Original Research

Morphometrical Studies on Humerus of Blue Bull (*Boselaphus tragocamelus*)

Kavita Rohlan[1], Rakesh Mathur[2], Ashok Dangi[3], Nikhil Shringi[4], Subha Ganguly[5]* and Vikas Kumar[1]

[1]Assistant Professor, Department of Veterinary Anatomy and Histology, Arawali Veterinary College, N.H. – 52 Jaipur Road, V.P.O. Bajor, Sikar – 332001, Rajasthan, INDIA
[2]Professor (Retd.); [3]Assistant Professor; [4]Teaching Associate VUTRC, Department of Veterinary Anatomy and Histology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner - 334001, Rajasthan, INDIA
[5]Associate Professor, Department of Veterinary Microbiology, Arawali Veterinary College, N.H. – 52 Jaipur Road, V.P.O. Bajor, Sikar – 332001, Rajasthan, INDIA

***Corresponding author:** ganguly38@gmail.com

Rec. Date:	Aug 29, 2017 06:00
Accept Date:	Jan 18, 2018 01:45
DOI	10.5455/ijlr.20170829060005

Abstract

The present study was carried out on the humerus of six Blue bulls. The shaft of the humerus was slightly twisted, cylindrical and presented four surfaces. The lateral surface presented a nutrient foramen in its distal third. It bore a small teres tubercle placed at the proximal third. The musculo-spiral groove was shallow. The deltoid tuberosity was found as a small rough convexity and was less prominent. In the proximal extremity, head was roughly rounded and faced caudo-dorsally. The neck was well-defined and was distinct only caudally and laterally. The lateral tuberosity was large and curved over the inter-tubercular groove. It consisted of a prominent cranial part and a less well defined small caudal part, which was triangular in outline. The minor tubercle was much smaller and did not divide noticeably. The inter-tubercular groove was present between the tubercles. The distal extremity had two condyles, two epicondyles and two fossae. The coronoid and olecranon fossae communicated by a small supra-trochlear foramen in some specimens.

Key words: Blue Bulls, Condyle, Coronoid Fossa, Humerus, Musculo-Spiral Groove, Supra-Trochlear Foramen

How to cite: Rohlan, K., Mathur, R., Dangi, A., Shringi, N., Ganguly, S., & Kumar, V. (2018). Morphometrical Studies on Humerus of Blue Bull (Boselaphus tragocamelus). International Journal of Livestock Research, 8(6), 177-184. doi: 10.5455/ijlr.20170829060005

Introduction

The Blue bull or *Nilgai* (*Boselaphus tragocamelus*) is the largest Asian antelope. Blue bull is a Schedule – III animal of the Wildlife Protection Act (1972), India and is in the "Least concern" category as per the IUCN Red Data List assessed by Mallon (2008). Blue bull can survive without water for several days, but they live close to waterholes. The deserts earlier limited their range, but the extension of irrigation canals and proliferation of tube-wells in the Thar desert have helped them

colonize the desert districts of Jodhpur, Barmer, Jaisalmer, Bikaner and Ganganagar. The Musculoskeletal system of Blue Bull has wide range of functional spectrum like fast running, leaping, digging and shoveling. The knowledge of osteo-morphology of bones of Blue bull is of great importance from vetero-legal point of view.

Material and Methods

In this study six specimens of adult Blue bull (*Boselaphus tragocamelus*) were used which were studied at Bikaner zoo. The skeletons were dug out from the graveyard located in the premises of the office of Deputy Conservator of Forest (WL), Bikaner. Afterwards, the specimens were put into hot water (Hot water Maceration Technique) for maceration in a large aluminum bowl. The bones were washed with bleaching powder to remove the offensive smell and were sun-dried afterwards for two to three days. Following measurements were taken for the humerus (Fig. 3 and 4) of the forelimb-

Fig. 3 & 4: Measurements of Humerus.

