



ISSN: 2230-9926

Available online at <http://www.journalijdr.com>

# IJDR

International Journal of Development Research

Vol. 11, Issue, 10, pp. 50740-50743, October, 2021

<https://doi.org/10.37118/ijdr.23051.10.2021>



RESEARCH ARTICLE

OPEN ACCESS

## ELBOW DYSPLASIA IN TWO GERMAN SHEPARDS OF THE SAME LITTER

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### ARTICLE INFO

#### Article History:

Received 10<sup>th</sup> July, 2021  
Received in revised form  
14<sup>th</sup> August, 2021  
Accepted 16<sup>th</sup> September, 2021  
Published online 23<sup>rd</sup> October, 2021

#### Key Words:

Elbow, Incongruity, Dysplasia, Osteoarthritis, Articulation, Congenital disease, German Shepards, dogs.

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### ABSTRACT

**Background:** Canine elbow dysplasia (ED) is a common developmental disorder of the cubital joint that can lead to varying degrees of degenerative joint disease in growing animals and adults. ED affects mainly young animals of large breeds, and its prevalence is higher in males. Canine ED have been extensively investigated, but much still remains to be discussed. Many studies report that ED is a congenital disease of genetic origin in dogs. **Cases Presentation:** Two German Shepards from the same litter were diagnosed with ED, a 6-month-old female weighing 26 kg with a history of acute claudication of the left thoracic limb (LTL) and her male sibling, which was then 8 months old and weighed 33 kg when diagnosed, even though he showed no clinical signs of this condition. Radiographic and computed tomographic (CT) exams were performed and revealed a non-union of the anconeal process (NUAP), a medial coronoid process disease of the ulna, and severe joint incongruity of LTL in the female. In the male, the images indicated fragmentation of the coronoid processes for both thoracic limbs and slight incongruities in the LTL and right thoracic limb (RTL). Both were subjected to elbow surgery and had full recovery, with no pain in the region where the osteotomy was performed nor pain during extension or flexion of the limb, demonstrating that the chosen treatment was satisfactory. **Discussion and conclusions:** It was very important to show the ED cases in two animals (three elbows) of the same litter, indicating a great probability of genetical contribution to this pathology. They were diagnosed with anatomical changes in the elbow joint. ED affects developing animals, and most commonly males. Environmental factors and a complex genetic inheritance play an important role for its predisposition. Recent evidence strongly points to joint incongruity as the most likely cause of ED in most dogs. Elbow dysplasia can be considered a syndrome that involves several disorders of this joint, and has a genetic nature, since animals from the same litter can show similar changes in the elbow region, while being exposed to the same environment and feeding during the same period.

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Citation: Daniel Cardoso Garcia, Larissa Eckmann Mingrone, Júlia Alves Lima, Letícia Gutierrez de Gutierrez, Isabela dos Santos Oliveira, José Wagner Amador da Silva and Marcelo Jorge Cavalcanti Sá. "Elbow dysplasia in two german shepards of the same litter", *International Journal of Development Research*, 11, (10), 50740-50743.

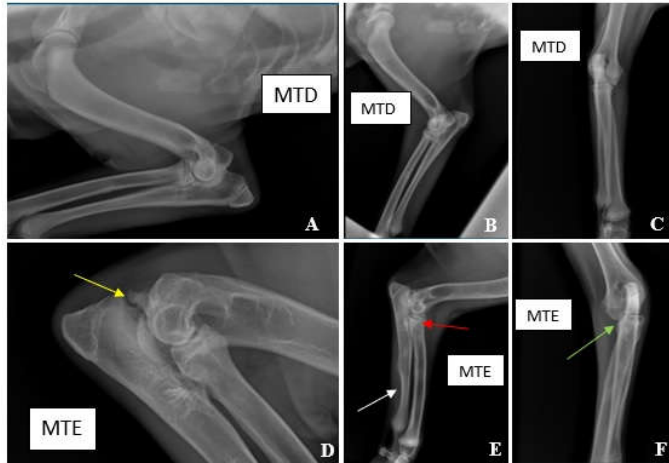
## INTRODUCTION

Elbow dysplasia (ED) is one of the most common hereditary diseases of developing dogs and results in lameness of the forelimbs in medium and large breed dogs, such as fragmentation of the medial coronoid process of the ulna (FCP), osteochondritis dissecans of the humeral condyle (OCD), nonunion of the ulnar anconeal process (NUAP) and elbow joint incongruence (IC). Each of these conditions can cause irreversible osteoarthritis (OA) of the elbow, due to cartilage damage, joint instability, and chronic synovitis [12]. Several epidemiological studies have examined the underlying gene for elbow dysplasia, which appears to be heritable in different races. To further complicate matters, there is evidence that the different manifestations of elbow dysplasia can be independently inherited [3,5,7,10,11].

