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Establishing a Body and Pelvic Biometric Standard and determining their Relationship in the French Bulldog

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Abstract

The dimensions of the pelvic diameter, which are directly obtained from radiographic images, are known as radiographic pelvimetry. This technique allows the determination of the standard pelvimetry for each breed and the anatomical classification of the pelvis. A radiographic study of the pelvimetric aspects of 20 French Bulldog bitches was performed to obtain data on the pelvic diameters and correlate these with external body and pelvic measurements. These external body and pelvic measurements were obtained using a metric tape, whereas radiographic pelvic dimensions were obtained directly from the radiographic images. A significant positive correlation was observed between pelvic radiographic measurements of the bi-ischiatic line, coxal tuberosity, and the area of the pelvic entrance and body weight, with a correlation index of 0.75 ($P<0.005$). A significant positive correlation was also observed between the cranial circumference (CC) and sacral diameter (SAD), with a correlation index of 0.76 ($P<0.05$). However, correlations between other external and radiographic pelvic measures were of a low magnitude, which indicated a significant association between different measures. Therefore, French Bulldog bitches can be classified as mesatipellic. The CC had a positive correlation with the SAD and several pelvic measurements were correlated with body weight. For reproductive efficiency, it is important to conduct studies within a physical standard; a breed determination, because there is a variation in the size, shape, and weight of the head between different breeds of dogs, and it is therefore important to establish mathematical formulas and normal ranges for each breed or standard.

Keywords: French Bulldog; Biometry; Pelvimetry

Introduction

Recently, demand for exotic canine breeds in Brazil has increased. Among these exotic breeds, those of small size, including French Bulldogs, are becoming increasingly popular because of their ease of adapting to the smaller domestic environments that are found in big cities. French Bulldog is small sized and brachycephalic dog with a strong robust skeleton, well-developed muscle mass, short hair, and short and flat snout [1]. In commercial kennels, it is essential to obtain a normal biometric standard. Therefore, breeding dogs must be selected that are within the desirable zoo technical profile to ensure better reproductive efficiency.

In Guzerá cattle, OKUDA and others [2] sought to establish, via pelvimetry, an outline for the standard values of pelvic diameters, such as the true conjugate (TC) and superior and inferior bi-iliac diameters. Additionally, correlation between these pelvic and body measures, i.e., the withers height, was verified. This study showed that several pelvic dimensions presented a strong positive correlation with the height of the animal, thoracic circumference (THC), and body weight. Among these, the withers height was the measure that had the highest positive correlation to that of the superior bi-iliac diameter (SBID).

The use of radiographic pelvimetry represents an important tool for the selection of Nelore cows, which give birth easily because they have a good pelvic angle and diameter [3]. However, pelvimetry performed using a pelvimeter and digital palpation are not applicable to dogs owing to anatomical implications. Thus, pelvimetry using radiography is a valuable method to evaluate the pelvic shape and diameter in dogs. Radiographic pelvimetry represents the mensuration of the distances and angles between pelvic structures, which can more precisely be performed using radiographic images. This is a routine procedure for evaluating the size of the pelvis in humans [4] however, this technique has also been used in sheep [5] and cows [6] to select the ideal females for reproduction based on their pelvic size.

Considering that French Bulldog is a brachycephalic and chondrodystrophic breed of increasing commercial interest in Brazil, the performance of studies on its reproductive anatomy, especially in females, is of great importance and will provide information on breeding characteristics. Thus, pelvimetric data on this breed should contribute to reducing economic losses associated with low reproductive efficiency [3].

The objectives of the present study were to measure the average pelvimetric values of French Bulldog bitches to establish an outline of the normal anatomical biometric standards of the pelvis and to verify the correlation between the external body and pelvic measurements, and between the external and internal pelvic measurements.

Materials and Methods

Animals

A total of 20 French Bulldog bitches of different ages, ranging from 2 to 4 years, were assessed, including nulliparous (n=3), primiparous (n=7), and multiparous (n=10) individuals, all of which were not pregnant during the study. Only animals with mature skeletons were included, considering that the closure of the epiphyseal plates of the ilium, ischium, and pubis occurs at approximately 4-6 months of age [7,8]. The animals were from the commercial kennel Grande Canafístula and from private breeders. They were fed with dry commercial canine food and water *ad libitum*.

