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Certain Morphometrical Studies of the Skull bones in Indian non-descript breed of dog *(Canis lupus familiaris)*

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ABSTRACT

Present study was conducted on the certain morphometric parameters of most of the facial and cranial bones of six adult non-descript Indian dog (*Canis lupus familiaris*) without any apparent skeletal disorders. A total of twenty six morphometric measurements were done in the facial and cranial bones of skull using scale, thread and Vernier calipers. Maximum length of the nasal bone along the side was slightly greater than overall length of the nasal bones along the midline. The foramen magnum width was larger than the height. The inter-orbital width was longer than the inter-canthi distance (ICD), i.e. the orbits were located on a fronto-lateral oblique plane. The skull, cranial and foramen magnum indices were found to have a negative correlation with the weight of skull, whereas nasal and facial indices were found to have a positive correlation with the weight of skull.

Key words : Morphometrical study, Skull bones, Non-descript Indian breed, Dog

INTRODUCTION

Skulls differ more in size and shape among domestic dogs than in any other mammalian species. For this reason, craniometry in dogs takes on added significance when characterizing specific breeds and crosses (Evans and Lahunta, 1964). The appearance of the dog's head is largely determined by the shape of the skull, the position and size of the eyes, and the form and carriage of the ears (Dyce *et al*., 2010). The shape of the skull is the most important criterion in determining the standard breeds of dog (Onar, 1999; Jouve and courant., 2001). The literature on craniometric indices of the adult Indian non-descript breed of dog is scanty. The present work was carried out because of there is a lack of comprehensive data on the head region of the adult Indian non-descript breed of dog.

MATERIALS AND METHODS

Present study was conducted on the skulls available in the Department of Veterinary Anatomy, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan (India). The study included certain morphometric parameters of most of the facial and cranial bones of six adult non-descript Indian dog (*Canis lupus familiaris*) without any apparent skeletal disorders. A total of twenty six morphometric measurements were done in the facial and cranial bones of skull using scale, thread and Vernier calipers. These were adapted from Brehm *et al*. (1985); Onar *et al.* (2001); Endo *et al*. (2002); Al-Sagair and El Mougy(2002); Olopade and Onwuka (2008, 2009) and Yahaya *et al.* (2012). These morphometric parameters of the facial and cranial bones of the non-descript Indian dog´s skulls are defined below and shown in Figs. 1-4.

CRANIOMETRIC INDICES

1. Inter-orbital width (IOW): Minimum distance between the upper edges of the orbits measured across the tip of the skull; Inter-canthi distance (ICD): Minimum distance between the medial canthi of the orbits; Maximum width of the neurocranium (WNC): Distance from the most lateral point of the cranial cavity on the left to most lateral point of the cranial cavity on the right; Nasal length along the mid-line (NL1): Overall length of the nasal bones along the midline; Nasal length on the side (NL2): Maximum length of the nasal bone along the side; Maximum zygomatic width (ZGW): Maximum width across zygomatic arches (Fig. 1).
2. Nasal width (NW): Maximum width of the nasal bone; Cranial length (CL): Distance from nuchal crest to the junction of the left and right nasofrontal sutures on the median plane; Viscerocranial length (VCL): Distance from the junction of the left and right nasofrontal sutures in the median plane to the anterior end of the inter-incisive suture; Skull length (SL): Maximum length of the skull from the cranial tip of the

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incisive bones to the caudal end of the nuchal crest (Fig. 2).

3. Nasal index (NI): (ZGW x 100) / NL1.
4. Cranial index (CI): (WNC x 100) / CL..
5. Facial index (FI): (ZGW x 100) / VCL .
6. Skull height (without mandible) (SH): Length from the level of the highest point of the frontal bone to the base of the jugular process.
7. Skull index (SI): (ZGW x 100) / SL.
8. Palate length (PLL): Length from the midline of the caudal end of the palatine bone to the cranial midline of the palatine part of the maxillary bone; Hard palate length (HPLL): Distance from the midline of the caudal end of palatine bone to the rostral end of the incisive bone on the midline; Hard palate length (HPLL): Distance from the midline of the caudal end of palatine bone to the rostral end of the incisive bone on the midline (Fig. 3).
9. Foramen magnum index (FMI): (FMH x 100)/ FMW;
10. Foramen magnum height (FMH):Mid-vertical height of the foramen magnum; Foramen magnum width (FMW): Largest width of the foramen magnum;Occipital triangle height (OCTH 1): Distance from the nuchal crest to the lower brim of the foramen magnum . Occipital triangle height (without foramen magnum) (OCTH 2): Distance from the caudoventral projection of the nuchal crest to the upper rim of the foramen magnum; Intercondylar width (ICW): Width between the lateral ends of the occipital condyles; Interparacondylar width (IPCW): The greatest breath between the ventromedial ends of the jugular processes; Occipital condyle thickness (OCT): Maximum width of single occipital condyle from the most lateral extent to the foramen magnum (Fig. 4).
11. Skull weight (W): Weight of skull.

