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Gross anatomical studies on phalanges bones of Bluebull (*Boselaphus tragocamelus*)

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Abstract

The gross anatomical observation was carried out on the phalanges of six adult Blue bulls. Two fully developed digits possessed three phalanges per digit, namely, proximal, middle and distal phalanx. The first phalanx was a long bone and presented a shaft and two extremities. The second phalanx was nearly half the length of the first phalanx. The third phalanx was irregularly prismatic bone, which presented four surfaces and six borders in blue bull.

Keywords: Bluebull, phalanges, extremities and condyles

Introduction

The Blue bull or Nilgai (*Boselaphus tragocamelus*) is the largest Asian antelope which commonly inhabits in north Indian plains from the base of the Himalayas in the north, Karnataka, Gir forest in south west across the border of Rajasthan in the West and the states of Assam and West Bengal in the East. 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) [17]. Blue bull can survive without water for several days, but they live close to waterhole. The aim of this study is to examine phalanges of Blue bull, in the vetero-legal cases, fails to identify the bones of this animal from those of some other small ruminants. This investigation will be helpful to the field veterinarians as well as wildlife veterinarians.

Materials and Methods

In this examination six specimens of adult Blue bull (*Boselaphus tragocamelus*) were used which were carried out at Bikaner zoo. Three of the specimens were of male and 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 morphological features.

Results and Discussion

In the present study, two fully developed digits possessed three phalanges per digit, namely, proximal, middle and distal phalanx similar to the reporters of Raghavan (1964) [25] in ox, Siddiqui *et al.* (2008) [28] in Black Bengal goat, Jangir (2010) [14] in Chinkara, Choudhary *et al.* (2014) [7] in chital and Choudhary and Singh (2016d) [6] in Blackbuck. However, five digits were present in dog (Miller *et al.*, 1964) [19], where each digit consisted of three phalanges, except for the first digit, which had only two phalanges; Smuts and Bezuidenhout (1993) [31] reported that second to fourth digits consisted of three phalanges each, fifth digit has two phalanges, while the first digit has a single phalanx in the African elephant; four digits were present in pig (Fransson *et al.*, 2009) [9], where each digit consisted of three phalanges each. Only one digit consisted of three phalanges were present in horse (Getty, 1975) [11].

First or Proximal Phalanx (*Phalanx proximalis vel os compile*)

The first phalanx was a long bone and presented a shaft and two extremities (Fig.1). The shaft

or body was elongated and compressed laterally as reported in ox (Raghavan, 1964) [25], in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6]. The dorsal and abaxial surfaces were continuous as revealed by Raghavan (1964) [25] in ox, Jangir (2010) [14] in Chinkara, Choudhary *et al.* (2014) [7] in chital and Choudhary and Singh (2016d) [6] in Blackbuck. The axial surface was flat (Fig.2) as reported by Raghavan (1964) [25] in ox and Siddiqui *et al.* (2008) [28] in Black Bengal goat, while it was somewhat elevated in horse (Getty, 1975) [11]. It had a nutrient foramen just below the half way mark. The caudal or palmar surface (Fig.3) bore a nodular elevation at its distal aspect on either side as described in ox (Raghavan, 1964) [25], in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6]. The proximal extremity was broader (Fig.2) as compared with distal one as described in horse (Getty, 1975) [11], in ox (Raghavan, 1964) [25], in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6]. It bore a concave articular surface, which was divided into two by a deep sagittal groove. The abaxial articular facet was larger and higher than the axial one as mentioned in ox (Raghavan, 1964) [25], Black Bengal goat (Siddiqui *et al.* 2008) [28], in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6], while dissimilar to horse (Getty, 1975) [11] in which, the axial one was larger. Caudally two articular facets were present (Fig.3), an axial, and relatively larger and higher abaxial facet for articulation with the proximal sesamoids, identical to the reports in ox (Raghavan, 1964) [25]. On the distal extremity, the articular surface was divided by a dorso-palmar groove into two condyles, of which, the abaxial one was larger as described by in ox (Raghavan, 1964) [25], in Black Bengal goat (Siddiqui *et al.* 2008) [28] in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.* 2014) and in Blackbuck (Choudhary and Singh 2016d) [6]. However, the medial condyle was larger in horse (Getty, 1975) [11]. The distal extremity presented a depression on both side as reported in horse (Getty, 1975) [11] and in dromedary (Smuts and Bezuidenhout, 1987) [30].

Second or Middle Phalanx (phalanges medie vel os Coronale)

The second phalanx was nearly half the length of the first phalanx (Fig.4) as reported in dromedary (Smuts and Bezuidenhout, 1987) [30], in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.* 2014) [7] and in Blackbuck (Choudhary and Singh 2016d); whereas in ox (Raghavan, 1964) [25], it was two third of the first phalanx. The shaft was elongated and presented three surfaces as revealed by Raghavan (1964) [25] in ox, Siddiqui *et al.* (2008) [28] in Black Bengal goat, Jangir (2010) [14] in Chinkara, Choudhary *et al.* (2014) [7] in chital and Choudhary and Singh (2016d) [6] in Blackbuck. The shaft was four sided and flattened dorso-palmarly in horse (Getty, 1975) [11]. The axial surface was rough and slightly depressed distally. It bore a small tubercular elevation a little above the middle. The palmar surface was slightly concave, while it was reported flat in dromedary (Smuts and Bezuidenhout, 1987) [30].

