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## **BASIC PARAMETERS OF ANGULARITY AND BIOSTATIC MODEL OF THE BOSNIAN BROKEN-HAIRED HOUND – BARAK**

### **SUMMARY**

Bosnian broken-haired hound called Barak belongs to a large group of hound dogs. Barak is indigenous breed of hound in Bosnia and Herzegovina, and it is widespread among hunters as working hunting dog. In order for the dog to act appropriately while standing or moving, its body needs to be built in such way to enable appropriate response to the impact of various external forces. All parts of dog's body stands in certain correlation that are specific to each group of dogs. Besides the the size of individual parts of extremities, or the body itself, the angles between the bones in joints are extremely important.

The aim of this paper was to determine the basic parameters of angularity of Bosnian broken-haired hound – Barak by conducting zootechnical measurements. The study involved 120 dogs, including 64 males and 56 females, aged from 9 months to 10 years, from entire territory of Bosnia and Herzegovina. The total of 6 parameters of angularity were measured on each dog. This is the first analysis of the angularity for the Bosnian broken-haired hound Barak, and the results can be used for further detailed description of this breed, as FCI standard for Barak does not describe any angle except for shoulder and pastern.

The results indicates almost equal values of angles in both males and females, and except for the angles of shoulder and croup, no statistical significance was observed in other angles between the genders.

**Keywords:** angularity, Barak, hound, movement

### **INTRODUCTION**

Bosnia and Herzegovina, and thus Republic of Srpska, is considered as area of great biodiversity and characterized by large number of indigenous breeds

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(Nikitovic *et al.*, 2015). Bosnian broken-haired hound called Barak is indigenous breed of hound in Bosnia and Herzegovina, and it is widespread among hunters as working hunting dog. Along with Barak, a large number of hounds used for hunting in Bosnia and Herzegovina belongs to breeds Serbian Hound, Serbian Tricolour Hound and Posavatz Hound (Nikitovic *et al.*, 2020). The body of Barak, as a working hound dog, should meet the basic measures and principles that applied to this group of dogs. Official FCI Standard describes that Barak has rectangular body which length should be 10% longer than height at withers (FCI, 2019). As for angles, the standard suggests that angle of shoulder joint should be 90°, and pastern should form the angle up to 10° with a vertical, while there are no values in the standard for other angles of joints, neither for forelegs nor hind legs.

In order for the dog to act appropriately while standing or moving, its body needs to be built in such way to enable appropriate, positive response to the impact of various forces from the external environment. The body is able to, by contractions of the muscles, produce biokinetic energy which, with appropriate transmission system, enables certain parts of body to move. The movement of the body, or its parts, is achieved by the mutual action of muscular system and adequate response from the skeleton. The dog's body must be built to stand in balance. In order to maintain that balance, it is necessary that resultant of all forces, which act on the body at any moment, should equal to zero (Nikolic and Hudec, 1988).

The body remains in balance, during rest or movement, only if the biostatic principles of the body structure are met. All parts of dog's body stands in certain correlation that are specific to each group of dogs. Besides the the size of individual parts of extremities, or the body itself, the angles between the bones in joints are very important. The typical movement of hound is trot, which enables the longest movement with minimum spend of biokinetic energy. Hind legs are the producers of biokinetic energy that enables the dog to move forward. In this system, the knee joint has very important role, and therefore must be adequately angled. Moving by trot implies synchronised movement of forelegs and hind legs in rhythm: hind right – front left, hind left – front right (Urosevic and Drobnjak 2018). Angularity of the forelegs must be adequate as well, since the forelegs enable the maximum use of kinetic energy produced by hind legs.

The hind legs significantly contributes and affects the balance of the body. Certain components of the hind legs must be in the appropriate proportion. The longer the femur, the longer are the muscles attached to it, and they provide more biokinetic energy that moves the body forward. If the angle of the hock, and therefore the angle of pastern, is more closed, the hind legs are more under the body. This position is not good for the movement process and increases the pressure on the hock. The movement is not harmonious (Urosevic and Drobnjak, 2018).

With a good biostatic model, the length of the forelegs steps are equal to the steps made by hind legs. With good angularity, the height reached by forelegs

is equal to height reached by hind legs. In the case of open angles on the forelegs and hind legs, the length of the steps is reduced, and thus the movement is slow and difficult (Urosevic and Drobnjak, 2018).

The aim of this paper was to determine the six basic parameters of angularity of Bosnian broken-haired hound – Barak, as there are no official standard values for the joint angles, but only for the bones position.

### MATERIAL AND METHODS

The research involved 120 dogs, including 64 males and 56 females, from entire territory of Bosnia and Herzegovina. All dogs were older than 9 months, and this age is considered in the cynology to be the youngest when dogs can be judged as the adults for the measurement of exterior parameters. The oldest dog was 10 years old.

