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SHORT COMMUNICATION

Gross Morphometric and Radiographic Studies on the Metacarpals of Indian Blackbuck (*Antilope cervicapra*)

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ABSTARCT

The metacarpus of Indian Blackbuck comprised of two metacarpal bones. The large metacarpal bone consisted of fused III and IV metacarpals. The shaft of the metacarpus presented two surfaces and two borders. The dorsal surface was smooth and semi-cylindrical in outline. The palmar surface was flat in outline and it presented a deep longitudinal groove which possessed similar foramina. These foramina communicated with the similar foramina on the palmar surface through transverse canals. The proximal extremity presented two slightly concave facets, separated by a median ridge in front and a shallow groove behind. The distal extremity was divided by a dorso-palmar cleft into two condyles. The small metacarpals (splint bones) were cord like bones inblackbuck. The metacarpal II was present on palmo-medial aspect and metacarpal V was present on palmo-lateral aspect of the large metacarpal.

Keywords: metacarpal, blackbuck, splint bones, morphometrical.

The Indian blackbuck (*Antilope cervicapra*) is an ungulate species of antelope native to the Indian subcontinent that has been classified as near threatened by IUCN since 2003, as its range has decreased sharply during the 20th century. The blackbuck is protected under Schedule "I" of the Indian Wildlife Protection Act, 1972 (Choudhary and Singh, 2015). The aim of this study is to investigate the metacarpals of Indian blackbuck, thereby making a contribution in filling the gap of knowledge in this field. As per knowledge, in many vetero-legal cases, one fails to identify the bones of this animal and confuse them with those of some other small ruminants. This investigation will be helpful to the field veterinarians as well as zoo veterinarians.

MATERIALS AND METHODS

The present study was conducted on the metacarpal boneof six adult Indian blackbuck of either sex. The permission for the specimen collection was sought from the Deputy Inspector General (WL), Ministry of Environment and Forests (MoEF), New Delhi, India and Principal Chief Conservator of Forest (PCCF), Government of Rajasthan. The skeletons were collected from the Jodhpur zoo after official approvals from the Principal Chief Conservator of Forest (PCCF) vide letter no. F, 3 (02) Tech-II/CCF/2010/714 dated 07.05.2014. The skeletons were dug out from the graveyard located in the premises of the office of Deputy Conservator of Forest (WL), Jodhpur. Subsequently, the specimens were put into hot water for maceration in a large aluminum bowl. A net was wrapped around each forelimb and hind limb for better retrieval of small bones. The bones were washed with bleaching powder to get rid of the offensive odour and were sun-dried afterwards for two to three days. After recovery of all the desired bones, these were kept in separate boxes. The gross study was carried out in the Department of Veterinary Anatomy, College of Veterinary and Animal Sciences, G.B. Pant University of Agriculture and Technology, Pantnagar. Different parameters of the metacarpal[Greatest length (Lg), Maximum breadth of proximal extremity (Bp), Maximum breadth of medial

Fig. 1: Dorsal view of the metacarpus showing proximal extremity of large metacarpal (a), shaft of metacarpal (b), dorsal groove (c), distal foramen (d), lateral condyle (e), medial condyle (f).

Fig. 2: Palmar view of the metacarpus showing proximal extremity (a), proximal foramen (b), shaft (c), distal foramen (d), lateral condyle (e), medial condyle (f)

Fig. 3: Radiograph of metacarpal of blackbuck showing medial facet (1), lateral facet (2), shaft of metatarsal bone (3), abaxial articular area (4), axial articular area (5), dorso-palmar ridge (6), dorso palmar groove.

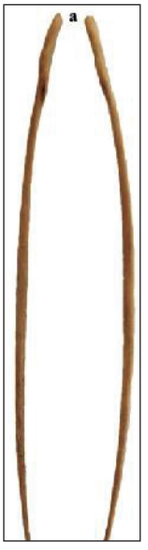

Fig. 4: Small metatarsals (splint bones) showing proximal extremity for articulation with large metacarpal (a), distal pointed end (b).

condyle (Bmc), Maximum breadth of lateral condyle (Blc), Maximum breadth of shaft (Bs) and greatest length of the small metacarpals (Lg)] were measured and subjected to routine statistical analysis (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

In the present study the metacarpus of blackbuck comprised of three metacarpal bones (Fig. 1, 2 and 3). The large metacarpal bone consisted of fused III and IV metacarpals (Fig. 4) as revealed by Raghavan (1964) in ox, Getty (1975) in sheep, Akers and Denbow (2008) in ruminants, Jangir *et al.*(2012) in chinkara and Choudhary *et al.* (2014) in chital. The fusion of III and IV metacarpals was confirmed by the radiographs. The septum of the fusion became partially absorbed in metacarpus.

