

## Hip Dysplasia in Large Breed of Dogs

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### INTRODUCTION

Hip dysplasia is a condition which includes the anomalous change of the hip joint. Previously this matter were recognized in human being by the father of medicine and Anatomy, Hippocrates about 400 years BC. Hip dysplasia in the canine species were earliest termed by Schnelle in 1935 (Schnelle 1935; BUIE 1947). More lately, this deformity has rarely been seen and detected in other animals, including bovine, equine and feline species and also in the rabbits and dingoes (Owiny et al. 2001). Hip dysplasia in dogs is caused by a number of causes, starting with genetics. Larger dogs, like the Great Dane, Saint Bernard, Labrador Retriever, and German Shepherd Dog, are more prone to hip dysplasia than smaller dogs. This hereditary propensity can be exacerbated by elements like an excessive growth rate, certain types of exercise, an incorrect weight, and an imbalanced diet. Some dogs start to exhibit symptoms of hip dysplasia as early as four months of age. Others have it concurrently with osteoarthritis as they get older. There are a few indications that owners should be aware of in both situations. Depending on the disease's severity, the amount of inflammation, the amount of joint looseness, and how long the symptoms have been present, these symptoms may vary. Hip dysplasia has been a problem for the dog. And these signs included a decline in activity, reduction in range of motion, a challenge or resistance climbing, leaping, running, or stair climbing, Laziness in the tail and "Bunny hopping," swaying gait. When moving, there is grating in the joint, reduction in thigh muscle mass The shoulders' muscles have a noticeable hypertrophy as a result of compensating for the back. Pain rigidity or limping, more than fifty years ago, Schnelle detected the problem of hip dysplasia in the United States of America, however few cares were rewarded by the breeders and researchers through the first twenty-five years to solve

this problem. Meanwhile, the problem has changed into very widespread issue in a large number of strains. This reality requisitioned for firm procedures of dominance this issue (Comhaire 2008).

### Pathogenesis and Symptoms

Hip dysplasia is considered as a growth of a movable, ill-fitting coxa-femoral articulation. In most of the cases, joint laxity affects both limbs and infrequently one is included. The constancy of the hip joint is usually certain by the lax tissue that is the association between the coxa acetabulum and the femoral head, like thigh muscles, joint capsule, and the major attachment ligaments (Karsli et al. 2021). Furthermore, the steadying consequence for the hip joint is occurred by a synovial fluid and the joint capsule, producing a vacuum-like space (Sevil-Kilimci and Kara 2016).

Scanty constancy permits an extra or fewer acute displacement of the head of femur bone out of the acetabular cavity, mostly in the dorsolateral view, inducing a partial luxation of different degrees until the total dislocation is happened for the joint. Joint dislocation make the body incapable of bearing the physiological weight as well the movement function within the articulation and overloading other certain parts in the body (Nakahara et al. 2014).

This stimulates lesions and erosion of numerous functional anatomical structures, like the articulation cartilages, attachments ligaments, bones, and articulation capsule. As a result, infection and deterioration of these tissues consequence in the arthritis and osteoporosis, finally leading to chronic osteopathy. Thickness of joint capsule and the sever rupture of the round ligament are seen, in addition to the loosening of the natural color of articular cartilage specially in the over loaded areas which display caps, destruction, and eburnation of subchondral bone in sever conditions (Lievense et al. 2004).

All these signs cannot be noticed only by the anatomical dissection of the bone specimens but the x-ray of affected bone is also needed for revealing the partial dislocation of hip joint. The partial dislocation affects the marginal edges of the acetabular cavity particularly during the abnormal weight-bearing. All the fibrocartilages marginal edges became flattened and micro cracks can be observed in addition to forming of exostoses and osteophytes which is consider as the final frame of the coxa arthrosis. Leading to obvious loss of acetabulum depth, lately formation of fibrous tissue consider a main reason for making the joint cup very shallow (Lewis et al. 2013).

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The mushroom-shaped deformation of the femoral head is a clear sign of hip dysplasia and the head of the femur loses its spherical well-rounded surface. With aging, the abnormality of the hip joint could be without any signs appear and this malformation start as thickness of the femur neck due to the remodeling that occur and result in the adaptation of the acetabular cavity surface and the femoral head to improve articular contact within the joint (Gulanber et al. 2006).

One of the dominant sign is the acute pain that produced by the irritation of extra movement and exercises. Cold, wet environmental conditions may worsen the pain. Other possible symptoms of hip dysplasia in dogs are lameness during walking and trolling after the rest time (Anderson 2011).