External Body Parameters

The external body parameters measured was the external body measurements and weight of the bitches. The external body measurements included the cranial circumference (CC), measured at the zygomatic processes; the THC, measured along the contours of the thorax, tangent to the extremity of the olecranon tuberosity, and caudally to the withers; the abdominal circumference (AC), measured immediately cranial to the ilia; the withers height, measured from the dorsal extremity of the spinous process of the first thoracic vertebrae to the ground; and the body length (BL), measured from the cranial extremity of the scapulohumeral joint to the ischiatic tuberosity [3,9]. All these parameters were measured using a metric tape with a precision of 0.1 cm, while the animals were standing. The animals were weighed with an analogical scale, without restricting food or water intake [3].

External Body Parameters

The studied external pelvic parameters were the different pelvic widths, including the external bi-iliac diameter (EBID), measured between the lateral extremities of the right and left coxal tuberosities; external bi-ischiatic diameter (EBIsD), measured between the lateral extremities of the right and left ischiatic tuberosities; and the right and left external ilio-ischiatic diameters (REIID and LEIID, respectively), measured between the lateral extremities of the coxal and ischiatic tuberosities [9]. External pelvic measurements were measured using a metric tape with a precision of 0.1 cm, while the animals were standing on an examination Table.

Measuring Internal and Radiographic Pelvic Parameters

For the radiographic examination, Equimex X-ray equipment with a maximum potency of 200 milliampere was used. Radiographs of the pelvis and caudal portion of the lumbar column were obtained with the animals positioned in the right lateral and dorsal recumbency. The use of chemical restraint was not required. The focus film distance was 90cm to minimize the object-film distance and image magnification [10].

Bitches were carefully positioned in such a way that their pelvises were as close and as straight as possible in relation to the radiographic film to obtain symmetrical positions of the pelvis [10].

Measurements of pelvic dimensions were directly performed on radiographic images (accuracy level of the measurements was 0.5cm) using a millimetric ruler (Figure 1A and 1B). Then, the following measurements were obtained: TC = the distance between the promontory and the cranial portion of the pubic symphysis; diagonal conjugate (DC) = the distance between the promontory and the caudal portion of the pubic symphysis; vertical diameter (VD) = the vertical distance between the end of the cranial portion of the pubic symphysis and the sacrum; sacral diameter (SAD) = the vertical distance between the craniocaudal extremity of the sacrum and the symphysis; sagittal diameter (SGD) = the distance between the caudoventral extremity of the sacrum and the symphysis; coxal tuberosity diameter (CTD) = the horizontal distance between both coxal tuberosities; SBID = the horizontal distance between the ilia; inferior bi-iliac diameter (IBID) = the horizontal distance between both acetabula; and the bi-ischiatic diameter (BICD) = the horizontal distance between both ischiatic tuberosity.

In addition, several ratios were calculated, including the height/width (VD/IBID, SGD/CTD, and SGD/IBID), and the pelvic inlet and outlet areas. The pelvic inlet area (PIA) was calculated based on the methodology described by OCAL and others [10] using the equation $(TC/2 + SBID/2)^2 \times \pi$ and the pelvic outlet area (POA) was calculated using the equation $(VD/2 + IBID/2)^2 \times \pi$ [6].