The shaft presented two surfaces and two borders. The dorsal surface was smooth and semi-cylindrical in outline as observed by Raghavan (1964) in ox, Getty (1975) in horse and Choudhary *et al.* (2014) in chital. This dorsal surface presented a shallow dorsal longitudinal groove. It lodged a proximal end a distal foramen as reported by Raghavan (1964) in ox, Budras and Robert (2003) in bovine and Jangir *et al.* (2012) in chinkara. The palmar surface was flat in outline and it presented a deep longitudinal groove which possessed similar foramina. These foramina communicated with the similar foramina on the palmar surface through transverse canals as elucidated by Raghavan (1964) in ox and Budras and Robert (2003) in bovine.

The proximal extremity presented two slightly concave facets, separated by a median ridge in front and a shallow groove behind in blackbuck as described by Raghavan (1964) in ox, Jangir *et al.* (2012) in chinkara and Choudhary *et al.* (2014) in chital. The medial facet was larger than the lateral one. These facets articulated with fused second and third and fourth carpals, respectively in blackbuck, unlike horse (Getty, 1975) and dromedary (Smuts and Bezuidenhout, 1987), where this surface articulated with second, third and fourth carpals. Just below this articular surface on the medial and lateral side, were two small facets for articulation with small metacarpal bone (II

Table 1: The measurements of the large metacarpal of Indian blackbuck in cm.

Specimen no.	Description		Greatest length (Lg)	Maximum breadth of proximal extremity (Bp)	Maximum breadth of distal extremity (Bd)	Maximum breadth of shaft (Bs)	Maximum breadth of medial condyle (Bmc)	Maximum breadth of lateral condyle (Blc)
1	Female-1	Left	17.62	2.27	2.16	1.35	1.01	0.95
		Right	17.63	2.28	2.17	1.36	1.02	0.96
2	Female-2	Left	17.64	2.28	2.15	1.37	1.01	0.94
		Right	17.67	2.27	2.16	1.35	1.01	0.93
3	Female-3	Left	17.68	2.30	2.15	1.36	1.02	0.92
		Right	17.70	2.28	2.14	1.37	1.01	0.94
4	Male-1	Left	17.78	2.33	2.18	1.39	1.00	0.99
		Right	17.77	2.34	2.23	1.38	1.02	0.97
5	Male-2	Left	17.78	2.32	2.20	1.41	1.03	0.98
		Right	17.76	2.33	2.21	1.40	1.04	0.99
6	Male-3	Left	17.75	2.35	2.23	1.42	1.02	0.97
		Right	17.77	2.34	2.21	1.42	1.03	0.98
	Range		17.62-17.78	2.27-2.35	2.14-2.23	1.35-1.42	1.00-1.04	0.92-0.99
	Mean		17.71	2.30	2.18	1.38	1.01	0.96
	SD		0.06	0.03	0.03	0.02	0.01	0.02
	SE		0.01	0.009	0.009	0.007	0.003	0.007
FemaleMean± SE			17.65 ± 0.00	2.28 ± 0.00	2.15 ± 0.00	1.36 ± 0.00	1.01 ± 0.00	0.94 ± 0.00
Male Mean± SE			17.76 ± 0.00	2.33 ± 0.00	2.21 ± 0.00	1.40 ± 0.00	1.02 ± 0.00	0.98 ± 0.00

and V) in blackbuckas reported in chinkara (Jangir *et al.* 2012). There was an eminence, the metacarpal tuberosity at the dorso-medial aspect, which was small as reported by Raghavan (1964) in ox and (Getty 1975) in horse.

The distal extremity was divided by a dorso-palmar cleft into two condyles in blackbuck as reported by Raghavan (1964) in ox, Budras and Robert (2003) in bovine, Jangir *et al.* (2012) in chinkara and Choudhary *et al.* (2014) in chital. In contrast, it was undivided in horse (Getty, 1975); however, in dromedary the divided condyles were not straight, but angulated (Smuts and Bezuidenhout, 1987). A dorso-palmar ridge divided each condyle into two articular areas. The abaxial articular area was higher than the axial one as noted by Raghavan (1964) in ox.