(Lg: Greatest Length; Bp: Maximum Breadth of Proximal Extremity; Bd: Maximum Breadth of Distal Extremity; Bs: Maximum Breadth of Shaft; Bh: Maximum Breadth of Head)

All the measurements were taken at the maximum levels. The arithmetic mean, standard deviation (S.D.) and standard error (S.E.) were calculated using statistical methods described by Snedecor and Cochran (1994).

DOI 10.5455/ijlr.20170829060005

Results and Discussion

Humerus was a long, twisted (Fig. 1), strong bone. This is in accordance with the findings of sheep and goat (Getty, 1975), Raghavan (1964) in ox, Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital, and Choudhary and Singh (2016) in Blackbuck; whereas dissimilar to the findings of whereas it was dissimilar to the findings in camel in which it was almost straight (Smuts and Bezuidenhout, 1987).

Fig.1: Cranial view of Right Humerus- 1.Lateral tuberosity; 2. Biccipital groove; 3. Medial tuberosity; 4.Deltoid tuberosity; 5. Anterior surface; 6. Radial /Coronoid fossa; 7. Medial condyle; 8. Lateral condyle

DOI 10.5455/ijlr.20170829060005

The lateral surface of the shaft was spiral, smooth, and presented a deep musculo-spiral groove (Fig. 1), which is in accordance with the findings of Bradley (1896) in ruminant, Sisson (1911) in ox, Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016) in Blackbuck. It was in contrast to the findings of Getty (1975) in horse where it was very prominent. The lateral surface presented a nutrient foramen in its distal third which is similar to the observations of Siddiqui *et al.* (2008) in black Bengal goat. Getty (1975) reported it to be present on the lower third of the medial surface. Chauveau (1905) and Smuts and Bezuidenhout (1987) reported it to be present on cranial surface in the horse. These findings are dissimilar to the findings of Bradley (1896) in ruminants, Sisson (1911) and Raghavan (1964) in ox, Miller *et al.* (1964) in dog, Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016) in Blackbuck where nutrient foramen was reported to be located on the distal third of caudal surface.

The prominent deltoid tuberosity was found as a small rough convexity similar to the observations of Getty (1975) in sheep, Sisson (1911) Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016) in Blackbuck. In contrast, it was a prominent in dog (Miller *et al.*, 1964) and in horse (Getty, 1975). The medial surface was almost straight in outline. It had a small teres tubercle placed at the proximal third similar to the observations of Raghavan (1964) in ox, Getty (1975) in horse, Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016) in Blackbuck. The cranial surface was roughly triangular, being wide above and narrow below. Caudal surface was concave in outline which was in agreement with the findings of Bradley (1896) in ruminants, Sisson (1911) and Raghavan (1964) in ox, Miller *et al.* (1964) in dog and Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016) in Blackbuck.

The head was roughly rounded (Fig. 2) more or less similar to ox (Raghavan, 1964) and horse (Getty, 1975), in Chinkar (Jangir, 2010), in Chital (Choudhary *et al.*, 2013) and in Blackbuck (Choudhary and Singh, 2016); while it was oval in dog (Miller *et al.*, 1964). The neck was well-defined and distinct only caudally and laterally, which is similar to the findings of Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016) in Blackbuck. On the contrary it was ill-defined as reported by Raghavan (1964) in ox.

DOI 10.5455/ijlr.20170829060005

Fig. 2: Caudal view of Right Humerus- 1.Posterior part of lateral tuberosity 2.Head 3.Deltoid tuberosity 4.Posterior surface 5.Olecranon fossa 6.Lateral epicondyle 7.Media epicondyle

The lateral tuberosity was large (Fig. 1), in Blue bull, which is in accordance with the findings of Sisson (1911) and Raghavan (1964) in ox, Miller (1964) in dog, Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016) in Blackbuck. During this study, the lateral tuberosity curved over the bicipital groove and consisted of a prominent cranial part and a less well defined small caudal part. The medial tuberosity was comparatively much smaller and did not divide noticeably, which is in consonance with the findings of Raghavan (1964) in ox, Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016b) in Blackbuck. The inter-tubercular or bicipital groove was present between both the tubercles. Bicipital groove did not divide in the present study in Blue bull which is similar to findings of Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016b) in Blackbuck. On the

DOI 10.5455/ijlr.20170829060005

contrary, it is sub-divided by an intermediate ridge in horse (Getty, 1975) and by an intermediate tuberosity in dromedary camel (Smuts and Bezuidenhout, 1987). The area for the insertion of the infra-spinous muscle was small, which is in consonance with the findings of Smuts and Bezuidenhout (1987) in dromedary.

