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## Gross anatomical study on radius-ulna bone of blue bull (*Boselaphus tragocamelus*)

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### Abstract

Radius was relatively shorter and broader as compare to ulna. Radius was fused to the ulna in the entire length except for two inter-osseous spaces, namely, proximal inter-osseous and distal inter-osseous spaces. Ulna was the longest bone of the fore-limb and was strongly curved. The Proximal extremity of radius was irregularly oval in outline with its long axis being medio-lateral in direction and the Distal extremity was thicker and larger than the proximal one. The proximal extremity of ulna comprised of olecranon process and semi-lunar notch. The olecranon process was directed dorso-caudally and had a well-developed summit, the tuber olecrani.

**Keywords:** Blue bull, radius, ulna, olecranon process

### Introduction

The Blue bull or Nilgai (*Boselaphus tragocamelus*) is the largest Asian antelope which is commonly inhabit in north Indian plains from the base of the Himalayas in the north, Karnataka, Gir forest, entire eastern length of Pakistan and across the border of Rajasthan in the West to the states of Assam and West Bengal in the East. Blue Bull is a Schedule – III animal, the Wildlife Protection Act (1972), India and is in the “Least concern” category as per the IUCN Red Data List assessed by Mallon (2008).

### Material and Methods

In this study, six specimens of adult Blue bull (*Boselaphus tragocamelus*) were used which were studied at Bikaner zoo. Out of them three were of male and rest three of female. The sex was confirmed by the history taken from the persons engaged in burying the dead animals in the zoo premises. These osteological specimens were studied to record their gross anatomical and morphological features.

### Result and Discussion

#### Radius and ulna

In the present study, the radius and ulna were fused through the entire length except for two inter-osseous spaces, (Fig.1&2) namely, proximal and distal inter-osseous spaces similar to the observation of Owen (1866) <sup>[13]</sup> in Moschida, most Antelopes, sheep, Elk, Rein-deer, Fallow-deer; Sisson (1911) <sup>[18]</sup> and Raghavan (1964) <sup>[16]</sup> in ox, Bradley (1896) <sup>[2]</sup> in ruminants, Getty (1975) <sup>[6]</sup> in sheep, Siddiqui *et al.* (2008) <sup>[17]</sup> in Black Bengal goat and France (2009) in Antelope, Jangir (2010) in Chinkara, Nazak *et al.* (2010) in Lion and Choudhary *et al.* (2013) <sup>[5]</sup> in Chital, These findings were inconsistent with the findings of Getty (1975) <sup>[6]</sup> and Frandson *et al.* (2009) in horse where the ulna was fused at the proximal third of the radius and presented only proximal inter-osseous space and Miller *et al.* (1964) <sup>[11]</sup> in dog studied that two bones were attached to each other only at their ends, whereas radius and ulna were separate bones as observed by Podhade *et al.* (2015) <sup>[15]</sup> in leopard and Sundaram *et al.* (2015) in orange rumped agouti.

The radius in the present study was a long bone, (Fig.1&2) relatively shorter and broader as compared to ulna similar to the findings of Owen (1866) <sup>[13]</sup> in true ruminants, Sisson (1911) <sup>[18]</sup> and Raghavan (1964) <sup>[16]</sup> in ox, Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in Chital. These findings are inconsistent with the observation of Kalita and Bhattacharya (2008) <sup>[8]</sup> in cat where radius and ulna were of almost equal thickness.

The shaft (Fig.1&2) was compressed cranio-caudally. Its cranial surface was convex, and

smooth proximally. Distally it possessed three grooves namely, medial, central and lateral which confirmed the findings of Raghavan (1964) <sup>[16]</sup> in ox, Getty (1975) <sup>[6]</sup> in horse, Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in chital; the central one was the widest.

The Proximal extremity (Fig.3) was irregularly oval in outline with its long axis being medio-lateral in direction similar to the reports of Miller *et al.* (1964) <sup>[11]</sup> in dog, Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in chital; on the contrary Talukdar *et al.* (2008) <sup>[19]</sup> reported that it was triangular in outline in elephant.

The nutrient foramen in the present study was found variably between lateral border and lateral margin of proximal inter-osseous space, which is more or less similar to the observations of Raghavan (1964) <sup>[16]</sup> in ox, Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in chital; however, it is located slightly above the middle of the caudal surface of the radius in dog (Miller *et al.*, 1964) <sup>[11]</sup>.