The average length of the large metacarpal of blackbuck was 17.71±0.01 cm. The average maximum breadth of proximal extremity, shaft and distal extremity was 2.30±0.009 cm, 1.38±0.007 cm and 2.18±0.009 cm, respectively. The average maximum breadth of medial and lateral condyle was 1.01±0.003 cm and 0.06±0.007 cm, respectively (Table 1). However the average greatest length of the large metacarpal was 16.80±0.02 cm. The average maximum Breadth of proximal extremity, shaft and distal extremity was 3.23±0.01 cm, 1.90±0.01 cm and 2.89±0.02 cm, respectively. The average maximum breadth of medial and lateral condyle was 1.35±0.04 cm and 1.33±0.04 cm in chital (Choudhary *et al.* 2014).

Two small metacarpals (Fig. 4), metacarpal II and V were also present in blackbuckas described by Getty (1975), Frandson *et al.* (2009) in horse and Jangir *et al.* (2012) in chinkara. However, five metacarpals were present in dog (Miller *et al.* 1964), in the African elephant (Smuts and Bezuidenhout, 1993) and in hedgehogs (Ozkan, 2004); four metacarpals were present in pig (Akers and Denbow, 2008; Frandson *et al.* 2009). The splint bones were not reported in Black Bengal goat (Siddiqui *et al.* 2008), in ox (Raghavan, 1964) and sheep (Getty, 1975), splint bones

Table 2: The measurements of the small metacarpals of Indian blackbuck in cm

Specimen no.	Description		Greatest length of Metacarpal II (Lgm)	Greatest length of Metacarpal V (Lgm)
1	Female-1	Left	10.83	10.84
		Right	10.81	10.82
2	Female-2	Left	10.83	10.83
		Right	10.82	10.81
3	Female-3	Left	10.80	10.84
		Right	10.79	10.83
4	Male-1	Left	10.80	10.84
		Right	10.79	10.82
5	Male-2	Left	10.85	10.83
		Right	10.84	10.81
6	Male-3	Left	10.84	10.84
		Right	10.81	10.82
	Range		10.79-10.85	10.81-10.84
	Mean		10.81	10.82
	SD		0.02	0.01
	SE		0.006	0.003
	FemaleMean± SE		10.81 ± 0.00	10.82 ± 0.00
	Male Mean± SE		10.82 ± 0.00	10.82 ± 0.00

were missing. The small metacarpals were cord like bones inblackbuck, which reached the distal third of the large metacarpal. The lateral one (Mc. V) was slightly larger than the medial one (Mc. II) as described by in horse (Getty, 1975) and in chinkara (Jangir *et al.* 2012).

The metacarpal II was present on palmo-medial aspect and metacarpal V was present on palmo-lateral aspect of the large metacarpal as revealed by Getty (1975) in horse and Jangir *et al.* (2012) in chinkara. The shaft presented two variably curved surfaces as reported by Jangir *et al.* (2012) in chinkara; on the contrary there were three surfaces in horse (Getty, 1975). The dorsal surface was rough and articular, while the palmar surface was smooth and non-articular.

The proximal extremity was comparatively more curved in metacarpal V than in metacarpal II. It possessed a curved articular facet for articulation with the corresponding facet on the large metacarpal as described by Getty (1975) in horse and Jangir *et al.* (2012) in chinkara. It was comparatively more curved in metacarpal II than the metacarpal V. The distal extremity was pointed like needle as reported by Jangir *et al.* (2012) in chinkara, while it was nodular in horse (Getty 1975). The length of metacarpal II and V was 10.81±0.006 cm and 10.82±0.003 cm, respectively (Table 2); while the length of metacarpal (Mc. II) in chital was 2.44±0.00 cm (Choudhary *et al.* 2014).

CONCLUSION

The metacarpus comprised of two metacarpal bones in blackbuck. The large metacarpal bone consisted of fused III and IV metacarpal as also reported in ox, sheep, goat and chinkara. The shaft of the metacarpus presented two surfaces and two borders. Two small metacarpal bones were also present as noted in horse and chinkara but dissimilar to ox, sheep and goat where only one small metacarpal (Mc. II) was present. The metacarpal II was present on palmo-medial aspect and metacarpal V was present on palmo-lateral aspect of the large metacarpal as also reported in horse and chinkara. However, five metacarpals were present in dog and elephant.

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