A coefficient of correlation were measured among weight of skull, nasal index, facial index, skull index, cranial index and foramen magnum index by using Microsoft excel 2010 data analysis tool (Table 2).

RESULTS

The data obtained for craniometric indices (mean ± SE) are shown in Table 1. Cranial index was less than 75. It was clearly revealed that non-descript Indian dog was dolichocephalic. Maximum length of the nasal bone along the side was slightly greater than overall length of the nasal bones along the midline, i.e. the nasal bones were longer at their sides than middle.The foramen magnum width was larger than the height. The inter-orbital width was longer than the inter-canthi distance (ICD), i.e. the orbits were located on a fronto-lateral oblique plane. Palate width at molar 2 was lesser than Palate width at molar 1, i.e. maxillary bone is wider in front narrower behind.

The skull, cranial and foramen magnum indices were found to have a negative correlation with the weight of skull, whereas nasal and facial indices were found to have a positive correlation with the weight of skull. Facial, skull, cranial and foramen magnum indices had positive correlation with the nasal index. Skull and foramen magnum indices were found to have positive correlation with the facial index, whereas cranial index had weak negative correlation with the facial index. Cranial and foramen magnum indices had positive correlation with the skull index. The cranial index had positive correlation with the foramen magnum index (Table 2).

DISCUSSION

It is one of the most comprehensive studies comprised of twenty six parameters in non-descript Indian dogs. The results were interpreted in mean.

Monfared (2013) reported the skull length and cranial length of the adult Iranian mixed-breed dogs were 17.6 cm and 11.2 cm respectively. Onar *et al*. (2001) investigated skull length and cranial length in adult male Kangal dogs were 25.873 cm and 14.112 cm respectively. In present study these were 21.833 cm and 12.117 cm respectively. In current work, the cranial index was 70.667, whereas it was 66.37 in the adult Iranian mixed-breed dogs (Monfared, 2013). It was clearly revealed that both non-descript Indian dogs and Iranian mixed-breed dogs were dolichocephalic (Cranial index was less than 75).

Onar *et al*. (2001) investigated viscerocranial length and maximum zygomatic width in adult male Kangal dogs were 13.088 cm and 13.003 cm respectively. In present study these were 10.517 cm and 11.150 cm respectively. A skull index of 50.29, a facial index of 99.62 was obtained by Onar *et al*. (2001) in adult male Kangal dogs. These parameters were 51.533 and 106.268 respectively in present study.

Maximum width of the neurocranium and skull height in adult male Kangal dogs were 6.515 cm and 7.667 cm respectively (Onar *et al.*, 2001), whereas in present work these were 8.567 cm and 9.633 cm respectively. Present investigation revealed palate length and hard palate length of 7.283 cm and 9.750 cm respectively, whereas in adult male Kangal dogs these parameters were 12.227 cm and 12.446 cm respectively (Onar *et al.*, 2001).

Nasal length along the mid-line and nasal length on the side were 7.017 cm and 7.767 cm respectively in present study, whereas

in adult male Kangal dogs greatest length of the nasals was 9.793 cm (Onar *et al.*, 2001). In present work occipital triangle height and occipital triangle height (without foramen magnum) were 4.983 cm and 3.483 cm respectively, whereas in adult male Kangal dogs the occipital triangle height was 6.053 cm (Onar *et al*., 2001).

Intercondylar width and Interparacondylar width in present study were 3.867 cm and 4.533 cm respectively. These parameters were 4.766 cm and 6.760 cm respectively as reported by *Onar et al.* (2001) in adult male Kangal dogs. Inter-canthi distance and Inter-orbital width in present report were 4.483 cm and 6.083 cm respectively, similarly in adult male Kangal dogs these were 5.199 cm and 4.614 cm respectively (Onar *et al.*, 2001).

Karimi *et al*. (2011) reported the foramen magnum height and foramen magnum width to be 1.92 cm and 1.97 cm in adult Mehraban Iranian sheep, whereas in present study these were 1.650 cm and 1.800 cm respectively. Nasal width in present study was 1.817 cm, whereas in adult Mehraban Iranian sheep was 2.88 cm (Karimi *et al*.,2011).

Özcan *et al*. (2010) reported nasal index in Tuj and Morkaraman Sheep were 37.91 and 37.43 respectively. In present deliberation it was much greater (159.763). Simoens *et al*.,(1994) studied foramen magnum index and occipital condyle thickness in the adult Pekingese dogs were 91.8 and 1.33 cm respectively. In present work these were 92.583 and 1.550 cm respectively.

