from genetic health problems. Years of selective breeding have predisposed some dog breeds and made them more susceptible to adverse health conditions, diseases and complications. Dog breeds like Siberian Huskies, German Shepherd Rottweilers, Dachshunds and Boxers are known to suffer from many hereditary disorders. Canine inherited disorders are actually more widespread than indicated in their original studies, which open up the door for several future scientific investigations. The need of the hour is better collaboration between different stake holders like dog fanciers, breeders, owners, industry and academics which shall help to report and provide solutions to these conditions across breeds. The potential to test the dog for multiple genetic disorders at single go has existed and is being carried out the need of hour is to harness the potential to make better selection decisions and pet care for the overall welfare of dogs.

Introduction

Hereditary disease is an important welfare issue in companion animals. Pure breeding of dogs has led to over 700 heritable disorders, of which almost 300 are Mendelian in nature (Pedersen, N.C. *et al.*, 2017). Many canine health issues can be attributed to a genetic condition or disease that is inherited from the parents. Genes, or unique sequences of DNA material, are the way that these genetic conditions are passed from parent to offspring. Different traits or inherited diseases differ among each other in modes of inheritance. Several genetic tests are available to search for the presence of the defective gene and then every effort is made on part of the breeder to avoid two such defective gene to come together and avoid the dog being homozygous for the gene mutations is a continuous process and there are few to hundreds of such mutations and it is practically impossible to identify and develop genetic kits and tests for all the potentially harmful mutations.

Inherited health issues in a dog may lower the quality of life for the dog. Breeders/ owners armed with knowledge of their dogs' carrier status and an understanding of genetics may have the ability to reduce these diseases in future generations. It is moral responsibility of veterinarians and breeders to adopt 'health-conscious' breeding and to ensure the optimum use of pre-breeding physical examinations, genetic testing and counselling.

There are certain guidelines which can be followed to preserve breeding lines and genetic diversity and at the same time reducing the risk of producing dogs carrying defective genes, or are affected with genetic defects.

Autosomal Recessive Disorders

Each dog inherits one copy of a gene from its mother and one from its father. An autosomal-recessive condition means that a dog must inherit two copies of an abnormal gene before its health is affected. In most situations, this occurs when both parent animals are asymptomatic carriers of the disorder. This disorder is recessive; an animal who carries one copy of the abnormal gene and one copy of the normal gene will not show signs of disease. The disorders are more likely to be seen when closely related animals are bred, such as in the case of purebred dogs and cats. This occurs due to similarities in the genetic makeup of closely related animals.

The autosomal recessive traits are hard to eradicate from the breeding pool. Many carriers show no outward signs of disease, making them difficult to detect. When bred with another carrier, the appearance of genetic disorders in offspring may appear random without an understanding of the factors that result in the expression of a recessive genetic disorder. The aim is to replace the carrier breeding-animal with a normal-testing offspring that equals or exceeds it in quality. You don't want to diminish breed diversity by eliminating quality dogs from the gene pool because they are carriers (Bell, J.S., 2003).

Suggestions

If a test for carriers is available, test your breeding stock. If no carrier test exists, breeders must assess whether each individual dog in their breeding program is at high risk of being a carrier. This requires knowledge of the close relatives in the pedigree. By determining the average carrier-risk for the breeding population, breeders can select mating that have a projected risk which is lower than the breed average. Breed to a dog that has a low risk. This will significantly diminish the likelihood that affected dogs will be produced. Breed a dog only once and replace it with an offspring to improve their chances of moving away from defective genes and also limits spread of the defective genes. A mating which has the potential to produce affected puppies should never knowingly be done (carrier to carrier, affected to carrier).

Autosomal Dominant Disorders

An autosomal-dominant condition means that a dog need only inherit one copy of an abnormal gene before its health is affected. Each affected dog has at least one affected parent, but it is expected that half of the offspring of an affected dog will be free of the defective gene. Many of the more severe autosomal-dominant conditions are generally not passed on to any further offspring because the dog is often too ill to reproduce, or dies before it reaches sexual maturity. For this reason autosomal-dominant conditions are usually quite rare. A problem with some autosomal dominant disorders is incomplete penetrance. In other words, some dogs with the

defective gene may not show the disorder. If a genetic test is available, this is not a problem. Otherwise, relative-risk assessment can identify which dogs are at risk of carrying incompletely penetrant dominant genes.

Suggestions

Autosomal dominant genetic disorders are usually easy to manage. Don't use the dog for breeding. To produce the next generation of a line, a normal full sibling of an affected dog can be used, or the parent that is normal can be used.

Sex-Linked Disorders

Dogs have 39 pairs of chromosomes. X and Y chromosomes determine gender. XX is a female while XY is a male. Females always give away an X chromosome to their offspring. If the male passes on the X chromosome, the offspring is female. And if it passes on the Y chromosome, the offspring is a male. If there is a mutation in a gene on the X chromosome, and the dog is female, they usually have no symptoms. The female do have the other copy of the same gene to take over and do the job and so it shall be in recessive condition. Both the X and Y chromosomes are active in males. If there is a mutation on the X chromosome of a male, there will be symptoms.