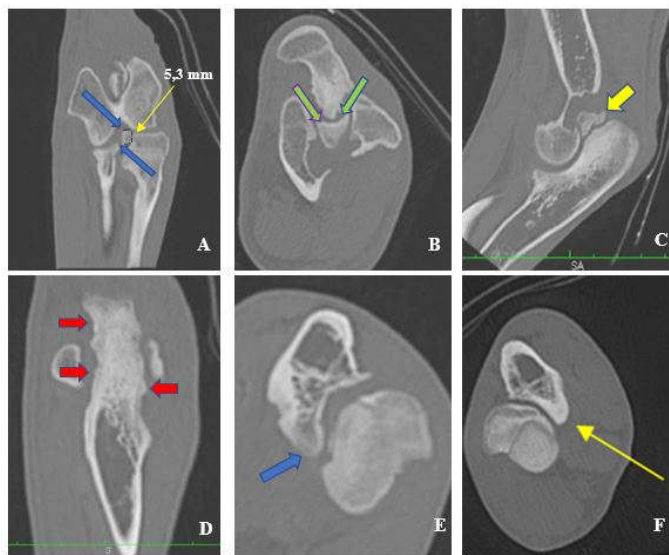
The differences in inheritance suggest that the syndrome that is currently referred to as ED is a common end point for a variety of genetic disorders that disrupt elbow development through several mechanisms. Because of the complexity of inheritance and the effects of environmental variables on disease expression, genetic testing for elbow dysplasia is unlikely to be possible in the future [13]. The objective of the present case is to contribute to the understanding of this condition due to the lack of reports on the heredity of elbow dysplasia that affect dogs of the German Shepherd breed.

**Case Presentation:** Two animals from the same litter, German Shepherd breed, one female and one male, weighing approximately 26 kg and 33 kg at the time of the physical examinations, when they were 6 months and 8 months old, respectively, were treated at the

Animal Care Barueri Veterinary Clinic, Barueri, São Paulo, Brazil. The first animal to be seen was the female, with a history of acute lameness of the left thoracic limb (LTL). After confirmation of ED in the same, an evaluation was requested to her male brother, even though he was not showing clinical signs. During the physical examination of the female, clinical symptoms of ED were observed, such as pain in LTL flexion and extension, pain on medial elbow compartment during palpation of the elbow joint, and lameness. Thus, radiographic and CT studies were requested (Figure 1 and 2, respectively), which showed non-union of the anconeus process, damage to the medial coronoid process, and severe LTL elbow incongruence (IC).

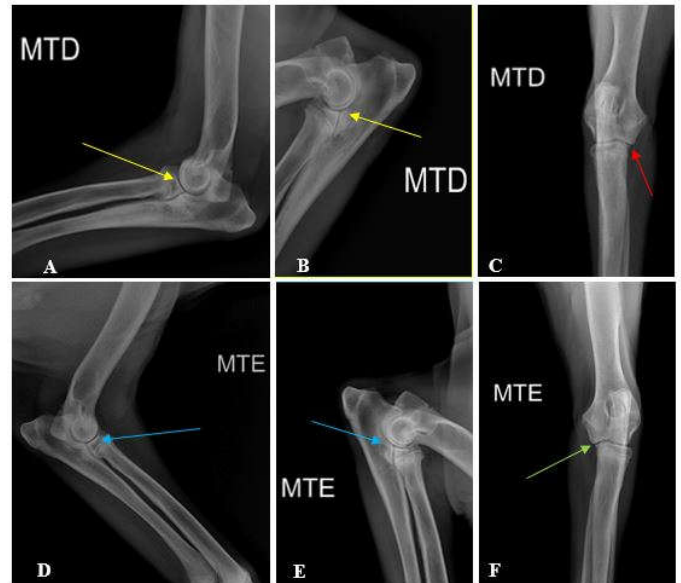


**Figure 1.** Female, 6 months old. Radiographies of normal right elbow in medial-lateral (A and B - stress and neutral positions, respectively) and cranial-caudal view (C). D and E shows medial-lateral radiographies views (stress and neutral positions, respectively) and cranial-caudal view (E) of the affected left elbow. In D there is non-union of the anconeal process of the ulna (yellow arrow). In E there is a deformation in the mid-to-distal shaft of the ulna (white arrow) and articular incongruence between the ulna and the radius (red arrow). In F there is a medial coronoid process anatomical defect (green arrow). MTD = right thoracic limb; MTE = left thoracic limb