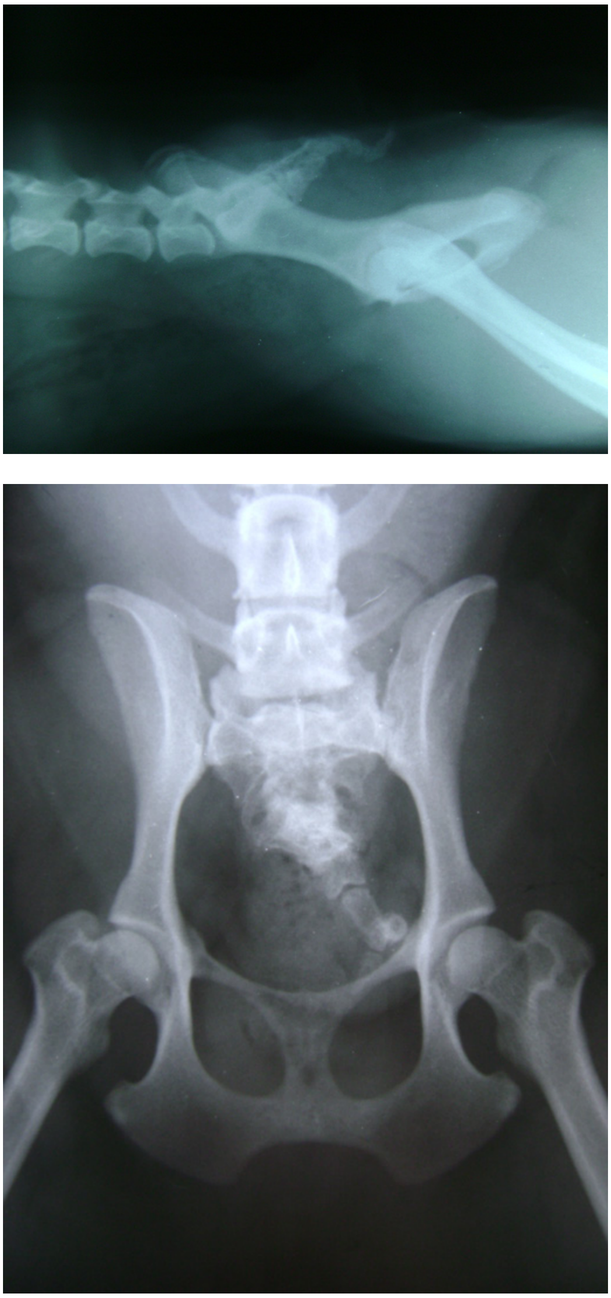

Figure 1: Radiographic examinations performed on French Bulldog bitches; **(A)** Latero-lateral projection. Note the higher angle side of the pelvis in relation to the vertebral column beyond the deformity of the vertebral bodies of the first thoracic vertebra; **(B)** Ventral-dorsal projection. Note the obvious deformity of the sacral vertebrae and first coccygeal vertebrae

Statistical Analysis

External and internal pelvimetric values and body dimensions were described as means, standard deviations, and coefficients of variation. They were submitted to the Bartlett and Cramer-von Mises tests for homoscedasticity and normality, respectively. The parametric data were submitted to analysis of variance (ANOVA), and correlations between external body and pelvic measurements, height/width ratios, and inlet and outlet pelvic areas were calculated using Pearson's correlation test. Differences were considered statistically significant at P values less than 0.05.

Results

The results obtained in the present study are presented in the following tables and are based on the following parameters: mean of external body measures (Table 1), mean of external pelvic measures (Table 2), mean of internal pelvic measures during pregnancy (Table 3), mean of height: width ratios of the radiographic pelvic measures and pelvic areas (Table 4), and correlation between body and pelvic external measures and pelvic radiographic measures (Table 5).

VALUES	External Body Parameters					
	Cranialcircumference	Thoraciccircumference	Abdominalcircumference	Withersheight	Bodylength	Weight
Mean ± SD	39.79 ± 2.41	53.20 ± 3.30	43.96 ± 3.92	33.03 ± 3.51	39.16 ± 4.79	10.79 ± 1.79
MinimumMaximum	*36.00 – 43.00*	*45.40 – 57.30*	*34.60 – 49.00*	*29.00 – 40.00*	*31.00 – 46.00*	*7.50 – 14.00*

Table 1: Mean ± standard deviation (SD) and minimum and maximum values of cranial, thoracic and abdominal circumferences, withers height, body length (cm), and body weight (kg) of 20 French Bulldog bitches

VALUES	External Body Parameters			
	External bi-iliac diameter	External bi-ischiatic diameter	Right	Left
			Ilio-ischiatic diameter	
Mean ± SD	7.08 ± 0.76	8.38 ± 0.79	12.04 ± 1.24	12.04 ± 1.27
MinimumMaximum	6.00 – 8.50	7.00 – 9.60	9.60 – 14.00	9.40 – 14.00

Table 2: Mean values found for the external pelvic measures: external bi-iliac diameter, external bi-ischiatic diameter, and right and left ilio-ischiatic diameters, all expressed in centimeters

VALUES	Radiographic Pelvic Parameters								
	TC	DC	VD	SAD	SGD	CTD	SBID	IBID	BICD
Mean ± SD	4.30 ± 0.32	8.38 ± 0.37	4.10 ± 0.40	4.55 ± 0.33	7.10 ± 0.38	7.75 ± 0.79	4.21 ± 0.40	4.00 ± 0.44	7.47 ± 0.63
Minimum-Maximum	3.75 – 4.80	7.75 – 8.80	3.40 – 4.80	4.10 – 5.15	6.60 – 7.80	6.25 – 8.90	3.70 – 4.90	3.40 – 4.90	6.80 – 9.10