In the present study, distal extremity consisted of two condyles, two epicondyles and two fossae. Medial condyle was larger as compared to the lateral one, similar to most of the animals reviewed. The medial epicondyle was larger than the lateral one, which is inconsistent with the findings of Smuts and Bezuidenhout (1987) in dromedary, Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016) in Black buck where the medial epicondyle was more massive than lateral one. The lateral epicondylar crest was prominent similar to the findings of Smuts and Bezuidenhout (1987) in dromedary, Jangir (2010), Choudhary *et al.* (2013) in Chital and Choudhary and Singh (2016) in Blackbuck. Coronoid or radial fossa was shallow and wide (Fig. 1), whereas the olecranon fossa was deep and narrow (Fig. 2), which confirmed the observations made by Jangir (2010) in Chinkara, Choudhary *et al.* (2013) in Chital, Choudhary and Singh (2016) in Blackbuck. Supra-trochlear foramen as reported by Miller *et al.* (1964) in dog, However, Owen (1866) reported that the olecranon fossa is perforated in Musk-deer, Konig and Liebich (2006) and Kalita and Bhattacharyya (2008) noted a supracondylar foramen immediately above the medial condyle in cat.

The average greatest length of the humerus was 26.394 ±0.61cm (Table 1). The average maximum breadth of proximal extremity, shaft and distal extremity were 8.64±0.06 cm 6.07 ±0.21cm and 5.94±0.22 cm respectively.

Table 1: Different measurements of humerus

Specimen no.	Description		Maximum length (Lg)	Maximum breadth of proximal extremity(Bp)	Maximum breadth of distal extremity(Bd)	Maximum breadth of shaft(Bs)	Maximum breadth of head (Bh)
1	Female -1	Left	24.55	8.4	5.1	5.45	5.45
		Right	24.5	8.45	5.15	5.4	5.4
2	Female -2	Left	24.25	8.65	5.25	5.3	5.35
		Right	24.3	8.4	5.3	5.35	5.45
3	Female -3	Left	24.35	8.45	5.45	5.35	5.5
		Right	24.4	8.5	5.4	5.45	5.6
4	Male -1	Left	28.28	8.55	5.53	6.3	5.65
		Right	28.3	8.75	6.75	6.75	7.8
5	Male -2	Left	28.35	8.8	6.8	6.8	7.85
		Right	28.4	8.9	6.81	6.85	7.83
6	Male -3	Left	28.5	8.95	6.84	6.88	7.88
		Right	28.55	8.9	6.87	6.9	7.86
Mean			**26.39**	**8.64**	**5.94**	**6.07**	**6.47**
S.D.			**2.09**	**0.2**	**0.78**	**0.72**	**1.22**
S.E.			**0.61**	**0.06**	**0.22**	**0.21**	**0.35**

DOI 10.5455/ijlr.20170829060005

The maximum breadth of head was 6.47±0.35 cm while according to Choudhary *et al.* (2013) the average greatest length of the humerus of Chital was 19.86± 0.04 cm. The average maximum breadth of proximal extremity, shaft and distal extremity were 5.39± 0.02 cm, 3.48± 0.03 cm and 3.65± 0.03 cm, respectively. The maximum breadth of head was 3.79± 0.03 cm and according to Choudhary and Singh (2016) the average length of the humerus of blackbuck was 13.87±0.019 cm. The average breadth of proximal extremity, shaft and distal extremity were 4.89±0.01 cm, 1.95±0.005 cm and 2.82±0.005 cm, respectively. The breadth of the head was 2.87±0.005cm.