Distal extremity (Fig.4) was thicker and larger than the proximal one, which was similar to the observations of Miller *et al.* (1964) <sup>[11]</sup> in dog, Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in chital. On the distal end, oblique articular surface was presented, which is similar to the findings of Chauveau (1905) <sup>[4]</sup> in pig, Sisson (1911) <sup>[18]</sup> and Raghavan (1964) <sup>[16]</sup> in ox, Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in chital. It consisted of three articular areas for first three carpal bones of the proximal row. The medial one was the largest, while the middle one is intermediate in size. The lateral one was the smallest, which is similar to Getty (1975) <sup>[6]</sup> in horse Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in Chital; On the contrary, the middle one was the largest in dog (Miller *et al.*, 1964) <sup>[11]</sup>.

## Ulna

In this study ulna (Fig.1&2) was an aborted long bone. It was the longest bone of the fore-limb similar to the observations of Miller *et al.* (1964) <sup>[11]</sup> in dog, Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in Chital. It consisted of a

shaft and two extremities.

The shaft (Fig.1&2) was roughly prismatic in Chital, which is in accordance with the observations of Sisson (1911) <sup>[18]</sup> and Raghavan (1964) <sup>[16]</sup> in ox, Miller *et al.* (1964) <sup>[11]</sup> in dog, Getty (1975) <sup>[6]</sup> in horse Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in Chital. It was strongly curved and presented three surfaces. Cranial surface was convex vertically and transversely, which is similar to the findings of Miller *et al.* (1964) <sup>[11]</sup> in dog. It fused with radius except for two locations of inter-osseous spaces. This surface was arched at proximal inter-osseous space. Nutrient foramen was not recorded in the present study in blue bull which is similar to Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in Chital, while it is located on the cranial surface Miller *et al.* (1964) <sup>[11]</sup> in dog and Getty (1975) <sup>[6]</sup> in horse.

Proximal extremity (Fig.3) comprised of olecranon process and semi-lunar notch. The olecranon process was directed dorso-caudally and had a well-developed summit, the tuber olecrani. It was the most massive process of the ulna similar to the findings of Owen (1866) <sup>[13]</sup> in most ruminants and Sisson (1911) <sup>[18]</sup> and Raghavan (1964) <sup>[16]</sup> in ox, Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in Chital. It had two surfaces and two borders. The medial surface was slightly concave and lateral surface was slightly convex. Cranial border was thin, and distally presented a beak like projection, the anconeus process. This process is similarly presented by Raghavan (1964) <sup>[16]</sup> in ox, Getty (1975) <sup>[6]</sup> in horse, Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in Chital.

The distal extremity (Fig.4) terminated as styloid process and fused with the radius for the formation of the lateral facet which is similar to the observations of Jangir (2010) in Chinkara and Choudhary *et al.* (2013) <sup>[5]</sup> in Chital; in contrast the ulna fused to the shaft of radius without forming styloid process in horse (Getty, 1975) <sup>[6]</sup>. However, distal extremity of radius formed styloid process in dog (Miller *et al.*, 1964) <sup>[11]</sup> and Konig and Liebich, 2006) <sup>[9]</sup> and in dromedary (Smuts and Bezuidenhout, 1987).



**Fig 1:** Caudal view of Right Radius-Ulna

1. Olecranon process, 2. Ulna, 3. Proximal extremity of radius,
4. Caudal surface of radius, 5. Shaft of ulna, 6. Styloid process,
7. Distal extremity of radius



**Fig 2:** Caudo-medial view of Right Radius-Ulna

1. Olecranon process, 2. Anconeus process, 3. Semilunar notch,
4. Proximal extremity of radius, 5. Shaft of ulna, 6. Shaft of Radius,
7. Proximal interosseous space



**Fig 4:** Lateral part of distal extremity of Right Radius-ulna

1. Shaft of Radius, 2. Shaft of ulna, 3. Distal interosseous space,
4. Lateral groove, 5. Middle groove, 6. Medial groove,
7. Styloid process



**Fig 3:** Proximal extremity of Right Radius-ulna

1. Summit of Olecranon process, 2. Anconeus process,
3. Semilunar notch, 4. Coronoid process, 5. Shaft of Radius,
6. Shaft of ulna, 7. Proximal interosseous space

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