The proximal extremity presented an articular surface which was divided into two concave facets by a dorso-palmar ridge (Fig.4). The abaxial facet was larger than the axial one as distinguished in ox (Raghavan, 1964) [25], in Black Bengal goat (Siddiqui *et al.* 2008) [28] in Chinkara (Jangir, 2010) [14],

in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6]. The distal extremity was smaller than the proximal (Fig.5) one as described by Raghavan (1964) [25] in ox and Siddiqui *et al.* (2008) [28] in black Bengal goat. The distal extremity was divided by a dorso-palmar groove into two condyles, the axial of which was comparatively larger than abaxial one as reported by Raghavan (1964) [25] in ox, Smuts and Bezuidenhout (1987) [30] in dromedary, Jangir (2010) [14] in Chinkara, Choudhary *et al.* (2014) [7] in chital and Choudhary and Singh (2016d) [6] in Blackbuck. The articular surface encroached considerably on the anterior and posterior aspects, as revealed in ox (Raghavan, 1964) [25].

Third or Distal Phalanx (Phalangeal distal vel in angular)

The third phalanx was irregularly prismatic bone, which presented four surfaces and six borders in blue bull (Fig.6) as reported by Raghavan (1964) [25] in ox, Siddiqui *et al.* (2008) [28] in black Bengal goat, Jangir (2010) [14] in Chinkara, Choudhary *et al.* (2014) [7] in chital and Choudhary and Singh (2016d) [6] in Blackbuck; but dissimilar to the observations of Getty (1975) [11] in horse, where it presented three surfaces, three borders and two angles. The abaxial surface was almost convex, rough and traversed by a cranio-caudal ridge. The area below the ridge was rough, raised and presented three foramina; of which caudal-most foramen was the largest. In contrast the area above the ridge was rough and perforated by a number of foramina in ox (Raghavan, 1964) [25], in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6]. The axial surface bore a groove, which possessed a foramen of considerable size; while there were a number of foramina in ox (Raghavan, 1964) [25], in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6]. The ventral or sole surface was nearly flat to slightly concave as reported in ox (Raghavan, 1964) [25], in Chinkara (Jangir, 2010), in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6]. The dorsal or articular surface was concave cranio-caudally, and sloped downwards and backwards facing posteriorly and dorsally as elucidated by Raghavan (1964) [25] in ox, Siddiqui *et al.* (2008) [28] in Black Bengal goat, Jangir (2010) [14] in Chinkara, Choudhary *et al.* (2014) [7] in chital and Choudhary and Singh (2016d) [6] in Blackbuck. It was divided by a cranio-caudal sharp oblique ridge into two areas; of which the abaxial one was smaller and higher in level than the axial one. In contrast the ridge was faint and abaxial area was comparatively larger in ox (Raghavan, 1964) [25], in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6]. This surface presented posteriorly a small transverse concave facet posteriorly for articulation with the distal sesamoid (Fig.6). The four surfaces were separated by six borders in Indian blackbuck. The dorsal border was straight and sharp, and presented a prominent extensor process posteriorly, which was small and rough in ox (Raghavan, 1964) [25], in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6]. Below to extensor process, axial and abaxial foramina were present; of which axial one was significantly larger. The anterior tip of this border, the apex was sharp as described in ox (Raghavan, 1964) [25], in Chinkara (Jangir, 2010) [14], in chital (Choudhary *et al.*, 2014) [7] and in Blackbuck (Choudhary and Singh, 2016d) [6].



Fig 1: Axial view of first phalanx
 1. Proximal extremity
 2. Shaft
 3. Axial depression
 4. Distal extremity



Fig 4: Axial View of second phalanx
 1. Proximal extremity
 2. Shaft
 3. Axial depression
 4. Distal extremity



Fig 2: 1. Proximal view of first phalanx, 2. Abaxial and axial articular facet, 3. Dorso-palmar sagittal groove



Fig 5: Distal view of second phalanx
 1. Shaft
 2. Abaxial articular facet
 3. Axial articular facet



Fig 3: 1. Distal view of first phalanx, 2. Abaxial and axial articular facet, 3. Sagittal groove



Fig 6: Axial view of third phalanx
 1. Extensor process
 2. Dorsal border
 3. Abaxial articular facet
 4. Axial articular facet
 5. Cranial foramen
 6. Ventral surface/solesurface
 7. Facet for distal sesamoid

Summary

Three phalanges per digit were observed; namely proximal, middle and distal phalanx.

The first or proximal phalanx was laterally compressed. Axial surface possessed a nutrient foramen just below the half way mark. The proximal extremity was broader as compared with distal one. The distal extremity had an articular surface divided by a dorso-palmar sagittal groove into two condyles, of which, the abaxial one was larger.

Second phalanx was nearly half the length of the first phalanx. The shaft presented three surfaces. The proximal extremity presented an articular surface which was divided into two concave facets by a dorso-palmar ridge.

The third phalanx was irregularly prismatic bone, which presented four surfaces and six borders. A prominent extensor process was present on the dorsal border, posteriorly. Below to this process, axial and abaxial foramina were present; of which axial one was significantly larger.

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