Table 3: Mean values observed for pelvic internal dimensions, directly measured from radiographic images: true conjugate (TC), diagonal conjugate (DC), vertical diameter (VD), sacral diameter (SAD), saggital diameter (SGD), coxal tuberosity diameter (CTD), superior bi-iliac diameter (SBID), inferior bi-iliac diameter (IBID), and bi-ischiatic diameter (BICD), all expressed in centimeters

VALUES	Ratios of Height/ Width and Pelvic Area				
	VD/IBID	SAD/CTD	SAD/IBID	PIA	POA
Mean ± SD	1.03 ±0.12	1.70 ± 0.17	1.79 ± 0.21	57.09 ± 8.22	51.86 ± 9.46
Minimum -Maximum	0.81 – 1.18	1.44 – 1.89	1.44 – 2.16	47.76 – 70.85	42.99 – 72.35

Table 4: Mean values observed for the ratios between vertical diameter (VD) and inferior bi-iliac diameter (IBID), sacral diameter (SAD) and coxal tuberosity diameter (CTD), and sacral diameter (SAD) and inferior bi-iliac diameter (IBID), and mean values for pelvic inlet (PIA) and outlet areas (POA), expressed in cm^2

Internal measures	External measures																			
	CC		THC		AC		WH		BL		EBID		EBIsD		REIID		LEIID		Weight	
	R	P	r	P	r	P	r	P	r	P	r	P	r	P	r	P	r	P	R	P
TC	0.64	0.02	0.25	0.43	0.03	0.90	0.44	0.14	0.43	0.15	0.32	0.30	0.61	0.03	0.24	0.43	0.20	0.51	0.58	0.04
DC	0.58	0.04	0.58	0.04	0.49	0.11	0.57	0.05	0.14	0.65	0.66	0.01	0.39	0.20	0.42	0.17	0.40	0.19	0.64	0.02
VD	0.51	0.08	0.39	0.20	0.14	0.66	0.44	0.14	0.47	0.12	0.26	0.05	0.26	0.41	0.38	0.21	0.38	0.21	0.56	0.03
SAD	0.76	0.003	0.44	0.14	0.42	0.16	0.18	0.55	0.41	0.18	0.51	0.08	0.65	0.01	0.17	0.59	0.17	0.58	0.63	0.02
SGD	0.44	0.15	0.57	0.05	0.40	0.19	0.30	0.33	0.10	0.73	0.67	0.01	0.30	0.33	0.34	0.26	0.33	0.27	0.40	0.19
CTD	0.55	0.06	0.64	0.02	0.39	0.20	0.65	0.02	0.25	0.42	0.52	0.07	0.67	0.01	0.39	0.20	0.39	0.20	0.75	0.005
SBID	0.39	0.20	0.68	0.01	0.38	0.21	0.32	0.30	0.51	0.08	0.46	0.12	0.55	0.06	0.56	0.05	0.56	0.05	0.66	0.01
IBID	0.24	0.44	0.53	0.07	0.19	0.53	0.31	0.32	0.54	0.07	0.37	0.22	0.40	0.19	0.52	0.07	0.52	0.07	0.56	0.05
BICD	0.49	0.11	0.64	0.02	0.42	0.17	0.44	0.14	0.58	0.04	0.55	0.06	0.53	0.07	0.54	0.06	0.55	0.06	0.78	0.003
VD/ IBID	0.21	0.49	-0.16	0.60	-0.04	0.89	0.07	0.82	-0.12	0.68	0.13	0.68	-0.14	0.65	-0.17	0.57	-0.19	0.54	0.05	0.87
SGD/ CTD	-0.11	0.72	-0.33	0.72	-0.13	0.66	-0.13	0.68	0.40	0.18	-0.33	0.85	-0.33	0.28	-0.34	0.27	-0.35	0.26	-0.38	0.22
SAD/ IBID	0.03	0.91	-0.18	0.56	0.05	0.85	-0.12	0.69	-0.41	0.18	-0.18	0.96	-0.51	0.56	-0.31	0.32	-0.31	0.31	-0.26	0.40
PIA	0.60	0.03	0.58	0.04	0.27	0.38	0.45	0.13	0.58	0.04	0.68	0.11	0.68	0.01	0.51	0.08	0.49	0.09	0.75	0.005
POA	0.45	0.13	0.56	0.06	0.21	0.50	0.45	0.13	0.60	0.03	0.41	0.05	0.41	0.18	0.56	0.06	0.55	0.06	0.68	0.01