X Linked Recessive

The recessive gene is located at the X chromosome. Disorders inherited as X-linked recessive disorders affect males more often than females. When possessing defected gene, the female can be homozygote (two copies of defected gene) or heterozygote (one copy of defected gene). A heterozygous female will not display symptoms of the disease, but is a carrier. Homozygous female will develop disease's symptoms. The male dog will be affected in case of inheriting the defected gene from affected mother. If the mother is homozygous for the defected gene, the chances are 100% that the male puppy will be affected. If the mother is heterozygous for the defected gene, the chances are 50% that the male puppy will be affected and 50% it will be healthy. If a male is affected, he would have received the defective gene from his carrier mother. All of his daughters will be carriers, but none of his sons.

Suggestions

If an affected female is bred, all the sons will be affected, and all the daughters would be carriers, so affected females clearly should not be bred. A normal male that is a littermate to an affected female, however, would be able to carry on the line without propagating the defective gene. If there is no test, the defective gene can be traced through the pedigree. By using relative-risk assessment to breed male to a female that is at low risk of being a carrier, you can prevent affected offspring, and select a quality son for replacement.

X-Linked Dominant

The dominant gene is located at the X chromosome. This mode of genetic inheritance is less common than the X-linked recessive inheritance.

Suggestions

These disorders are managed the same way as autosomal dominant disorders. The difference is that affected males will always produce all affected daughters.

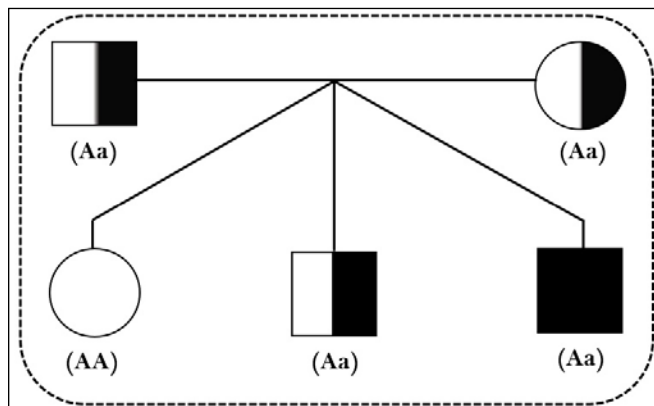


Figure 1. Autosomal recessive inheritance

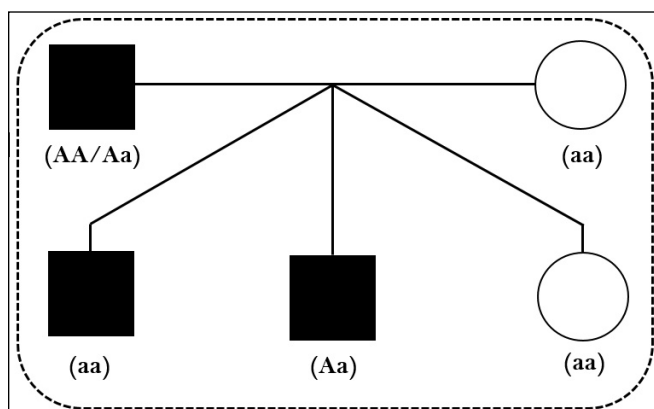


Figure 2. Autosomal dominant inheritance

Conclusion

Breeders of dogs and cats desire to produce the best with their mating. However, breeding has become more complicated today. Breeders should carefully consider sire and dam pairings so that the resulting puppies are free from the clinical effects of inherited genetic disease. The goal of any mating should be to produce puppies not clinically affected by inherited disease conditions. With the ready access to DNA testing this can, and should be done. Breeders/ owners take responsibility for the animals they're creating by choosing not to perpetuate traits and practices that negatively affect the health of their animals. It is up to all veterinarians, breeders, and breed associations to educate prospective breeders on these aspects to promote healthy breeding practices for dogs and cats. Open reporting systems of the health results should be encouraged. It should be everyone's goal to produce healthy offspring, but this is not possible if the only available health information is about normal dogs and cats, but not abnormal dogs and cats.

References

- Bell, J.S., 2003. Breeding Strategies for the Management of Genetic Disorders. Retrieved from <https://www.vin.com/doc/?id=3848654>.
- Pedersen, N.C., Shope, B., Liu, H., 2017. An autosomal recessive mutation in *SCL24A4* causing enamel hypoplasia in Samoyed and its relationship to breed-wide genetic diversity. *Canine Genet Epidemiol.*, 4, 11.
- Shearin, A.L., Ostrand, E.A., 2010. Leading the way: canine models of genomics and disease. *Dis Model Mech.*, 3, 27–34.