The angles of shoulder joint and elbow joint were measured on the forelegs, while the angles of knee joint and hock joint were measured on the hind legs. Additionally, the angles of neck and croup were also measured on each dog. Values of the measured angles were determined using protractor.

The obtained results were processed using the software *Statistical Package for the Social Sciences (SPSS) for Windows Release 17.0.0*. Descriptive statistic values were calculated: coefficient of variation (CV), standard error (SE), standard deviation (SD), minimum value (MIN), maximum value (MAX) and mean value ( $\bar{x}$ ). Using the T test, statistical differences were calculated for each of the measured parameters between the genders. As statistically significant were taken differences  $P < 0.05$ .

### RESULTS AND DISCUSSION

Values of angularity parameters in examined Barak dogs are shown in Table 1. The angle of the shoulder joint in males ranged from  $90^\circ$  to  $125^\circ$ . The average value of the male's shoulder joint was  $109.64^\circ$ . The standard deviation (SD) was 8.13, while the coefficient of variation (CV) was 7.42%. In females, the minimum of shoulder joint angle was  $92^\circ$ , and it was measured in only one individual, while the maximum value of  $120^\circ$  was measured in two females. The mean value of this parameter in females was  $106.23^\circ$  with a standard deviation (SD) of 7.75. There is statistical difference ( $P < 0.05$ ) between the genders for this parameter.

The angle of the elbow joint in males' averages at  $128.23^\circ$  with standard deviation of 7.81. Variation interval ranges from  $110^\circ$  to  $145^\circ$ . One dog has the minimum value of this angle, and also one dog has the maximum value. The coefficient of variation was 6.10%. In females, a large interval of variation was noticed in the elbow joint angle and ranged from  $100^\circ$  to  $149^\circ$ . Most females, 11 of them, had the value of this angle that amounts  $135^\circ$ . The mean value of females' elbow joint was  $128.39^\circ$ , with standard deviation of 11.62. No statistical difference between the genders ( $P > 0.05$ ) was found for this exterior parameter.

Table 1. Values of angularity parameters in examined Barak dogs

Parameter	Gender	N	Min	Max	CV	SE	$\bar{x} \pm SD$	t
Shoulder joint angle	♂	64	90.00	125.00	7.42	1.01	109.64±8.13	2.339*
	♀	56	92.00	120.00	7.30	1.03	106.23±7.75	
Elbow joint angle	♂	64	110.00	145.00	6.10	0.97	128.23±7.81	0.692 <sup>ns</sup>
	♀	56	100.00	149.00	9.05	1.55	128.39±11.62	
Knee joint angle	♂	64	92.00	145.00	7.70	1.10	114.75±8.83	0.334 <sup>ns</sup>
	♀	56	95.00	139.00	9.18	1.40	114.16±10.48	
Hock joint angle	♂	64	110.00	155.00	7.74	1.29	133.59±10.34	0.533 <sup>ns</sup>
	♀	56	107.00	155.00	6.78	1.20	132.64±8.99	
Neck angle	♂	64	15.00	55.00	32.33	1.31	32.44±10.49	1.512 <sup>ns</sup>
	♀	56	15.00	55.00	30.98	1.22	29.70±9.19	
Croup angle	♂	64	20.00	53.00	20.96	0.94	35.91±7.52	2.086*
	♀	56	20.00	49.00	20.82	0.92	33.14±6.90	

In the examined population of males, the knee joint angle ranged from 92° to 145°, with coefficient of variation of 7.70%. The mean value was 114.75° with standard deviation of 8.83. The largest number of male dogs (68.76%) has the knee joint angle in the interval between 110° and 120°. The mean value of this parameter in females was 114.16°, with standard deviation of 10.48. Interval of variation ranged from 95° to 139°. Both minimum and maximum values were recorded in two female dogs. No statistical difference between the genders ( $P > 0.05$ ) was found for this parameter.

The mean value of hock joint angle in males was 133.59°. The minimum value of 110° was recorded in one male dog, while the maximum value of 155° was recorded in two male dogs. The coefficient of variation was 7.74% and standard deviation (SD) was 10.34. In females, both minimum (107°) and maximum values (155°) were recorded in one dog. Most females had the angle of hock joint at 130°, while the mean value was 132.64°, with standard deviation of 8.99. No statistical difference between the genders ( $P > 0.05$ ) was found for this exterior parameter.