CC: Cranial Circumference; THC: Thoracic Circumference; AC: Abdominal Circumference; WH: Withers Height; BL : Body Length; EBID: External Bi-Iliac Diameter; Ebisd: External Bi-Ischiatic Diameter; REIID: Right External Ilio-Ischiatic Diameter; LEIID: Left External Ilio-Ischiatic Diameter; TC: True Conjugate; DC: Diagonal Conjugate; VD : Vertical Diameter; SAD: Sacral Diameter; SGD: Sagittal Diameter; CTD: Coxal Tuberosity Diameter; SBID: Superior Bi-Iliac Diameter; IBID; Inferior Bi-Iliac Diameter; BICD: Bi-Ischiatic Diameter; VD/IBID: Vertical Diameter/ Inferior Bi-Iliac Diamenter; SGD/ SBID: Sagittal Diameter/ Superior Bi-Iliac; SGD/IBID: Sagittal Diameter/ Inferior Bi-Iliac Diameter; PIA: Pelvic Inlet Area; POA: Pelvic Outlet Area

Table 5: Correlation coefficients (r) and respective P values between external body and pelvic measures and internal pelvic measures

The estimated correlation coefficients for the possible associations among external body and pelvic diameters and radiographic pelvic measures are shown in Table 5. The values found from the correlation analysis among the external body and pelvic measures and radiographic pelvic measures were, in general, low, varying from 0.03, for the correlation between CC and SGD/IBID, to 0.68, for the correlation between THC and SBID, EBIsD and PIA, and body weight and POA. Significant positive correlations ($P < 0.005$) were observed between the following variables: CC and SAD ($r = 0.76$ and $P < 0.003$), body weight and CTD ($r = 0.75$ and $P < 0.005$), body weight and EBIsD ($r = 0.78$ and $P < 0.003$), and body weight and POA ($r = 0.75$ and $P < 0.005$).

Discussion

Pelvimetry is not usually applied in dogs; hence, there are limited studies that have been undertaken with this species. Direct pelvimetry was used for only one type of pelvis from different dog breeds [11,12]. A general view of the canine pelvis has been described and some examples of pelvic dimensions from different breeds have been cited [13]. A dorsoventral flattening of the pelvis in two short legged, wide headed canine breeds was observed in the Pekingese and Sealyham Terrier [12].

To the best of our knowledge, the present study represents the first to use and compare indirect and radiographic pelvimetry involving the same dog breed. Although the number of examined females was small, it was similar to the number of assessed animals in previous studies in this area and it was adequate for allowing the performance of statistical analyses [10].

When analyzing data from body biometry, BL, withers height, and THC were in accordance with the standards described by *Fédération Cynologique Internationale* (FCI). Such observations demonstrated that the animals used in the present study were within the standards established for the French Bulldog breed, presenting characteristic body dimensions.

The mean body weight and standard deviation of the assessed dogs was 10.79 ± 1.79kg, which is in accordance with the official registry of the *Brazilian Confederation of Cinofilia* and FCI for the French Bulldog breed, which states 11kg as the average weight for this breed.

Regarding the pelvic shape, from analysis of the observed measurements, the pelvises of the female French Bulldogs were classified as being mesatipellic, with SBID and IBID similar to the TC diameter (Figure 2). Morphologically, the pelvis of the French Bulldog female tends to be of a rounded shape, considering its vertical axis, with a discrete narrowing of the caudal portion, as observed in other animals. In a similar study with Holstein cows, different types of pelvises (platypellic, mesatipellic, and dolichopellic) occurred within the studied animals, even though they belonged to the same breed [14].