Other than the stiffness of the limbs, the dog faces swinging of pelvis and disability to complete lifting of the hind limb from the ground. Animal also feel difficulties in climbing stairs, jumping over barriers and partial atrophy of thigh muscles, as well as the restriction in the range of motion (ROM) in the hip joint (Mabuchi et al. 2006). Even still under anesthesia, the adduction, abduction and rotation movement is mostly painful and all these symptoms shown occasionally, but frequently turn out to be continuous at later stage of the case. The researchers proved that there is no linear relationship that links the three conditions i.e., degree of pain, movement troubles, and the degree of morphological variations in the joint and this is what clearly noticed in the chronic degenerative arthropathies (Todhunter et al. 1999).

### Diagnosis

Mostly used technique to diagnose hip dysplasia in canine species is by X-ray examination. Nevertheless, further procedures for diagnosis such as stretching, flexion and extension of the limb are recommended to diagnose hip dysplasia and the degree of joint laxity, pain, twinge, and deficiency of joint laxity consider as first signs of joint dysplasia and obviously seen in new born puppy especially when the osseous structure is not adequately developed for radiography test. Lifting the femur bone in a dog can estimate the degree of dislocation of the femur head and also provide good knowledge about joint development (Cargill and Thorpe-Vargas 1995; Kohn 2007).

Various studies measured a total of 786, dogs' average age was 6-8 weeks in both sexes, via palpation procedure under anesthesia and re-examined again after 10 months by radiography. The findings referred that approximately in 90% of the dogs at 8 weeks of age, the kinetic ability for femur head cannot exceed further than 2 mm, and they will have mild or acute hip dysplasia at age of one year. Conversely, rather tight joints with a lifting possibility of 2 mm or less, showed dysplasia later in about 40% of dogs. It is also noticed that most results of hip dysplasia diagnosis in both young and adult dogs through the palpation technique have a high rate of error, hence it should be confirmed with the x-ray examination (Samuelson 1972 ; Evans 1989 ; Zhang et al. 2009).

The examination main problem is in the diagnosis of different degree of joint laxation particularly the minor degrees in the maturation stage which can't be examined in growing dogs, and become possible only when the skeletal system reaches the total growth phase, thus the first stages of joint luxation and subluxation is difficult to discover. Hence the x-ray is the better way for early diagnosis (Poy et al. 2000).

Then, the suitable size of the X-ray film used is 25 cm x 35 cm and should be a high-quality film with optimum density, contrast and acuity as well to pay attention to the condition of yielding the radiographic film through revealing and extending the legs, pelvis bones, and femurs, with the knee joint. The "frog-leg" like position is a radiographic position described as the pelvis should held in symmetrically projection (Fries and Remedios 1995).

The femurs should be stretched caudally and parallel that makes the knee to rotate in the medial direction, thus that the knee cap manifest centrally in the trochlear grooves. Highly quality X-ray films are of the greatest significance to evade false positive or false negative explanations. Therefore, correct standing position is essential for finding any small variation from the anatomical deviations considered within the normal limits for breed and age. The better positioning of animal makes a resting of skeletal muscles and helps the detection of joint laxity. It require anesthesia either general anesthesia or epidural anesthesia for the radiography of the pelvic joints (Peterson 1992).

In 1954 Schnelle announced about a classification scheme suggesting a new classification system which provide a variation of pathological results regarding the variety of hip dysplasia severity. The Orthopedic Foundation for Animals (OFA) in the United State of America published three significantly schemes giving the breed a number for evaluating the normal cases with following grades i.e., 'Excellent'; 'Good' and 'Fair' for conformation of the pelvic joints (Todhunter et al. 1999; Fordyce 2002).

The grades 'Borderline Conformation'; 'Mild'; 'Moderate' and 'Severe' Hip Dysplasia are not recommended for breeding. The Scientific Committee of the Federation Cynologique International (FCI), in an effort to establish an International Certificate, compared the classification systems of their breeders' organizations and proposed a standardized grading system (Brass and Paatsama 1983; Peterson 1992).

A scheme was explained in Britain just to restrict the hip dysplasia in German shepherd breed about ten years ago and particularly in 1983 this scheme extended to involve other types of dog breeds. The scheme is classified and evaluated nine different aspects of hip dysplasia numbered from "0" which means (normal) and "6" and that means (extremely abnormal). With aging, the osseous deformity occur as an expression for the hip dysplasia. The researchers (Freudiger et al. 1973; Bartolomé et al. 2015) confirmed that the age of one year consider as the typical age for radiological diagnosis in Germany and Britain. The Scientific Committee of the FCI recommended that the suitable age for the large breed dogs is about one and half year and further that their

taxonomy scheme valid to dogs between one and two years, may be adopted for older dogs but the secondary arthritis variation have to be evaluated according to the age of dogs (Stock et al. 2011).

The age of 24 months has been established as the minimum age for evaluation of the dogs by the Orthopedic Foundation for Animals. Some dogs look as semi-normal in the age of 6 to 18 months but later they will show other signs of hip dysplasia during the radiographic examination. These signs are considered as an appearance of minor arthritic modifications and it is easier to identify than insignificant grades of laxity, but degenerative arthropathy can sometimes have other ancestries (Bouw 1982).