When it comes to the angle of the neck, a large interval of variation is noticeable. Both males and females has minimum value of 15°, and maximum value of 55°. Males has mean value of 32.44°, with standard deviation of 10.49. Mean value in females was 29.70°, with standard deviation of 9.19. No statistical difference between the genders ( $P > 0.05$ ) was found for this exterior parameter.

As for the angle of the croup, interval of variation in males ranged from 20° to 53°. The mean value for this angle was 35.91°, with a standard deviation of

7.52. Based on the obtained results, it can be concluded that there are dogs with straight croup, which is desirable feature, and also dogs with lowered or steep croup, which is not a good characteristic for the hound. In females, the mean value of the croup angle was  $33.14^\circ$ , with standard deviation of 6.90 and coefficient of variation of 20.82%. For this exterior parameter, it was determined that there is a statistical difference ( $P < 0.05$ ) between the genders.

Angularity of the legs, as well as position of the neck and croup, is very important for the hounds, in terms of adequate movement and accomplishment of work tasks. The length of individual parts of the forelegs and hind legs must be balanced, which means they must be approximately the same, in order for dogs to move properly. Also, there must be the harmony between the angles, which means that shoulder joint angle should be approximately equal to hip angle, and the elbow joint angle should correspond to knee joint angle. If the value of the shoulder angle increases (becomes more open), the ability of the forelegs to step out decreases (Urosevic and Drobnjak, 2018).

In the examined population of Barak dogs, the elbow angle in males averages at  $128.23^\circ$ , while the knee angle averages at  $114.75^\circ$ , which means the difference between the angles is bigger than desirable. The same situation is in females, where corresponding angles of elbow and knee averages at  $128.39^\circ$  and  $114.16^\circ$  respectively. It is noticeable that the values of the angles are almost the same in males and females, and except for the angle of shoulder joint, no statistical significance was observed in other angles between the genders.

The FCI standard for Bosnian broken-haired hound called Barak suggests that angle of shoulder joint should be  $90^\circ$ . It is noticeable that the mean value of this parameter is higher than standard by  $19.60^\circ$  in males, and  $16.20^\circ$  in females. The minimum values of this angle are within the values prescribed by the standard for both males and females.

The angles of the neck and croup in relation to the horizontal plane are also very important (Nikitovic *et al.*, 2020). The angle of the neck averages at  $32.44^\circ$  in males, and  $29.70^\circ$  in females. The croup angle averages at  $35.91^\circ$  and  $33.14^\circ$  in males and females respectively.

Since there is no research of angularity in other breeds of hounds from the Balkans, adequate comparison is not possible. The shepherd dog Tornjak is the closest breed to Barak that is also autochthonous breed in Bosnia and Herzegovina (Nikitovic, 2020). Since both breeds originated and developed in the same area, it would be interesting to compare the angles of these breeds, though not belonging to the same group of dogs. The mean value of the Tornjak's neck angle is  $23.50^\circ$ , while the shoulder angle averages at  $122.75^\circ$ , and elbow angle at  $149.62^\circ$ . Average knee angle is  $121.00^\circ$ , hock joint angle is  $141.50^\circ$ , and croup angle  $32.00^\circ$ . The mean value of the Tornjak females' neck angle is  $25.71^\circ$ , shoulder angle averages at  $118.86^\circ$ , and elbow angle at  $142.57^\circ$ . When it comes to the hind legs in females, the average value of the knee angle is  $124.57^\circ$  and hock joint angle is  $138.00^\circ$ . The females' croup are bent at average angle of  $33.00^\circ$  (Urosevic *et al.*, 2014).

Comparing the results of examined population of Barak and corresponding research for Tornjak in Bosnia and Herzegovina, we can see that all measured angles of Barak dogs is smaller than Tornjak's, for both males and females, except for the neck angle. When it comes to the croup angle, the Barak has slightly lower croup, which means the angle is higher than Tornjak, while in females, there is almost no difference between the two breeds for this parameter.

Although both breeds originated and developed in the same area and under approximately the same ambient conditions, there are large differences in angularity, the forelegs and neck in particular. This difference in angularity results in different biostatic model between these two breeds, as well as different ways of how they work.

### CONCLUSIONS

Bosnian broken-haired hound called Barak belongs to the group of hounds, with a rectangular body shape. Important exterior indicators of hound dogs include the size and ratio of joint angles, though not the common method of measurement. This is the first analysis of the angularity for the Bosnian broken-haired hound Barak, and the results can be used for further detailed description of this breed.

As for the results, we can conclude from this research that the angle of the shoulder is higher than the value prescribed by FCI standard, in both males and females. A quite large interval of variation is noticeable in females' elbow joint angle, as well as for neck angle in both males and females. No statistical difference was found in angles between the genders, except for shoulder joint angle and croup angle. This research shows us a great heterogeneity in the examined population.

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