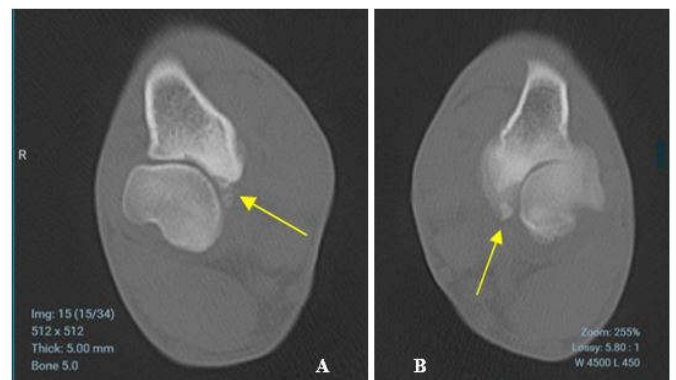


**Figure 2.** A- Tomographic images of left affected elbow (A to E) and right normal elbow (F) of the female, 6 months old German Shepard. A - Articular incongruence between the radius and ulna (blue arrows) showed by a 5,3 mm gap (yellow arrow). B and C - Cross-sectional images of the non-union of the anconeus process of the left thoracic limb (green arrows in B and yellow arrow in C). D - Signs of degenerative joint disease (red arrows) showing periosteal reactions in supracondylar crests and lateral and medial surfaces of the proximal part of the ulna, as well as the lateral and medial humeral epicondyles. E - Medial coronoid process disease (blue arrow) of the left ulna with areas of subcondral erosion and augmented bone attenuation. F - Normal Coronoid process of the right ulna

After 2 months, when the male was evaluated, although there were no clinical signs on physical examination, complementary early imaging tests were requested. In the radiographic and tomographic images (Figures 3 and 4, respectively), FCP was observed bilaterally and a slight elbow IC was seen in LTL and RTL.



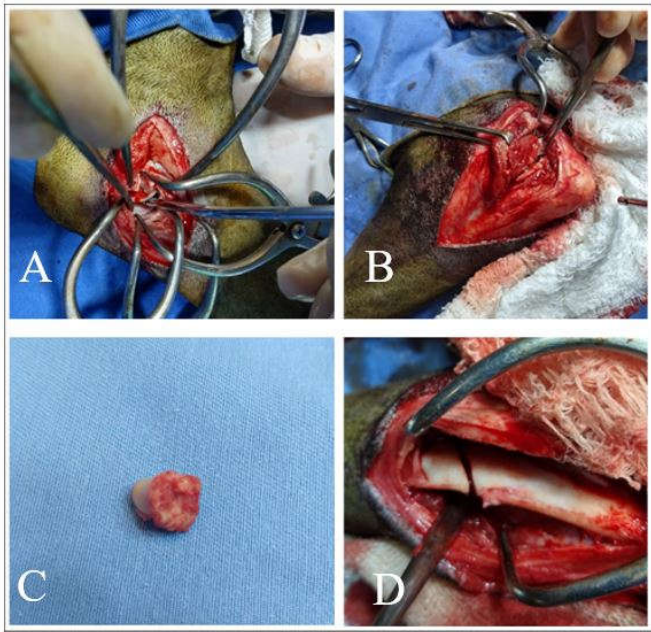
**Figure 3.** Male, 8 months old. A to F - Radiographies of both right and left affected elbow joints. Neutral positions on medial-lateral images of right (A) and left elbow (D). Stress positions on medial-lateral images of left (B) and right elbows (E). Cranial-caudal radiographies views of the right and left elbows (C and F, respectively). Slight joint incongruence of both elbows represented by the yellow arrows in A and B (right elbow) and D and E (left elbow). In C and E there are medial coronoid processes anatomical defects in the right ulna (red arrow) and left ulna (green arrow). MTD = right thoracic limb; MTE = left thoracic limb



**Figure 4.** Tomographic images of both right and left affected elbows (A and B, respectively) of the male, 8 months old German Shepard. Medial coronoid processes fragmentations (FCP) of the right and left ulnas (yellow arrows in A and B, respectively).

Both animals underwent elbow surgery. In the female bi-oblique dynamic proximal ulna osteotomy (BODPUO) was performed concurrently with bilateral joint exposure to remove the medial coronoid process and the anconeus process of the LTL (Figure 5). RTL was normal and nothing was done. Two months after the female surgery, her male brother also underwent surgery which was performed through BODPUO and removal of the coronoid process in the LTL. After forty-five days from this first procedure on the male, a second elbow surgical procedure was performed on the RTL with the aim of FCP removal and joint cleaning, but without BODPUO this time. The patients presented complete recovery, and did not present pain in the regions in which the osteotomy and joint opening were performed to remove the coronoid processes, nor pain in the extension and flexion of the limb, improving the range of motion and lameness in the female, demonstrating that the removal of all

fragments was satisfactory, as well as the release of the ulna through the BODPUO for joint readjustment during the remaining residual growth period of the animals.