The period between 2-6 years old is the best time for the final estimation announced by the Orthopedic Foundation for Animals (Morgan and Stephens 1985). Henrigson et al. (1966) found that variation due to age might invalidly be recognized to pelvic dysplasia after six years. In contrast, if the X-ray image is not considered as an acceptable standard, then it may reduce the diagnosis of few cases of moderate partial luxation in dogs one year old (Genevois et al. 2020).

The long period of waiting delays the vital decisions about breeding and selection of dogs for controlling of pelvic dysplasia, hence, the dogs should be marked by a clear sign on the pinna that might be a letter or numbers in addition to marking the radiographic film. (Ohlerth et al. 2019).

### Genetic Evidence

Such as color and height and most traits that involved under the Mendelian laws of dominant and recessive genes. Hip dislocation progresses under a group of composite genes action and it is difficult to know their heredity transmission and understand it according to these laws. Presently it is hard to figure out how many genes that involved in hip dysplasia, nonetheless there are large number of genes (Zhang et al. 2009; Alsada et al. 2020).

Thus, pelvic dysplasia is considered as a quantitative character with constant diversity between the sound joint and the worst alteration, that of lasting dislocation. Hip dysplasia is confirmed by many statistical methods of population genetics as a polygenetic trait (Bartolomé et al. 2015). Polygenetic difference is specifically determined both by the addition or the combination of genetic factors. There are two heredity traits i.e., additive and non-additive heredity and the additive heredity traits turn out to be more obvious according to the number of current genes (King 2017).

Meanwhile, non-additive heredity doesn't depend on the number of genes very much but depend on group of gene combinations. The last revealed gene grouping cannot be affected by selection; only genes are inherited, not a set of them (Ohlerth et al. 2019).

The selection process will be successful only when the dissimilarity of the features rely on the additive action of genes. The genetic pattern for the parents can be proven only by statistical methods that might represent a sufficient

number of descendants. The additive gene inheritance showed that the significant role that played, and that what obtained through the selection in contradiction of hip dysplasia (Stock et al. 2011; Gaspar et al. 2016).

The progeny can be enhanced if the canine breeds that have an average small figure of genes for positive traits are bred with alike small transporters of these genetic factors. After long period of selection in the large breed dogs such as German shepherd dogs, it is expected that heritability process will be reduced by decreasing the additive gene variation (Guo et al. 2011).

In addition to that some impacts of non-additive gene combination also exists, revealing that the approximation of hip dysplasia heritability in German shepherd dogs fluctuated from 20-60% (Henrigson et al. 1966; Leighton et al. 1977; Hedhammar et al. 1979; Stock et al. 2011).

The variation be determined by the dog groups examined and the procedures that applied. It was proven that some large breed dogs which rarely suffered from hip dysplasia, may also have a small ratio of additive genetic variation and lesser heritability (Henricson and Olsson 1959; Hedhammar et al. 1979; Van Der Velden and Brooymans-Schallenberg 1983).

The basic reasons that have been suggested for the wide spreading of hip joint dysplasia could be chosen for other characteristics with potential heredity links to hip dysplasia. The extreme angulation for the hind limb, oblique croup, defective character, and oddity, have been conferred nonetheless need a confirmed research (Kaman and Gosling 1967; Hedhammar et al. 1979; Steiger 2007; Guo et al. 2011; Anderson 2011).

The characteristic traits of hip dysplasia which is considered as one of Quantitative hereditary characteristics, are affected by different grades through environmental factors (Gustafsson et al. 1975; Belfield 1976; Hedhammar et al. 1979). Example include obesity, extra protein and calcium intake and high energy diet, rapid growth rate and excessive exercising (Bouw 1982; Fries and Remedios 1995).

Many theories revealed that the environment and climate condition, style of life and diet might influence on the hip dysplasia disorder but in contrast other theories contested these factors but without genetic predisposition for some breeds of dogs, environmental stimuli alone will not form the hip dysplasia in these breeds (Hedhammar 2007; Peterson 2017).

The continuous selection process for different large breeds of dogs e.g. Boxer, Rottweiler, Hovawart, Golden Retriever, Dobermann, Newfoundland, Great Dane, Leonberger, German wirehaired pointer and German shepherd dogs in Germany proven the success of individual genotyping however it was not determined easily (Adams et al. 2000; Alsada Alwaeily et al. 2020).

Although from some dog's breeds that appears to be free from the hip dysplasia, the polygenetic mode of inheritance makes it understandable. Within ten years the hip dysplasia in dogs that were free from this disorder, raised from 10% to 25% and continuously rising (Muller and Saar 1972; Van Der Velden and Brooymans-Schallenberg 1983; Lattimer 1995).