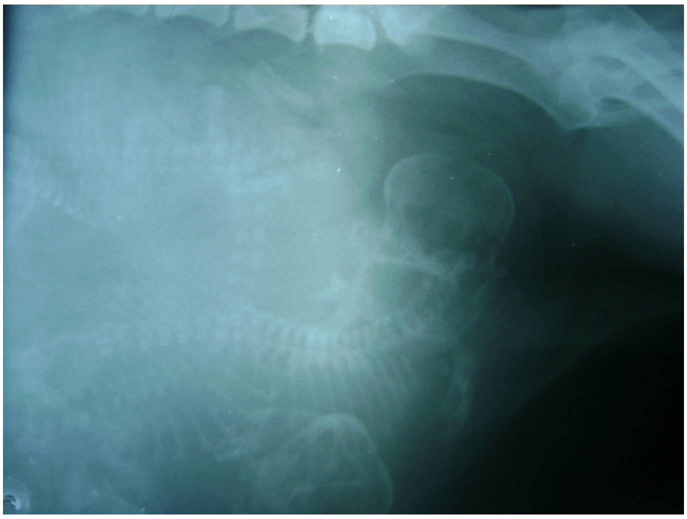

Figure 2: Pelvis of French Bulldog bitch showing true conjugate diameter and bi-iliac similar. Note the bilateral hip dislocation

In a study by Linde-Forsberg [15], pelvimetry was a technique found to be useful in dogs. In this study, the relation between the height and width of the pelvic canal was smaller in bitches with obstructive dystocia. It should, thus, be possible to estimate whether a bitch was likely to whelp or suffer from obstructive dystocia by taking X-rays of the pelvis and various pelvic measurements. However, the shape of the pelvis varies between breeds and before pelvimetry can become generally useful in clinical practice, more bitches of various breeds must have their measurements and angles determined, and an index for each breed should be calculated.

The evaluation of the correlation between external body and pelvic measures and internal body measures was performed to verify the possibility of using external pelvimetry as a tool to characterize the pelvis of female dogs, without the need to perform radiographic examination (radiographic pelvimetry), when it is not feasible. Our analysis showed the existence of significant positive correlations between several radiographic pelvic diameters, such as coxal tuberosity, BICD and PIA, and body weight and between SAD and CC. Therefore, body weight represents the most correlated parameter, compared to internal pelvic measures, even though it was influenced by other variables.

The same analysis indicated the existence of moderate significant positive correlations (r = 0.66) between external body measures and radiographic pelvic measures, as observed between TC and CC; between coxal tuberosity, superior bi-iliac and BICD and THC; between coxal tuberosity and withers height; and between POA and BL. A moderate correlation was observed between several external pelvic measures and radiographic pelvic measures, such as among DC and sagittal diameters and EBID and among TC, PIA, and EBIsD.

However, as observed in female buffaloes [16] and in Jersey cows [17], the correlation between external body and pelvic characteristics, especially withers height and EBID, which is more commonly correlated to TC, was low (r = 0.44) and not statistically significant (P >0.05). Correlation analysis indicated the existence of low positive correlation between body biometry and internal pelvic measures. Therefore, body biometry is not adequate for predicting the internal pelvic dimensions of French Bulldog females. According to Monteiro and others [18], in brachycephalic and mesaticephalic cats, body biometrics do not demonstrate good predictive value for determining internal pelvic measurements.

Low positive correlations were also observed between external pelvic measures (right and left BICDs) and all radiographic pelvic measures and between height/width ratios (VD/IBID, SAD/CTD, and SAD/IBID) and all external body measures.

It is important to study the pelvis as a tool for the early diagnosis of congenital pelvic alterations or as a feature to be evaluated by specific programs of reproductive management based on pelvimetric data.

The present study contributes data that can be used as a reference for the establishment of the reproductive management of French Bulldogs, to avoid breeding females that present unwanted pelvimetric measures. Once the pelvis shape is inherited [15], it is possible to advise breeders on how to breed their dogs based on pelvic X-rays of their animals, and to choose those with good pelvic shape, thus avoiding mating two dogs with poor pelvic shapes.

In conclusion, adult French Bulldog bitches can be classified as having a mesatipellic pelvis, and CC, SAD, coxal tuberosity, BICD, and PIA that are positively correlated to body weight. Thus, pelvimetry can be used as a tool to select dogs for breeding purposes, avoiding the utilization of animals that present unwanted pelvic dimensions.

Reference

1. Hermans JC (2002) Dogs of France of yesterday and today. Numerous illustrations, all current French breeds and 40 extinct breeds (out of print) (Chiens de France d'hier et d'aujourd'hui. Nombreuses illustrations, toutes les races françaises actuelles et 40 races disparues (ouvrage épuisé)). Pp350.