A skull weight of 61.17 g was recorded in a group of German shepherd dogs between 61 and 105 days old (Onar,1999). In present study it was 156.658 g. It was much greater due to age. Onar (1999) recorded the coefficient of correlation in the skull of German shepherd dogsbetween 45 and 105 days age. According to him skull weight showed a negative correlation with all indices except the skull measurements, whereas in present study the skull, cranial and foramen magnum indices were found to have a negative correlation with the weight of skull, whereas nasal and facial indices were found to have a positive correlation with the weight of skull.

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Table: 1Morphological Parameters (Mean±S.E.) of Cranial and Facial bones in adult Indian nondescript dog.

S.No	Morphometrical Parameters	Mean±SE
1.	IOW	6.083±0.172
2.	ICD	4.483±0.237
3.	WNC	8.567±0.414
4.	NL1	7.017±0.239
5.	NL2	7.767±0.304
6.	NW	1.817±0.065
7.	ZGW	11.150±0.092
8.	NI	159.763±5.183
9.	CL	12.117±0.508
10.	CI	70.667±1.220
11.	VCL	10.517±0.264
12.	FI	106.268±2.089
13.	SL	21.833±1.038
14.	SH	9.633±0.430
15.	SI	51.533±1.994
16.	FMH	1.650±0.062
17.	FMW	1.800±0.113
18.	FMI	92.583±3.510
19.	OCTH1	4.983±0.197
20.	OCTH2	3.483±0.194
21.	ICW	3.867±0.150
22.	IPCW	4.533±0.198
23.	OCT	1.550±0.076
24.	PLL	7.283±0.275
25.	HPLL	9.750±0.411
26.	W(g)	156.658±8.089

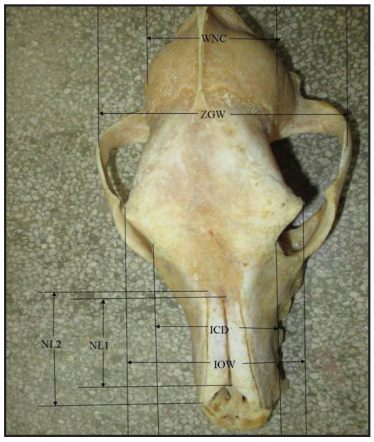

Fig.1 & Fig 2 : Photograph of adult non-descript Indian dog (dorsal view) showing maximum zygomatic width (ZGW), maximum width of the neuro cranium (WNC), inter orbital width (IOW), nasal length along the midline (NL1), nasal length along the side (NL2) and inter-canthi distance (ICD). viscero cranial length (VCL), nasal width (NW), cranial length (CL) and skull length (SL).

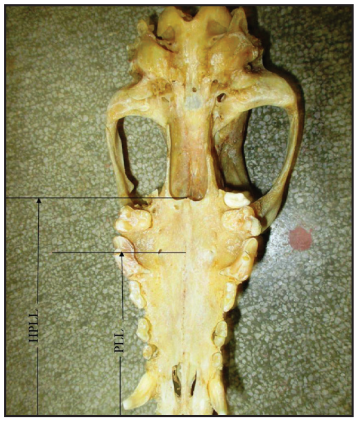

Fig.3 Photograph of adult non-descript Indian dog (ventral view) showing palate length (PLL) and hard palate length (HPLL).

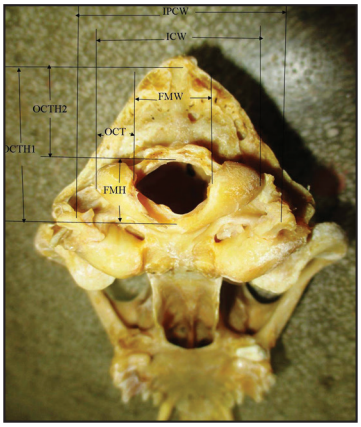

Fig.4 Photograph of adult non-descript Indian dog (Caudal view) showing foramen magnum height (FMH), foramen magnum width (FMW), occipital triangle height (OCTH 1), occipital triangle height (without foramen magnum) (OCTH2), occipital condyle thickness (OCT), intercondylar width (ICW) and interparacondylar width (IPCW).

Table: 2 Correlation Coefficient among weight of skull, nasal index, facial index, skull index, cranial index and foramen magnum index in adult Indian nondescript dog.

	W	*NI*	*FI*	*SI*	*CI*	*FMI*
W	1					
NI	0.050	1				
FI	0.304	0.691	1			
SI	-0.055	0.276	0.712	1		
CI	-0.729	0.226	-0.021	0.231	1	
FMI	-0.747	0.400	0.198	0.554	0.697	1