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The results of strict selection led to the strains with an inferior rate of the dominance of hip dysplasia, which was mating only with dogs free of hip dysplasia showing normal and better shape. One of the most important breeds that were selected from among other different breeds that was evaluated where all of their radiographs for the hip dysplasia that was taken from strict program of the German Shepherd Dog Club (SV) since 1967 (Miqueleto et al. 2013).

It showed a largest number of radiographic images that examined are 154,774 until the end of 1987. In 1976, the dogs categorized as “normal”, “near normal” (marginal), “still accepted” (moderate-dysplasia) and this German Shepherd breed have been yearly evaluated regarding to this category (Runge et al. 2010).

The category that named “A” stamp, this German Shepherd breed classified as an official breed without restricted rules. Just dogs that suffer from extreme hip dysplasia were be disqualified from reproduction. Annually the percentage of mating is decreased for the puppies that suffer from mild hip dysplasia which is forbidden to any breed of dogs not carrying the "A" mark, and that make most of breeders to be interested to choose the individuals with normal or semi normal condition, according to the available rich genetic information. Add on to easily accession and know all the history of strains (Genevois et al. 2020).

In 1967 the scheme has been shown to progress and achieved the rate of dogs lacking symptoms of hip dislocation raised up to 20% over ten years. As well as a minor increase was noticed in the semi-normal type besides and a decrease in the simple and mild types. Some certain radiographs with the features of mild to moderate hip dysplasia, already identified by a specialist veterinarian, were not sent for authorized estimation and major documentation (Henrigson et al. 1966). An article shows that this ratio might be 15%. The point that the cases of mild hip dysplasia illness dropped meaningfully, display the bearing to a significant upgrading in pelvis joint modulation in the species. Hence, subsequently, it is not, complemented that the recurrence revealed is demonstrative of the whole German shepherd dog population in West Germany (Brass 1989; Miqueleto et al. 2013). Similar direction was noticed in German shepherd dogs in Paris, Finland and Switzerland all used the same agenda that recommend by the FCI (Brass 1989 ; Genevois et al. 2020). To acquire the whole removal of pelvis dysplasia means an uphill struggle. Constant choosing of the perfect constitution makes the genetic will at a low level, postponing the realization of this goal. The suitable pelvic position of offspring copulation, parents, and ancestors is a hopeful onset and the descendants analysis is extremely suggested. Hedhammar et al. (1979) recommended the calculation of at least thirty dogs that were selected randomly from groups of the progenies of five to 10 litter.

However, Freudiger et al. (1973) measured the estimation of the pelvic joints of at least eighteen canine from three or more litters, for the testing of sires. Hip dysplasia can be transmitted from progenitor to the offspring depending on the male and female genetic map.

The progeny program taking a long period of time as well high budget for the selection of high-quality breed. In addition to this process consuming time exceeded of two diagnosis result, heritability and selection factors are related because phenotypes with higher heritability will cause faster change when the same selection pressure is placed. Hence, the males dogs (sires) that own high awards clearly have a higher impact on the breed more than the females (dam). With over half the population of domesticated dog breeds being affected by hip dysplasia, new methods for abating this disorder need to be done. Carbohydrate sulfotransferase 3, fibronectin 1, and fibrillin 2 are three very recently mutated genes that showed in a modern researches about pelvic dysplasia (Reagan 2017).

It will be very helpful if each owner support the breed control programs, because of the high percentage of wrong and negative data that obtained during the procedure of hip palpation in dogs suffer from mild or extreme hip joint dislocation, thus the researchers recommendation are to use a plans for a future genetic alignment which depend on major documentation of all observed individuals of a dog breed beside of using radiographic assessment to adequately evaluate hip condition and electronic data-processing may offer indispensable information (Ginja et al. 2010).

### Conclusion

Hip dysplasia in canine species consider as a one of the most painful, polygenic and heritable disease. Its symptoms are clearly obvious and showed as an anomalies in hip joint due to wrong position of acetabular cavity and the head of femur bone. The period of this disease starts at the third week in predisposed dogs. Thus, in conclusion, by looking at the genetic components of hip dysplasia, most newly articles and researches proved that there are three main mutated genes responsible about the appearance of hip dysplasia. So the researchers can possibly discover some modern methods to fix these mutations that could occur. For the owners and breeders, DNA tests are obtainable to hypothetically recognize the mutated genes before breeding and the environmental factors also affect canine hip dysplasia, so dog owners need to have the proper knowledge about their canine(s) to ensure that they are feeding them a proper diet and giving them the appropriate amount of exercise. as well as using radiography method will improve and help the breeder during the pedigree selection. Estimation process for hip joints will be very beneficial method and economical for breeders and owners of dogs, in addition to provide a healthy life to the dog by reducing the stress of more severe and risky operations.

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