2. Okuda HT, Pedutti Neto J, Bombonato PP (1993) An influence of childbirth in pelvimetry of Guzerá cows (An influência do parto na pelvimetria de vacas da raça Guzerá. Revista da Faculdade de Zootecnia, Veterinária e Agronomia). J Faculty Anim Sci Vet Agron 1: 35-45.

3. Oliveira PC, Bombonato PP, Balieiro JCC (2003) Pelvimetry in Nellore cows. Braz J Vet Res Animal Sci 40: 297-304.

4. Morgan MA, Thurnau GR (1988) Efficacy of the foetal-pelvic index for delivery of neonates weighing 4000 grams or greater: a preliminary report. Am J Obstet Gynecol 158: 1133-7.

5. Cloete SW, Haughey KG (1990) Radiography pelvimetry for the estimation of pelvic dimentions in Merino, Domer S A Mutton Merino ewes. J S Afr Vet Assoc 61: 55-8.

6. Van Donkersgoed J (1992) A critical analysis of pelvic measurement and dystocia in beef heifers. Compend Continuing Educ Practicing Vet 14: 405-9.

7. Páfaro V (2007) Radiographic pelvimetry in different breeds of adult female canines (Canis familiaris, Linnaeus, 1758). Pelvimetria radiográfica em diferentes raças de fêmeas caninas adultas (Canis familiaris, Linnaeus, 1758). Dissertação (Mestrado em Medicina Veterinária (Cirurgia Veterinária) - Universidade Estadual Paulista Júlio de Mesquita Filho. Dissertation (Master's Degree in Veterinary Medicine (Veterinary Surgery) - Paulista State University Júlio de Mesquita Filho.

8. Celimli N, Intas DS, Yilmazbas G, Intas KS, Keskin A (2008) Radiographic pelvimetry and evaluation of radiographic findings of the pelvis in cats with dystocia. vet Prax Ausg K 36: 277-84.

9. Barreto MBP, Santos RMB, Wischral A, Cavalcanti Júnior MJ, Maia JAA, et al. (2004) Pelvimetry and pelvicology in bovine females of the breed in Girolanda cattle at different reproductive stages (Pelvimetria e pelviologia em fêmeas bovinas da raça Girolanda em diferentes estágios reprodutivos). Braz J Vet Sci 7: 131-9.

10. Eneroth A, Linde-Forberg C, Ulhorn M, Hall M (1999) Radiographic pelvimetry for assessment of dystocia in bitches: a clinical study in two terrier breeds. J Small Anim Pract 40 : 257-64.

11. Ocal MK, Dabanoglu I, Kara ME, Turan E (2003) Computed tomographic pelvimetry in German shepherd dogs. Dtsch Tierarztl Wochenschr 110: 17-20.

12. Wright JG (1934) Some aspects of canine obstetrics. Vet Record 15: 563-85.

13. Rasbecnh O (1973) The anatomy of the birth canal. In: Reproduction of Domestic Animals. Carl Fr Mortensen a/s, Copenhagen 1-18.

14. Oliveira LF (2008) Pelvimetry and severity score in calving cows. 2008. 60f. Dissertation (Master in Veterinary Medicine)- (Pelvimetria e escore de dificuldade de parto em vacas da raça Holandesa. 2008. 60f. Dissertação (Mestrado em Medicina Veterinária)) - Universidade Federal de Minas Gerais. Federal University of Minas Gerais, Brazil.

15. Linde-Forsberg C (2002) Pelvimetry to Diagnose Dystocia in the Bitch. WSAVA 2002 Congress 1-6.

16. Oliveira AC, Bombonato PP, Baruselli SP (2001) Pelvimetry and pelvicology in crossbred buffaloes (Bubalus bubalis). Braz J Vet Res Anim Scie 38: 114-21.

17. De Vuono RS (2000) Pelvimetria e pelviologia em vacas Jersey [Pelvimetry and pelviology in Jersey cows]. Dissertação (Mestrado) – Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, São Paulo 56 f.

18. Monteiro CLB, Campos AIM, Madeira VLH, Silva HVR, Freire LMP, et al. (2013) Pelvic differences between brachycephalic and mesaticephalic cats and indirect pelvimetry assessment. Vet Record 172: 16-22.