Conclusion

The results of the present study on gross morphological and morphometrical parameters were very useful for forensic investigation of wild animals. In humerus the musculo-spiral groove was deep. The deltoid tuberosity was prominent. The head was roughly rounded and the neck was well defined. The lateral tuberosity was large and curved over the bicipital groove. The medial tuberosity was undivided. There was no communication between the coronoid and olecranon fossae.

Acknowledgements

The authors convey their sincere thanks to the Ministry of Forest, Govt. of Rajasthan, Deputy Conservator of Forest (WL), Bikaner, Additional Principal Chief Conservator of Forest (APCCF), Jaipur (Rajasthan) and Deputy Forest Protection Plan, Jaipur who backed the investigators during the course of the approval.

References

1. Bradley, O.C. (1896). *Outlines of Veterinary Anatomy, Part I- The Anterior and Posterior Limb*. William R. Jenkins, Veterinary Publisher and Bookseller, NY, pp. 83-86.
2. Chauveau, A. (1905). 2nd English ed. (Translated and ed. Fleming, G.). *The Comparative Anatomy of the Domesticated Animals*, NY D. Appleton and Company, pp. 98-119.
3. Choudhary, O.P. and Singh, I. (2016). Morphometrical studies on humerus of Indian black buck (*Antilope cervicapra*). *Journal of Wildlife Research*, 4(1): 06-09.
4. Choudhary, O.P., Mathur, R., Joshi, S. and Yadav, S.C. (2013). Gross and biometrical studies on humerus and radius ulna of chital (*Axis axis*). *Indian Journal of Veterinary Anatomy*, 25(1): 23-24.
5. Getty, R. (1975). *Sisson and Grossman's The Anatomy of the Domestic Animals*, W.B. Saunders Comp. Philadelphia. pp. 273-96.
6. Jangir, D.K. (2010). Thesis entitled "Gross studies on the bones of the forelimb in Indian Gazelle (*Gazella gazella bennettii*)". *College of Veterinary and Animal Sciences, RAJUVAS, Bikaner*, pp. 78-91.
7. Kalita, A. and Bhattacharyya, R. (2008). Comparative Anatomy on the Appendicular Skeleton of the Domestic Cat and Local Dog of Mizoram, Souvenir and Abstract, Silver Jubilee National Symposium on *Advancement in Veterinary Anatomy Teaching & Research with Special Reference to Their Clinical Application* and XII Annual Convention of Indian Association of Veterinary Anatomists, pp. 8.
8. Konig, H.E. and Liebich, H.G. (2006). *Veterinary Anatomy of Domestic Animals*, 3rd ed., Schattauer, Stuttgart Germany, pp: 49-104, 145-64.
9. Mallon, D.P. *Boselaphus tragocamelus* (2008). IUCN red list of Threatened species version 2013. *International Union for Conservation of Nature*.

 DOI 10.5455/ijlr.20170829060005

10. Miller, M.E., Christensen, G.C. and Evans, H.E. (1964). *Anatomy of the Dog*, WB Saunders Company, Philadelphia, USA, pp. 64-78.
11. Owen, R. (1866). On the Anatomy of Vertebrates. *Part II: Birds and mammals*, London Longmans, Green, and Company, pp. 482-4.
12. Raghavan, D. (1964). Anatomy of ox. *Indian Council of Agricultural Research, New Delhi*, pp. 97-117
13. Siddiqui, M.S.I., Khan, M.Z.I., Sarma, M., Islam, M.N. and Jahan, M.R. (2008). Macro-anatomy of the bones of the limb of Black Bengal Goat (*Capra hircus*). *Bangladesh J. Vet. Med*., 6(1): 59–66.
14. Sisson, S. (1911). *A Text Book of Veterinary Anatomy*, W.B. Saunders Company, Philadelphia and London, pp: 127-31
15. Smuts, M. and Bezuidenhout, A.J. (1987). *Anatomy of the Dromedary*, Clarendon Press, Oxford, UK, pp: 24-34.
16. Snedecor, G.W. and Cochran, W.G. (1994). *Statistical Methods*, 8th ed. lowa State University Press, Ames, lowa, USA.

DOI 10.5455/ijlr.20170829060005