**Figure 5.** A- Photographic image showing the medial access to elbow joint to remove the coronoid process. B- Photographic image showing the caudo-lateral joint access to remove the anconeus process. C- Photographic image of the removed anconeus process. D- Photographic image showing bi-oblique dynamic proximal ulnaostectomy (BODPUO) surgical procedure

## DISCUSSION AND CONCLUSIONS

According to the literature, ED is commonly diagnosed in young dogs, more often in males, which represent about twice the affected population compared to females [8]. This report is in agreement with the literature regarding the mentioned pattern, since it is about young animals of 6 months and 8 months of age at the time of diagnosis and treatment. Regarding the predisposition of breeds, a higher frequency of ED has been described in large animals, and the breeds most affected by the various pathological changes are Labrador Retrievers, German Shepherds, and Rottweilers, both for osteochondritis dissecans (OCD) and for medial coronoid disease (FCP) [2,8]. Likewise, the breed of the patients presented in this report corroborates to those indicated with greater predisposition to ED. Improper growth between radius and ulna in more severe cases can cause disorder in dogs of different breeds. This inadequate growth may result from congenital, hereditary, nutritional, or even traumatic causes [15]. Thus, this report is in agreement with those in the literature, which shows two siblings with changes in the elbows, suggesting a genetic basis, or even hereditary, for the occurrence of ED in both animals. In these two cases we could observe different progressions of the disease, as well different morphologic changes on radiography images. The female, already showing clinical signs such as elbow pain and lameness with a worse elbow disease in LTL, in which there was an important IC and medial coronoid disease without its fragmentation, while in the unaffected RTL, there was not radiographic alterations or clinical signs of ED. On the other hand, the male had the joint disease in both elbows, but with mild radiographic changes in respect to IC, but both medial coronoid processes already fragmented (FCP). One thing to note is the absence of clinical signs at the time of the male's physical examination. So, having in mind that ED has a possible genetic and heritable component in its manifestation, we requested the patients' owner to bring in the male puppy to do an early ED scanning exam to see if he already had morphological changes in his elbow joint even not showing any signs of the disease such as pain or lameness. Nor had the owner any complainment about the male during his growing up period.

Some authors suggest that one of the mechanisms that contributes to the development of ED would be joint incongruities and incompatibility of biomechanical forces that occur between the bones in the elbow joint [6,8,9]. They highlighted that this hypothesis suggested the occurrence of genetic predisposition, and that, concomitantly with secondary factors, such as high-energy diet and growth rates or excessive exercise, they culminated in the inadequate development of the elbow joint and the consequent installation of the ED process [14]. This hypothesis is in agreement with the case in question, as the results of the imaging exams showed elbow IC in both animals that were exposed to the same environment and to the same high-energy diet ("super premium feeding"), as they were part of the same litter and had the same owner. The treatment for the fragmentation of the medial coronoid process could be surgical or conservative depending on the patient's age [14]. In this report, the surgical procedure was indicated, since the patients were still young and medial coronoid processes disease were visualized, with fragmentations observed in one of the patients. Computed tomography images allowed visualization of the elbow in different planes without the need to reposition the patient, allowing a wide delineation of the bones and their relationships at the level of the elbow. But for this, it was necessary to use general anesthesia [1]. It is noteworthy that the results of computed tomography were essential not only for confirming the diagnosis of ED, FCP and NUAP, but also for indication of surgical treatment, since treatment of FCP removal and articular cleaning is indicated for dogs under one year of age showing clinical signs or not. NUAP is also surgical in young animals, where it can be removed or anatomic repositioned with compression screw if the fragment allows it [4]. Currently, there is still great difficulty in diagnosing ED, especially for the veterinarian who does not have a deeper training in orthopedics, due to the high complexity of the elbow joint. This is even worse when CT scan is not available. However, like this report, there have been an increase in research and cases reports related to elbow joint and its pathologies in general, in an attempt to further clarify the various conditions and disease manifestations that can affect it, especially with regard to ED. In conclusion, ED can be considered a syndrome that involves several disorders of the elbow joint, and has a genetic nature, since animals from the same litter showed similar changes in the elbow compartment, when being exposed to the same environment and feeding during the same period of time

**Abbreviations:** Elbow dysplasia (ED), left thoracic limb (LTL), right thoracic limb (RTL), bi-oblique dynamic proximal ulna ostectomy (BODPUO), fragmentation of the medial coronoid process of the ulna (FCP), osteochondritis dissecans of the humeral condyle (OCD), nonunion of the ulnar anconeus process (NUAP) and elbow joint incongruence (IC), osteoarthritis (OA), computed tomography scan (CT) scan.

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